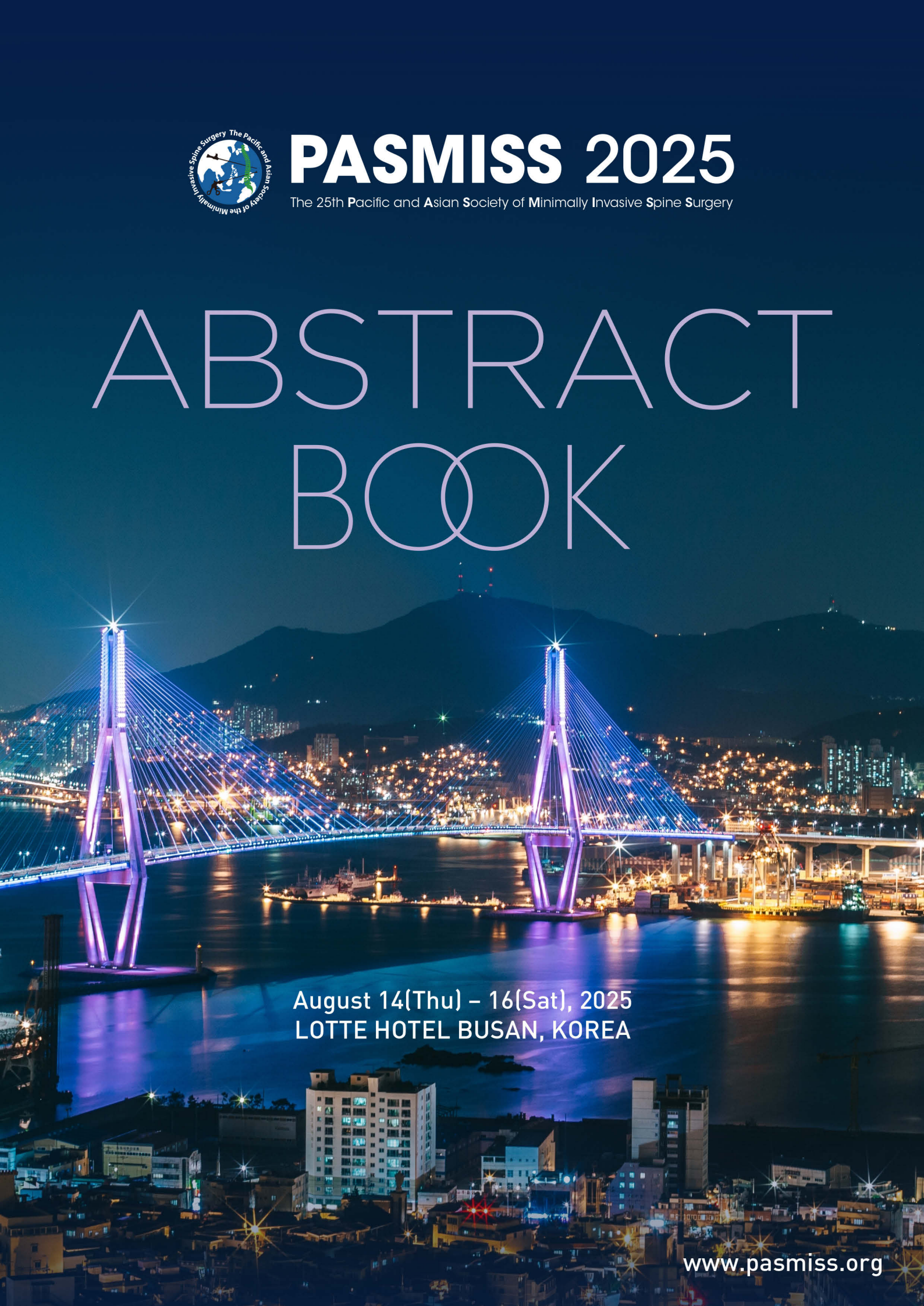
PASMISS 2025

The 25th **P**acific and **A**sian **S**ociety of **M**inimally **I**nvasive **S**pine **S**urgery

ABSTRACT BOOK



August 14(Thu) – 16(Sat), 2025
LOTTE HOTEL BUSAN, KOREA

www.pasmiss.org

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Program at a glance

Aug. 14 (Thu)		
15:00-16:00		Video session 1
16:00-17:00	PASMISS Board Meeting	Video session 2
18:00~20:00	Welcome Reception	

	Aug. 15 (Fri)				Aug. 16 (Sat)		
Time	Room A	Room B	Room C	Time	Room A	Room B	Room C
07:45-08:00	Opening			07:30-08:00	Breakfast Symposium		
08:00-08:30	Free Paper 1	Free Paper 2	Quick Fire 1	08:00-08:30	Free Paper 17	Free Paper 18	Quick Fire 9
08:30-09:00	Free Paper 3	Free Paper 4	Quick Fire 2	08:30-09:00	Free Paper 19	Free Paper 20	Quick Fire 10
09:00-10:00	Symposium 1	Symposium 2		09:00-10:00	Symposium 7	Symposium 8	
10:00-10:20	Coffee Break			10:00-10:20	Coffee Break		
10:20-10:50	Free Paper 5	Free Paper 6	Quick Fire 3	10:20-11:00	Plenary lecture 2		
10:50-11:20	Free Paper 7	Free Paper 8	Quick Fire 4	11:00-11:40	Invited lecture		
11:20-12:00	Plenary lecture 1			11:40-12:40	Symposium 9	Symposium 10	
12:00-12:10	Group photo			12:40~	Adjourn & closing remark		
12:10-13:10	Luncheon 1	Luncheon 2					
13:10-14:10	Symposium 3	Symposium 4					
14:10-14:40	Free Paper 9	Free Paper 10	Quick Fire 5				
14:40-15:10	Free Paper 11	Free Paper 12	Quick Fire 6				
15:10-15:30	Coffee Break						
15:30-16:30	Symposium 5	Symposium 6					
16:30-17:00	Free Paper 13	Free Paper 14	Quick Fire 7				
17:00-17:30	Free Paper 15	Free Paper 16	Quick Fire 8				
18:30~21:00	Presidential dinner						

[Venue Information]

- Room A: Crystal Ballroom 1 (3F)
- Room B: Crystal Ballroom 2 (3F)
- Room C: Pearl Room (3F)

- E-poster: Foyer of Pearl Room (3F)

- Booth Exhibition: Crystal Ballroom 3 (3F)

- PASMISS Board Meeting: Crystal Ballroom 1 (3F)
- Welcome Reception: Crystal Ballroom 3 (3F)
- Preview Room: Foyer of Pearl Room (3F)

Scientific Programs

August 14 (Thu)

PASMISS 2025

The 25th Pacific and Asian Society of Minimally Invasive Spine Surgery

August 14 (Thu)

Pearl Room, 3F

Pre-Course_Endoscopic Spine Surgery Video Forum

15:00-16:00	**Video session 1.** **Learning Biportal Endoscopic Spine Surgery from Korean Experts** Moderator: Jae-Young Hong (Korea)	41p
15:00-15:12	Biportal Endoscopic Interlaminar Approach: Step-by-Step Basics Speaker: Sang-Min Park (Korea)	
15:12-15:24	Biportal Paramedian Approach for Lumbar Foraminal and Extraforaminal Lesions Speaker: Sub-Ri Park (Korea)	
15:24-15:36	Biportal Endoscopic ULBD in Cervical myelopathy Speaker: Seok-Bong Jung (Korea)	
15:36-15:48	Biportal Endoscopic Lumbar Interbody Fusion: Basic Technique and Indications Speaker: Ju-Eun Kim (Korea)	
15:48-16:00	Discussion	
16:00-17:00	**Video Session 2.** **Challenging Cases in Endoscopic Spine Surgery: Advanced Solutions and Technical Strategies** Moderator: Si-Young Park (Korea)	47p
16:00-16:10	Revision Endoscopic Spine Surgery Speaker: Hyoung-Bok Kim (Korea)	
16:10-16:20	Biportal Cervical Foraminotomy: Key Anatomical Considerations and Technique Speaker: Min-Seok Kang (Korea)	
16:20-16:30	Thoracic Biportal Endoscopic Discectomy and Decompression Speaker: Seung-Hyun Choi (Korea)	
16:30-16:40	Full-Endoscopic TLIF via Trans-Kambin Approach for Indirect Decompression Speaker: Jae-Heung Shin (Korea)	
16:40-16:50	Biportal Endoscopic Lumbar Interbody Fusion Using Multiportal Technique for Large Cage Insertion Speaker: Hyun-Jin Park (Korea)	
16:50-17:00	Discussion	

Scientific Programs

August 15 (Fri)

PASMISS 2025

The 25th Pacific and Asian Society of Minimally Invasive Spine Surgery

August 15 (Fri)

Room A (Crystal Ballroom 1, 3F)

07:45-08:00	Opening	
07:45-07:55	Opening Remarks Jae Chul Lee (President of PASMISS 2025, Korea)	
07:55-08:00	Introduction of Scientific Program Jae Hyup Lee (Chair of Scientific Committee, Korea)	
08:00-08:30	**Free paper 1 (Basic)** Moderators: Kuo-Yuan Huang (Taiwan), Jae Hyup Lee (Korea)	123p
08:00-08:05	Targeting TSP-1/TGF-β1 Signaling and Oxidative Stress in Ligamentum Flavum Hypertrophy: A Potential Therapeutic Strategy Presenter: Yu-Chia Hsu (Taiwan) Authors: Yu-Chia Hsu, Ruei-jyun Yang, Ting-Yuan Tu, Yan-Jye Shyong, Cheng-Hsiang Kuo, Yuan-Fu Liu, Shu-Shien Shih, Chao-Jui Chang, Cheng-Li Lin	
08:05-08:10	Thrombospondin-1 Plays a Role in Intervertebral Disc Aging and Degeneration. Presenter: Yuan Fu Liu (Taiwan) Authors: Yuan-Fu Liu, Cheng-Li Lin	
08:10-08:15	Development of a new treatment for osteoporotic vertebral fractures using adipose-derived stem cell spheroids Presenter: Yuta Sawada (Japan) Authors: Yuta Sawada, Shinji Takahashi, Kumi Orita, Akito Yabu, Masayoshi Iwamae, Yuki Okamura, Yuto Kobayashi, Hiroshi Taniwaki, Hiroaki Nakamura, Hidetomi Terai	
08:15-08:20	Nucleus pulposus-derived mesenchymal stem cells combining with Pure Platelet-rich plasma applying in Intervertebral disc degeneration treatment Presenter: Jie Huang (China) Authors: Jie Huang, Chenjun Liu, Haiying Liu	
08:20-08:30	Discussion	
08:30-09:00	**Free paper 3 (Navigation)** Moderators: Hee-Kit Wong (Singapore), Kwang-Sup Song (Korea)	131p
08:30-08:35	Hybrid Endoscopic thoracic discectomy using robotic arm and navigation for high migrated calcified disc herniation Presenter: Yi-Hao Liang (China) Authors: Yi-Hao Liang, Rohit Akshay Kavishwar, Maria Pedraza, Dimas Rahman Setiawan, Jae-Hwan Kim, Jin-Sung Kim	
08:35-08:40	Enhancing Precision in Oblique Lumbar Interbody Fusion: A Clinical Evaluation of O-arm Navigation-Assisted Techniques Presenter: Hongxun Sang (China) Authors: Hongxun Sang,*, Jin Zhang, Guofang Fang, Jiachang Wu, Shihao Zhang, Weida Zhuang, Min Chen, Xiuwang Li	
08:40-08:45	Safer Robotic Spine Surgery and Its Cost: A Retrospective Study of 1,200 Cases Presenter: Yen-Mou Lu (Taiwan) Author: Yen-Mou Lu	
08:45-08:50	Educational Utility and Screw Insertion Accuracy of Robotic-Assisted Spine Surgery Among Young Residents Presenter: Saori Soeda (Japan) Authors: Saori Soeda, Koichi Sairyo	
08:50-09:00	Discussion	

August 15 (Fri)

Room A (Crystal Ballroom 1, 3F)

09:00-10:00	**Symposium 1 (Cervical & Pediatric Deformity)** Moderators: Huilin Yang (China), Chong Suh Lee (Korea)	61p
09:00-09:10	Latest updates of cervical deformity correction Speaker: Seok Woo Kim (Korea)	
09:10-09:20	Cervico-thoracic kyphosis correction Speaker: Sunny Kim (USA)	
09:20-09:30	Complex cervical deformity surgery in rare genetic disease Speaker: Hyoungmin Kim (Korea)	
09:30-09:40	Solid Rod Tether for Thoracic Scoliosis? An Analysis of Progressive Curve Straightening Behaviour in Bi-Portal Endoscopic Anterior Spinal Fusion. Speaker: Hee-Kit Wong (Singapore)	
09:40-09:50	MISS for AIS: Evolving technique and long-term outcomes in the Adolescent Spine Speaker: Jae-Hyuk Yang (Korea)	
09:50-10:00	Discussion	
10:00-10:20	Coffee break	
10:20-10:50	**Free paper 5 (Endoscopy)** Moderators: Cheng-Li Lin (Taiwan), Seok-Bong Jung (Korea)	139p
10:20-10:25	Application of Uni-portal Non-coaxial Spinal Endoscopic Surgery (UNS) in Lumbar Interbody Fusion Presenter: Jizheng Li (China) Author: Jizheng Li	
10:25-10:30	Clinical and Radiologic Outcomes of Biportal Endoscopic Lumbar Interbody Fusion Using a Single Expandable Cage: A Single-Center Study with Minimum 1-Year Follow-up Presenter: Sub-Ri Park (Korea) Authors: Sub-Ri Park, Namhoo Kim, Jin-Oh Park	
10:30-10:35	Radiological and Clinical Outcomes of PEEK cage Versus 3D-Printed Titanium cage in Biportal Lumbar Interbody Fusion: A Retrospective Comparative Study Presenter: Seok-Bong Jung (Korea) Authors: Seok Bong Jung, MD, Nackhwan Kim, MD, PhD	
10:35-10:40	Uniportal Endoscopic Fusion versus Endoscope-Assisted Oblique Lateral Lumbar Interbody Fusion for Degenerative Spondylolisthesis: A Comparative Efficacy Study Presenter: Simao Song (China) Authors: Simao Song, Yuhao Pan	
10:40-10:50	Discussion	
10:50-11:20	**Free paper 7 (Endoscopy)** Moderators: Jwo-Luen Pao (Taiwan), Heui Jeon Park (Korea)	147p
10:50-10:55	Clinical Spectrum, Efficacy, and Safety of Biportal Endoscopic Spine Surgery for Lumbar Disorders : A Retrospective Analysis Presenter: Jun-Yeong Seo (Korea) Author: Jun-Yeong Seo	
10:55-11:00	Clinical efficacy of UBD-TLIF versus transforaminal lumbar interbody fusion in the treatment of grade 1 lumbar spondylolisthesis Presenter: Shisheng He (China) Authors: Xinbo Wu, Xiao Xiao, Shisheng He	
11:00-11:05	Full-Endoscopic Trans-Kambin Triangle Lumbar Interbody Fusion with Reverse Insertion of an Oblique Lateral Cage: A Case Series Presenter: Jui-Ming Yang (Taiwan) Authors: Jui-Ming Yang, Yuan-Fu Liu, Wei-Lun Chang, Cheng-Li Lin, Che-Chia Hsu, Yi-Hung Huang	
11:05-11:10	Two-Year Radiological Fusion Outcomes Following Biportal Endoscopic Transforaminal lumbar interbody fusion using kidney Bean-Shaped Interbody Cages Presenter: Ja-Yeong Yoon (Korea) Authors: Sang-Bum Kim, Dong-Hwan Kim, Daehee Choi, Ja-Yeong Yoon	
11:10-11:20	Discussion	

August 15 (Fri)

Room A (Crystal Ballroom 1, 3F)

11:20-12:00	**Plenary lecture 1** Moderators: Jae-Yoon Chung (Korea), Jae Chul Lee (Korea)	53p
11:20-11:35	Pedicle screw fixation: 40 years of development and challenges Speaker: Christian Mazel (France)	
11:35-11:50	Oncologic aspect of spinal deformity Speaker: Christian Mazel (France)	
11:50-12:00	Discussion	
12:00-12:10	Group photo	
12:10-13:10	**Luncheon Symposium 1** Moderator: Jae Chul Lee (Korea)	
12:10-12:30	(Amgen Korea X Chong Kun Dang Pharm.) Building Stronger Bones: The Role of EVENITY and Prolia in Osteoporosis Management Speaker: Tae-Hoon Kim (Korea)	
12:30-12:50	(CGBIO) Current Fusion Strategies in TLIF: BMP-Based Grafting and Cage Selection Speaker: Jae-Young Hong (Korea)	
12:50-13:10	(Donga ST) The evidence of Limaprost in the Treatment of Lumbar Spinal Stenosis Speaker: Jae Jun Yang (Korea)	
13:10-14:10	**Symposium 3 (Endoscopic Surgery: Lumbar Disc Herniation)** Moderators: Keng-Chang Liu (Taiwan), Jae-Sung Ahn (Korea)	73p
13:10-13:20	Autologous mesenchymal stromal cells for repair intervertebral disc defect after discectomy: a prospective controlled study and 5-year follow-up Speaker: Baoshan Xu (China)	
13:20-13:30	Biportal Endoscopic Surgery: Extracanal Lumbar Disc Herniation Speaker: Chaisiri Chaichankul (Thailand)	
13:30-13:40	Various biportal endoscopic discectomy approaches customized for different types of lumbar disc herniation Speaker: Yong Jin Park (Korea)	
13:40-13:50	Biportal endoscopic lumbar discectomy for cauda equina syndrome Speaker: Ho-Jin Lee (Korea)	
13:50-14:00	Optimizing outcomes of biportal endoscopic lumbar discectomy; from setting to managing complications Speaker: Dae-Woong Ham (Korea)	
14:00-14:10	Discussion	

August 15 (Fri)

Room A (Crystal Ballroom 1, 3F)

14:10-14:40	**Free paper 9 (Endoscopy)** Moderators: Yudha Mathan Sakti (Indonesia), Yong-Gi Choi (Korea)	155p
14:10-14:15	Long-Term Benefits of Minimally Invasive Discectomy: Reduced Risk of Spinal Fusion and Insights Across Patient Subgroups Presenter: Sheng Liu (Taiwan) Authors: Sheng Liu; Sung-Huang Laurent Tsai; Hao-Yu Liu; Chia-Han Lin; Hung-En Huang; Ching-Yu Lee; Chia-Hsien Chen; Tsung-Jen Huang; Meng-Huang Wu; Yu-Chiang Hung; James Cheng-Chung Wei; Abdul Karim Ghaith; Mohamad Bydon	
14:15-14:20	The efficacy and safety of biportal endoscopic compared with microscopic discectomy in lumbar herniated intervertebral disc (ENDO-BH Trial): a multicenter, prospective, assessor-blind, randomized controlled trial Presenter: Sang-Min Park (Korea) Authors: Sang-Min Park, Hyun-Jin Park, Kwang-Sup Song, Dae-Woong Ham, Ho-Joong Kim, Min-Seok Kang, Jin-Sung Kim	
14:20-14:25	A novel repair strategy using knotless squeeze anchors for lumbar disc herniation with endplate junction lesions under biportal endoscopic spinal surgery Presenter: Lejian Jiang (China) Authors: Lejian Jiang, Qingfeng Hu	
14:25-14:30	Endoscopic Interlaminar Standalone Decompression for Lumbar Lateral Recess Stenosis with Subligamentous Disc Herniation: A Disc-Preserving Alternative to Discectomy Presenter: Tsung-Mu Wu (Taiwan) Authors: Tsung-Mu Wu, Kuan-Ting Chen, Chi-Sheng Chien, Kin-Weng Wong	
14:30-14:40	Discussion	
14:40-15:10	**Free paper 11 (Endoscopy)** Moderators: Paresh Chandra Dey (India), Lim Soo Taek (Korea)	163p
14:40-14:45	Unilateral Biportal Endoscopic Discectomy via the Contralateral Sublaminar Approach for Lumbar Disc Herniation with Very High-Grade Migration : A Technical Note and Case Series Presenter: Yong Jin Park (Korea) Author: Yong Jin Park	
14:45-14:50	Treatment of lumbar disc herniation with multiple annulus fibrosus suture methods under Uni-portal Non-coaxial Spinal Endoscopic Surgery (UNS) Presenter: Jizheng Li (China) Author: Jizheng Li	
14:50-14:55	Optimizing Surgical Approach Selection in Endoscopic Lumbar Discectomy Using 3D CT/MR Fusion Imaging Presenter: Jiro Hirayama (Japan) Author: Jiro Hirayama	
14:55-15:00	Comparative Efficacy and Experience of Uni-portal versus Bi-portal Spinal Endoscopy in Treating Far Lateral Lumbar Disc Herniation (FLLDH) Presenter: Chuanchao Du (China) Authors: Chuanchao Du, Jincai Yang	
15:50-15:10	Discussion	
15:10-15:30	Coffee break	

August 15 (Fri)

Room A (Crystal Ballroom 1, 3F)

15:30-16:30	**Symposium 5 (Endoscopic Surgery: Lumbar Spinal Stenosis)** Moderators: Baoshan Xu (China), Keun Ho Park (Korea)	83p
15:30-15:40	Current Perspectives on Biportal Endoscopic Decompression Alone for Lumbar Spinal Stenosis Speaker: Hyung-Rae Lee (Korea)	
15:40-15:50	The role of biportal endoscopic surgery in severe lumbar stenosis and cauda equina syndrome Speaker: Pawin Gajaseni (Thailand)	
15:50-16:00	Full-Endoscopic Decompression Surgery for the Treatment of Lumbar Stenosis:Focusing on Surgical Indication, Surgical Approach and Clinical Outcome Speaker: Ching-Hsiao Yu (Taiwan)	
16:00-16:10	Adjacent segment disease after lumbar Spine Fixation managed by Destandau Endospine using 4K-3D Endovision Speaker: Paresh Chandra Dey (India)	
16:10-16:20	Preoperative planning for FESS and UBE in spinal endoscopic surgery using 3D-MR/CT fusion imaging. Speaker: Jiro Hirayama (Japan)	
16:20-16:30	Discussion	
16:30-17:00	**Free paper 13 (Endoscopy)** Moderators: Jiro Hirayama (Japan), Kyu-Yeol Lee (Korea)	171p
16:30-16:35	Uniportal Full-endoscopic Unilateral Laminotomy for Bilateral Decompression in Lumbar Spinal Stenosis: Relationship between Decompression Range and Functional Outcomes Presenter: Bin Zhu (China) Author: Bin Zhu	
16:35-16:40	No-Punch Decompression Can Effectively Reduce the Risks of Neurological Injury in Unilateral Biportal Endoscopic Surgery Presenter: Jwo-Luen Pao (Taiwan) Authors: Jwo-Luen Pao, Ta-Li Tsu, Yu-Hao Huang	
16:40-16:45	Biportal endoscopic laminectomy versus conventional open laminectomy in patients with lumbar spinal stenosis (ENDO-BS Trial): A multicenter, prospective, assessor-blind, randomized controlled trial Presenter: Hyun-Jin Park (Korea) Authors: Hyun-Jin Park, Sang-Min Park, Kwang-Sup Song, Min-Seok Kang, Ki-Han You, Si-Young Park, Choon-Keun Park, Jin-Sung Kim	
16:45-16:50	Unilateral Biportal Endoscopic Precision Decompression for Lumbar Spinal Stenosis with Degenerative Scoliosis Clinical and Radiographic Outcomes Presenter: Bing Tan (China) Author: Bing Tan	
16:50-17:00	Discussion	
17:00-17:30	**Free paper 15 (Endoscopy)** Moderators: Yi Hung Huang (Taiwan), Ju-Eun Kim (Korea)	178p
17:00-17:05	Prognostic Factors for Postoperative Outcomes in Biportal Endoscopic Spine Surgery Presenter: Peem Sarasombath (Thailand) Authors: Pawin Gajaseni, MD, Peem Sarasombath, MD, Warat Tassanawipas, MD, Chaisiri Chaichankul, MD	
17:05-17:10	Comparison of Safety and Efficacy of Anesthesia Methods in Percutaneous Endoscopic Lumbar Discectomy: A Network Meta-Analysis Presenter: Bin Zheng (China) Authors: Bin Zheng, Zhenqi Zhu	
17:10-17:15	Biportal endoscopic decompression for degenerative lumbar spondylolisthesis with stenosis Presenter: Ho-Jin Lee (Korea) Authors: Wongthawat Liawrungrueang, Ho-Jin Lee	
17:15-17:20	Ligamentum Flavum Preservation in PTED Enhances Long-Term Stability and Patient Satisfaction Over Partial Resection: A Randomized Controlled Trial Presenter: Wei Hu (China) Author: Wei Hu	
17:20-17:30	Discussion	
18:30~	**Presidential dinner**	

August 15 (Fri)

Room B (Crystal Ballroom 2, 3F)

08:00-08:30	**Free paper 2 (AI)** Moderators: Meng-Huang Wu (Taiwan), Yongsoo Choi (Korea)	127p
08:00-08:05	AI-based analysis highlights the critical role of erector spinae muscle health in predicting outcomes after lumbar spinal fusion Presenter: Namhoo Kim (Korea) Authors: Namhoo Kim, Sub-Ri Park, Jae Won Shin, Byung Ho Lee, Si-Young Park, Jin-Oh Park, Kyung-Soo Suk, Seong-Hwan Moon, Hak-Sun Kim, and Ji-Won Kwon	
08:05-08:10	Feasibility of Lumbopelvic Muscles Volume for Estimating Total Muscle Volume on Computed Tomography: AI-Based Automatic Image Analysis Presenter: Yongsoo Choi (Korea) Author: Yongsoo Choi	
08:10-08:15	Risk prediction of osteoporotic vertebral compression fractures in postmenopausal osteoporotic women by machine learning modeling Presenter: Jun Zou (China) Authors: Jun Zou MD PhD, Xiao Sun MD, Huilin Yang MD PhD	
08:15-08:20	Automated Measurement of Pelvic Parameters Using Convolutional Neural Network in Complex Spinal Deformities: Overcoming Challenges in Coronal Deformity Cases Presenter: Dong-Ho Kang (Korea) Authors: Dong-Ho Kang; Ye-Jin Jeong; Sung Taeck Kim; Younguk Kim; Bong-Soon Chang; Hyoungmin Kim; Sam Yeol Chang; Du Hyun Ro	
08:20-08:30	Discussion	
08:30-09:00	**Free paper 4 (AI)** Moderators: Ching Hsiao Yu (Taiwan), Jung Sub Lee (Korea)	135p
08:30-08:35	Evaluation of Deep Learning for Scoliosis Pre-Screening Using Preprocessed Chest X-ray Images Presenter: Min-gu Jang (Korea) Author: Min-gu Jang	
08:35-08:40	Deep learning from X ray to evaluate MRI disc problem Presenter: Chien-Chun Chang (Taiwan) Author: Chien-Chun Chang	
08:40-08:45	Deep Learning MRI Analysis for Differentiating Malignant from Benign Vertebral Compression Fractures : A Retrospective Multicenter Study Presenter: Joonghyun Ahn (Korea) Authors: Joonghyun Ahn, Young-Hoon Kim, Jun-Seok Lee, Sang-Il Kim, Hyung-youl Park, June Lee, Youjin Shin, Jae Chul Lee	
08:45-08:50	Automated Differentiation of Vertebral Compression and Burst Fractures from X-ray Images Using a Novel Machine Learning Model Presenter: Kuo-Yuan Huang (Taiwan) Authors: Kuo-Yuan Huang, Li-Wei Cheng, Hsin-Hung Chou, Yu-Xuan Cai, Chin-Chiang Hsieh, Po-Lun Chu, I-Szu Cheng, Sun-Yuan Hsieh	
08:50-09:00	Discussion	

August 15 (Fri) Scientific Programs

Room B (Crystal Ballroom 2, 3F)

09:00-10:00	**Symposium 2 (Tumor & Osteoporosis)** Moderators: Hidetomi Terai (Japan), Bong-Soon Chang (Korea)	66p
09:00-09:10	Bone Health Optimization Speaker: Warat Tassanawipas (Thailand)	
09:10-09:20	New paradigm in osteoporosis treatment: beyond bisphosphonate Speaker: Hae-Dong Jang (Korea)	
09:20-09:30	Predicting survival in patients with metastatic spinal tumors Speaker: Dong-Ho Kang (Korea)	
09:30-09:40	Can there a place for nonmetallic implants in the management of Metastatic spine disease? Speaker: Naresh Kumar (Singapore)	
09:40-09:50	Separation surgery in metastatic spinal tumor Speaker: Jae Hwan Cho (Korea)	
09:50-10:00	Discussion	
10:00-10:20	Coffee break	
10:20-10:50	**Free paper 6 (Deformity)** Moderators: Hee-Kit Wong (Singapore), Dong-Gune Chang (Korea)	143p
10:20-10:25	Surgical Correction of Degenerative Lumbar Scoliosis Presenter: Ruey-Mo Lin (Taiwan) Authors: Ruey-Mo Lin, Jiun-cheng Shiu, Wei-yu Li, Yu-Meng Hsiao	
10:25-10:30	The changes of muscle character during treatment of adolescent idiopathic scoliosis Presenter: Kun Bo Park (Korea) Author: Kun Bo Park	
10:30-10:35	Apical Vertebral Rotation Correction at the Lumbosacral Curve: A Key to Enhancing Coronal Alignment in Degenerative Lumbar Scoliosis Presenter: Ratchatapak Raksintham (Thailand) Authors: Ratchatapak Raksintham, Peem Sarasombath, Pawin Gajaseni, Warat Tassanawipas, Chaisiri Chaichankul	
10:35-10:40	The Influence of Pelvic Sagittal Parameters on the L5/S1 Intervertebral Foramen Size Presenter: Jiang Shengdan (China) Authors: Jiang Shengdan, Zheng Xinfeng, Li Bo, Wang Yong,Zheng Huoliang	
10:40-10:50	Discussion	
10:50-11:20	**Free paper 8 (Deformity)** Moderators: Yen-Jen Chen (Taiwan), Sung Su Kim (Korea)	151p
10:50-10:55	Different characteristics between acute and delayed proximal junctional failure in adult spinal deformity surgery Presenter: Se-Jun Park (Korea) Author: Se-Jun Park	
10:55-11:00	Efficacy of Proximal Junctional Tethering in Spinal Fusion Surgery for Preventing Proximal Junctional Kyphosis and Proximal Junctional Failure: A Meta-analysis Presenter: Meng-Huang Wu (Taiwan) Authors: Yu-Chi Hsu, Hsuan-Tung Lee, Ying-Fong Su, Yang-Ching Chen, Serena S. Hu, Ching-Chi Hsu, Pei-I Tsai, Wei-Bin Hsu, Den-Tai Lin, Ching-Yu Lee, Tsung-Jen Huang, Tan Lam Minh Nguyen, Meng-Huang Wu*	
11:00-11:05	One-Stage Posterior Minimally Invasive Surgery in Adult Spinal Deformity Presenter: Chun Yeh (Taiwan) Author: Chun Yeh	
11:05-11:10	The risk factors for mechanical complications after deformity correction in degenerative lumbar scoliosis patients with sagittal imbalance Presenter: Sung Min Kim (Korea) Authors: Sung-Min Kim, In-seok Son, XiongJie Li, Yong-Chan Kim	
11:10-11:20	Discussion	

August 15 (Fri)

Room B (Crystal Ballroom 2, 3F)

11:20-12:00	**Plenary lecture 1** Moderators: Jae-Yoon Chung (Korea), Jae Chul Lee (Korea)	53p
11:20-11:35	Pedicle screw fixation: 40 years of development and challenges Speaker: Christian Mazel (France)	
11:35-11:50	Oncologic aspect of spinal deformity Speaker: Christian Mazel (France)	
11:50-12:00	Discussion	
12:00-12:10	Group photo	
12:10-13:10	**Luncheon Symposium 2** Moderator: Sang-Bum Kim (Korea)	
12:10-12:30	(Daewon Pharmaceutical) Spinal pain management; combined therapy Speaker: Namhoo Kim (Korea)	
12:30-12:50	(GS Medical) Advancement and Advantage of 3D Porous Ti Cages for OLIF Speaker: Young-Yul Kim (Korea)	
12:50-13:10	(Baxter) Managing complications during endoscopic spine surgery including epidural hematomas Speaker: John Choi (Austrailia)	
13:10-14:10	**Symposium 4 (Robot & Navigation)** Moderators: Yen-Mou Lu (Taiwan), Yung Park (Korea)	78p
13:10-13:20	Navigation/Robot assistant degenerative lumber stenosis. Speaker: Hongxun Sang (China)	
13:20-13:30	The role of navigation for lumber endoscopic spine surgery Speaker: Meng-Huang Wu (Taiwan)	
13:30-13:40	What can we optimize with navigation in uniportal endoscopic lumbar interbody fusion for degeneration lumbar diseases? Speaker: Yi Hung Huang (Taiwan)	
13:40-13:50	O-arm navigation in OLIF Speaker: Ji-Won Kwon (Korea)	
13:50-14:00	Application of robotic endoscopic surgery Speaker: Sang-Min Park (Korea)	
14:00-14:10	Discussion	

August 15 (Fri)

Room B (Crystal Ballroom 2, 3F)

14:10-14:40	**Free paper 10 (Thoracolumbar Fusion)** Moderators: Hun-Kyu Shin (Korea), Dong Eun Shin (Korea)	159p
14:10-14:15	Effects of anti-osteoporosis medication in adult posterior spine fusion patients : a systematic review and meta-analysis Presenter: Ji-Won Kwon (Korea) Authors: HyungSub Jin, Hyung Ju Jin, Kyung Soo Suk, Byung Ho Lee, Si Young Park, Hak Sun Kim, Seoung Hwan Moon, Sub-ri Park, Namhoo Kim, Jae Won Shin, Ji-Won Kwon	
14:15-14:20	The bony density of the pedicle plays a more significant role in the screw anchorage ability than other regions of screw trajectory Presenter: Jingchi Li (China) Author: Jingchi Li	
14:20-14:25	Pedicle screw migration and loosening after long segments of lumbosacral fusion stopping at L1 or L2 Presenter: Hae-Dong Jang (Korea) Authors: Hae-Dong Jang, Jae Chul Lee, Sung-Woo Choi, Byung-Joon Shin	
14:25-14:30	Repair of L5 pars defect using headless compression screw with assistance of three-dimensional planning and patient-specific drill guides: The preliminary report and technical notes Presenter: Wei-Yu Li (Taiwan) Authors: Wei-Yu Li, Ruey-Mo Lin	
14:30-14:40	Discussion	
14:40-15:10	**Free paper 12 (MIS Fusion)** Moderators: Ruey-Mo Lin (Taiwan), Chang-Hoon Jeon (Korea)	167p
14:40-14:45	Enhancing Minimally Invasive Transforaminal Lumbar Interbody Fusion with a Novel V-Shape Bichannel Endoscopy System: Clinical Experience and Technical Considerations Presenter: Xiong Shilang (China) Authors: Xiong Shilang, Shisheng He	
14:45-14:50	Spontaneous facet fusion following lateral lumbar interbody fusion supplemented with percutaneous pedicle screw fixation in degenerative lumbar disease Presenter: Hyun-Jun Kim (Korea) Authors: Jaewan Soh, Jae Chul Lee	
14:50-14:55	Hounsfield Units, Vertebral body quality score, and Posterior Disc Height Distraction as Predictors of Cage Subsidence After OLIF Surgery Presenter: Bong Mo Koo (Korea) Authors: Bong Mo Koo, Jiwon Park, Jaeyoung Hong	
14:55-15:00	Oblique lumbar interbody fusion combined with anterolateral screw fixation and stress endplate augmentation for treating degenerative lumbar spondylolisthesis with osteoporosis Presenter: Xingrui Peng (China) Author: Xingrui Peng	
15:50-15:10	Discussion	
15:10-15:30	Coffee break	

August 15 (Fri)

Room B (Crystal Ballroom 2, 3F)

15:30-16:30	**Symposium 6 (Adult Spinal Deformity)** Moderators: Zhaomin Zheng (China), Ki Tack Kim (Korea)	88p
15:30-15:40	Surgical Tips for OLIF51 Speaker: Byung-Joon Shin (Korea)	
15:40-15:50	Minimally invasive surgery for optimal surgical outcomes in the treatment of adult spinal deformity Speaker: Dong-Gune Chang (Korea)	
15:50-16:00	New Surgical Strategy in Treating Adult Degenerative Scoliosis to Prevent the Post-operative Coronal Imbalance. Speaker: Yen-Jen Chen (Taiwan)	
16:00-16:10	Microstructural and Biomechanical Changes in Spinal Degeneration: Potential Implications for Degenerative Spinal Deformity Speaker: Kuo-Yuan Huang (Taiwan)	
16:10-16:20	How can we apply LDI in our practice? A nonsystematic review Speaker: Nam-Su Chung (Korea)	
16:20-16:30	Discussion	
16:30-17:00	**Free paper 14 (Fracture/Osteoporosis/Tumor)** Moderators: Zairin Noor (Indonesia), Chung-Hwan Kim (Korea)	175p
16:30-16:35	Implant-Based Vertebral Augmentation versus Balloon Kyphoplasty in Thoracolumbar Vertebral Compression Fractures: A Comparative Analysis Presenter: Soo Hyun Oh (Korea) Author: Soo Hyun Oh	
16:35-16:40	AI-Enhanced Spine Imaging: A Novel Framework for Osteoporosis Detection and Grading in the Indian Population Presenter: Sudhir Ganesan (India) Author: Sudhir Ganesan	
16:40-16:45	The Interplay among Bone Mineral Density, FRAX-Based Fracture Risk, Skeletal Muscle Mass, and Frailty in Patients with Osteoporotic Vertebral Fractures Presenter: Sungsoo Park (Korea) Authors: Yongsoo Choi, Sungnyun Back, Minyoung Kim, Youngjae Kim, Sungsoo Park, Jaeryeong Park	
16:45-17:00	Discussion	
17:00-17:30	**Free paper 16 (Fracture/Osteoporosis/Tumor)** Moderators: Shisheng He (China), Kee-Won Rhyu (Korea)	182p
17:00-17:05	Prophylactic Antibiotics in Vertebroplasty and Kyphoplasty: A Nationwide Analysis of Infection Rates and Antibiotic Use Presenter: Hyung-Youl Park (Korea) Author: Hyung-Youl Park	
17:05-17:10	Impact of Endoscopic and Open Approaches on Spinal Alignment and Reoperation after Treatment for Pyogenic Spondylodiscitis Presenter: Ting-An Cheng (Taiwan) Authors: Ting-An Cheng, Hao-Chun Chuang, Yu-Chia Hsu, Yuan-Fu Liu, Kuo-Yuan Huang, Ruey-Mo Lin, Yi-Hung Huang, Cheng-Li Lin	
17:10-17:15	Unveiling Nonlinear Synergy: BMI, Osteoporosis & Disc Degeneration in Post-UBE Lumbar Stability Presenter: Jingbo Ma (China) Authors: Jingbo Ma; Yu Ding	
17:15-17:20	Posterior Fixation with Vertebroplasty for Osteoporotic Vertebral Fractures at the Thoracolumbar Junction: A Comparative Study of the Percutaneous and Conventional Open Pedicle Screw Fixation Presenter: Ryo Sasaki (Japan) Author: Ryo Sasaki	
17:20-17:30	Discussion	
18:30~	**Presidential dinner**	

August 15 (Fri)

Room C (Pearl room, 3F)

08:00-08:30	**Quick fire 1** Moderators: Byung Ho Lee (Korea), Sang-Min Park (Korea)	202p
08:00-08:03	A new 3D full-body scanner analyzing the sagittal and coronal balance of the adult spine: a preliminary prospective observational study Presenter: Tae Hoon Kang (Korea) Authors: Tae Hoon Kang, Seokin Jang, Inwook Seo, Minseok Choi, Yongsoo Park, Yohan Lee, Jae Hyup Lee, Minjoon Cho	
08:03-08:06	Real-Time Anatomical Structure Identification in Lumbar Endoscopic Spine Surgery Using Artificial Intelligence Presenter: Yoonjae Cho (Korea) Authors: Taesik Goh, Yoonjae Cho, Jungsub Lee	
08:06-08:09	Percutaneous Transpedicular Intravertebral Cage Augmentation with Short-Segment Fixation Using Specially Designed Cannulated Cage Trials for Advanced Kummell Disease: A Preliminary Study Comparing with Vertebroplasty with Short-Segment Fixation Presenter: Sung Cheol Park (Korea) Authors: Sung Cheol Park, Gene Cheh, Yongjung Kim, Min-Seok Kang	
08:09-08:12	Changes in facet orientation can simultaneous affect the potential risk of annulus tears and zygapophyseal joint osteoarthritis: a clinical review and biomechanical simulation Presenter: Zhipeng Xi (China) Author: Zhipeng Xi	
08:12-08:15	Deep learning Algorithm to predict hip disease on lumbar spine X-rays. Presenter: Masashi Tsujino (Japan) Author: Masashi Tsujino	
08:15-08:30	Discussion	
08:30-09:00	**Quick fire 2** Moderators: Ahmad Ramdan (Indonesia), Jaewan Soh (Korea)	207p
08:30-08:33	Uni-portal non-coaxial spinal endoscopic surgery assisted by intraoperative O-arm total navigation for unilateral laminotomy for bilateral decompression in patients with lumbar spinal stenosis:A retrospective study Presenter: Jianmin Li (China) Authors: Jianmin Li;Shuqiang Wang	
08:33-08:36	The Role of Paraspinal Muscle Health in Predicting Adjacent Segment Disease After Lumbar Spinal Fusion : A Systematic Review and Meta-Analysis Presenter: Tan Lam Minh Nguyen (Taiwan) Authors: Tan Lam Minh Nguyen, Hsuan-Tung Lee, Yu-Chi Hsu, Tan Thanh Nguyen, Duy Nguyen Anh Tran, Serena Hu, Khanh Nguyen Quoc Le*, Meng-Huang Wu*	
08:36-08:39	Clinical characteristics and surgical treatment strategies of multi-regional (≥3) spinal canal stenosis Presenter: Lei Niu (China) Authors: Lei Niu; Rui He; Huang Fang; Wenzi Zhang	
08:39-08:42	Endoscopic vs. Conventional Lumbar Interbody Fusion: Less Invasive, but Equally Effective? Presenter: Hyo-jong Kim (Korea) Authors: Hyo-jong Kim, Weon-wook Park, Kyu-yeol Lee, Se-lim Kim, Gyu-ha Son. Jin-woo Park	
08:42-08:45	Extending the Indications of Minimally Invasive Scoliosis Surgery in Idiopathic Scoliosis: Feasibility in Very Severe Curves Exceeding 75° Presenter: Hong Jin Kim (Korea) Authors: Hong Jin Kim, Jae Hyuk Yang, Yunjin Nam, Seung Woo Suh	
08:45-09:00	Discussion	

August 15 (Fri)

Room C (Pearl room, 3F)

10:20-10:50	**Quick fire 3** Moderators: Eun Seok Son (Korea), Han-Dong Lee (Korea)	212p
10:20-10:23	Observation on the Application Effect of Retroperitoneal Laparoscopy in Debridement and Bone Graft Fusion for Lumbar Spinal Infections Presenter: Tan Hongdong (China) Author: Tan Hongdong	
10:23-10:26	A novel steerable PKP for treatment of thoracolumbar osteoporotic vertebral compression fractures:a study of the clinical efficacy and safety Presenter: En Song (China) Author: En Song	
10:26-10:29	Trans-pedicular Intravertebral Cage Augmentation (TPICA) with Short-level Fixation in the Treatment of Kummell Disease: Mid-term Results from a Case Series Presenter: Dae-Woong Ham (Korea) Authors: Dae-Woong Ham, Chan-Woo Cheong, and Kwang-Sup Song	
10:29-10:32	Minimal Invasive Spine Surgery for Very Elderly Patients with Destructive Spondylodiscitis: Case Series Presenter: Yunsung Jung (Korea) Authors: Yunsung Jung, Min-Woo Kim	
10:32-10:35	Clinical outcome and image study of percutaneous vertebroplasty and augemtation with SpineJack system for compression fracture with vacuum cleft Presenter: Jiun-Cheng shiu (Taiwan) Authors: Jiun-cheng Shiu, Wei-yu Li, Yumeng Hsiao, Ruey-Mo Lin	
10:35-10:50	Discussion	
10:50-11:20	**Quick fire 4** Moderators: Harmantya Mahadhipta (Indonesia), Hyun-Jin Park (Korea)	217p
10:50-10:53	Novel Technique Of Assisted Uniportal Interlaminar Percutaneous Endoscopic Lumbar Discectomy To Increase Versatility For Discectomy : Technical Notes Presenter: Yudha Mathan Sakti (Indonesia) Authors: Yudha Mathan Sakti, Zikrina Lanodiyu, Deas Makalingga Emiri, Wilhelmina Wilma Wijaya	
10:53-10:56	Alteration of Spinopelvic Alignment Following Percutaneous Endoscopic Lumbar Discectomy Presenter: Yudha Mathan Sakti (Indonesia) Authors: Yudha Mathan Sakti, Zikrina Lanodiyu, Bernadeta Fuad Paramita Rahayu, Deas Makalingga Emiri, Wilhelmina Wilma Wijaya	
10:56-10:59	Comparative Analysis of Percutaneous Transforaminal Endoscopic Technique and VBE Technique in Treating Single-Level Lumbar Disc Herniation Presenter: Haoyu Gong (China) Authors: Haoyu Gong, Yunshan Fan,Muhang Tian, Shisheng He	
10:59-11:02	Clinical Study of Annulus Fibrosus Suture Repair Treatment Under Dual Medium Spinal Endoscopy(DMSE) Presenter: Yunsong Lu (China) Author: Yunsong Lu	
11:02-11:05	Cauda equina syndrome due to intra-dural hematoma after endoscopic fusion Presenter: Hyoung Bok Kim (Korea) Authors: Hyoung Bok Kim, Sang ho Kim, Yung Park, Joong Won Ha	
11:05-11:08	Indications for and outcomes of full endoscopic lumbar discectomy between spinal levels. Presenter: Miho Aoki (Japan) Authors: Miho Aoki, Yoshiro Nanjo, Yasumitsu Kondo	
11:08-11:20	Discussion	

August 15 (Fri)

Room C (Pearl room, 3F)

14:10-14:40	**Quick fire 5** Moderators: Nam-Su Chung (Korea), Hee Jung Son (Korea)	223p
14:10-14:13	A New Docking Point for Bi-Portal Spinal Endoscopy Technique Through the Intervertebro-Foramen: Technical Note on the Safety and Reproducibility of "Doom's Point" Presenter: Chuanchao Du (China) Author: Chuanchao Du	
14:13-14:16	Does the number of drain tubes influence the formation of postoperative spinal epidural hematoma following biportal endoscopic unilateral laminotomy for bilateral decompression in patients with two-level adjacent lumbar spinal stenosis Presenter: Zhuolin Zhong (China) Authors: Zhuolin Zhong, Guojun Wei, Xiaowei Jing, Tianxin Wu, Shaohua Zhang, Qingfeng Hu	
14:16-14:19	Technical Strategies for Revision Foraminal Decompression/Discectomy by Biportal Endoscopy: A Clinical Series Presenter: Yeon-Ho Kim (Korea) Author: Yeon-Ho Kim	
14:19-14:22	Comparative Analysis of Full Endoscopic Unilateral Laminotomy with Bilateral Decompression Using 3D Versus 2D Spine Endoscopy for the Treatment of Spinal Stenosis: A Retrospective Study Presenter: Yuhsuan Chung (Taiwan) Author: Yuhsuan Chung	
14:22-14:25	Does grade one stenotic spondylolisthesis increase the revision rate of single level Percutaneous Stenoscopic Lumbar Decompression (PSLD), A retrospective study of at least three years follow-up. Presenter: Po Yuan Lin (Taiwan) Authors: Po Yuan Lin MD, Ching Hsiao Yu MD	
14:25-14:40	Discussion	
14:40-15:10	**Quick fire 6** Moderators: Hongxun Sang (China), Taekeun Ahn (Korea)	228p
14:40-14:43	The fine line of bone resection: subtle differences impact nerve safety in LE-ULBD Presenter: Zhi-Kang Yao (Taiwan) Author: Zhi-Kang Yao	
14:43-14:46	Biportal Endoscopic Lumbar Interbody Fusion for Pedicle Insufficiency Fracture with Spondylolytic Spondylolisthesis Presenter: Dong-Yun Kim (Korea) Author: Dong-Yun Kim	
14:46-14:49	Contralateral Sublaminar Approach for L5-S1 Foraminal Stenosis: A Viable Surgical Option? Presenter: Sung-nyun, Baek (Korea) Authors: Sung-nyun Baek, M.D., Yong-soo Choi, M.D., Ph.D.	
14:49-14:52	How to Prevent and Manage Epidural Hematoma in Endoscopic Spinal Surgery Presenter: Yu-Hao Huang (Taiwan) Authors: Yu-Hao Huang, Ta-Li Hsu, Jwo-Luen Pao	
14:52-14:55	Original Uni-portal Bi-channel & Dual-media Spinal Endoscopy system assists for transpedicular antero-dura decompression(UBD-TADD): feasibility and technical notes Presenter: Muhang Tian (China) Authors: Muhang Tian, Xinbo Wu, Shisheng He	
14:55-15:10	Discussion	

August 15 (Fri)

Room C (Pearl room, 3F)

16:30-17:00	**Quick fire 7** Moderators: Whoan Jeang Kim (Korea), Eun-Min Seo (Korea)	233p
16:30-16:33	Postoperative Contralateral Facet Cyst After Endoscopic Unilateral Laminectomy for Bilateral Decompression: A Case Report Presenter: Weonmin Cho (Korea) Authors: WeonMin Cho , Jae Won Shin , Si Young Park, Hak Sun Kim , Seong Hwan Moon	
16:33-16:36	Quality of Life and Functional Outcomes after Caudal Epidural Steroid Injection Versus Selective Nerve Root Block in Chronic Low Back Pain: A Single-Center Retrospective Cohort Study Presenter: Eric Robhets Lovin (Indonesia) Author: Eric Robhets Lovin	
16:36-16:39	Observation on the Clinical Efficacy of VBE Combined with Percutaneous Internal Fixation in the Treatment of Lumbar Discitis Presenter: Xu Liang (China) Author: Xu Liang	
16:39-16:42	Biportal Endoscopic-assisted Treatment for Symptomatic Tarlov Cyst – Technical Report and Preliminary Results at CMUH Presenter: Chih-hsien, Lin (Taiwan) Author: Chih-hsien, Lin	
16:42-16:45	The treatment of facetogenic low back pain by full endoscopic lumbar rhizotomy: the systematic review of current literatures Presenter: Chao-Jui Chang (Taiwan) Authors: Chao-Jui Chang; Yuan-Fu Liu; Yu-Meng Hsiao; Wei-Lun Chang; Che-Chia Hsu; Cheng-Li Lin	
16:45-17:00	Discussion	
17:00-17:30	**Quick fire 8** Moderators: Pawin Gajaseni (Thailand), Ji-Won Kwon (Korea)	238p
17:00-17:03	The risk factors associated with delirium after lumbar spine surgery in elderly patients Presenter: Yifan Wang (China) Authors: Yifan Wang; Zhimin Pan; Zheng Wang	
17:03-17:06	Minimally Invasive versus Open Micro Lumbar Discectomy Early outcome observations Presenter: Mansoorali Hakim Sitabkhan (India) Author: Dr. Mansoorali Hakim Sitabkhan	
17:06-17:09	Persistent Pain After Decompression: Unmasking the Role of Facet Joint Pathology in Lumbar Facet Cyst Surgery Presenter: Ahmad Ramdan (Indonesia) Authors: Ahmad Ramdan, Abdul Kadir Hadar, Agus Hadian Rahim, Greesea Dinamaria	
17:09-17:12	Posterior thoracic interbody fusion - when is it useful Presenter: Hyuk-joon Sohn (Korea) Authors: Hyuk-joon Sohn, MD, Eun Seok Son, MD, PhD,	
17:12-17:15	Newly developed probe showing depth in anteroposterior view for safe PPS insertion Presenter: Takeshi Aoyama (Japan) Authors: Takeshi Aoyama, Hirokazu Furukawa, Takahiro Iida	
17:15-17:18	Comparison of Acupuncture and Lumbar Traction in Reducing Subsequent Lumbar Fusion or Discectomy for Lumbar Disc Herniations: Real World Evidence from the Multinational Database Presenter: Sung Huang Laurent Tsai (Taiwan) Authors: Sung Huang Laurent Tsai, MD MPH; Ching Yu Lee, MD, PhD; Chia Hsien Chen, MD, PhD; Tsung Jen Huang, MD; Meng Huang Wu, MD, PhD;	
17:18-17:30	Discussion	

Scientific Programs

August 16 (Sat)

PASMISS 2025

The 25th Pacific and Asian Society of Minimally Invasive Spine Surgery

August 16 (Sat)

Room A (Crystal Ballroom 1, 3F)

07:30-08:00	**Breakfast Symposium** Moderator: Jae-Young Hong (Korea)	
07:30-08:00	(SK chemicals) When to Use Anabolic Agent for Treatment of Osteoporosis? Presenter: Chang Hwa Hong (Korea)	
08:00-08:30	**Free paper 17 (Cervical)** Moderators: Zenya Ito (Japan), Kyung-Chung Kang (Korea)	186p
08:00-08:05	Effect of fusion vs. pseudarthrosis on development of adjacent segment degeneration and disease after anterior cervical discectomy and fusion (ACDF), at least 5 years follow-up Presenter: Jun-Young Choi (Korea) Authors: Jun-Young Choi, Jae Jun Yang	
08:05-08:10	Research on the Mechanism of Discogenic Neck Pain Based on the Anatomy of the Cervical Sinuvertebral Nerve Presenter: Qinghao Zhao (China) Authors: Qinghao Zhao, Qingchu Li	
08:10-08:15	Age-related Postoperative Outcomes in Cervical Myelopathy Surgery: A Propensity-Matched Comparison Between Patients Aged ≥75 Years and Younger Patients Presenter: Bong Mo Koo (Korea) Authors: Jiwon Park, Dae-woong Ham, Byung-Taek Kwon, Bong Mo Koo, Jae-Young Hong, Jin S. Yeom	
08:15-08:20	The efficacy and safety of mini-open (air/water medium) endoscopy-assisted anterior cervical discectomy and fusion for the treatment of cervical spondylotic myelopathy Presenter: Hejun Yang (China) Author: Hejun Yang	
08:20-08:30	Discussion	
08:30-09:00	**Free paper 19 (Endoscopy)** Moderators: Chaisiri Chaichankul (Thailand), Byung Wan Choi (Korea)	194p
08:30-08:35	Comparison of Open Microscopic and Bi-portal Endoscopic Approaches in Multi-Level Posterior Cervical Foraminotomy: Radiological and Clinical Outcomes Presenter: Hyung-Rae Lee (Korea) Authors: Hyung-Rae Lee, In-Hee Kim, and Jae-Hyuk Yang	
08:35-08:40	Clinical Efficacy of Percutaneous Endoscopic Treatment via the Lateral Mass Approach for Cervical Spondylotic Radiculopathy Presenter: Kexiao Yu (China) Authors: Kexiao Yu, Jinwei Ran, Zhengjian Yan	
08:40-08:45	Delta Large-Channel Endoscopy Versus Anterior Cervical Discectomy and Fusion for Cervical Spondylotic Radiculopathy: A Retrospective Cohort Study Presenter: Guo Weichun (China) Authors: Yu Ling, Chen Jingteng, Yang Jian, Xia Kezhou, Sun Xiangran, Guo Weichun	
08:45-09:00	Discussion	

August 16 (Sat)

Room A (Crystal Ballroom 1, 3F)

09:00-10:00	**Symposium 7 (Endoscopic Surgery: Cervical)** Moderators: Shrinivas Rohidas (India), Si Young Park (Korea)	93p
09:00-09:10	Unilateral Biportal Endoscopic Surgery for Degenerative Cervical Spine Diseases Speaker: Jwo-Luen Pao (Taiwan)	
09:10-09:20	Endoscopy-Assisted Cervical Arthroplasty for Myelopathy Due to Cervical Disc Herniation and Spondylosis Speaker: Keng-Chang Liu (Taiwan)	
09:20-09:30	Endoscopic cervical spine surgery- Destandau's technique Speaker: Shrinivas Rohidas (India)	
09:30-09:40	Recent Techniques in Posterior Cervical Endoscopic Spine Surgery: A Literature Review Speaker: Sub-Ri Park (Korea)	
09:40-09:50	Optimal and Relative Indications for Biportal Endoscopic Cervical Surgery Speaker: Seok-Bong Jung (Korea)	
09:50-10:00	Discussion	
10:00-10:20	Coffee break	
10:20-11:00	**Plenary Lecture 2** Moderators: Seok Woo Kim (Korea), Sang-Bum Kim (Korea)	55p
10:20-10:35	Surgical application of O-arm navigation Speaker: Michael Grevitt (UK)	
10:35-10:50	Sharing experience of cervical total disc arthroplasty Speaker: Michael Grevitt (UK)	
10:50-11:00	Discussion	
11:00-11:40	**Invited Lecture** Moderators: Hyoung-Yeon Seo (Korea), Se-Jun Park (Korea)	58p
11:00-11:15	Ergonomic and spine surgery Speaker: Daniel Park (USA)	
11:15-11:30	Next-Gen Spine Robotics: From prototype to Practice Speaker: Seong Yi (Korea)	
11:30-11:40	Discussion	
11:40-12:40	**Symposium 9 (Cervical Spine)** Moderators: Koji Sato (Japan), Jae Jun Yang (Korea)	103p
11:40-11:50	Recent advances in AI for cervical spin disease: A comprehensive review Speaker: Han-Dong Lee (Korea)	
11:50-12:00	Complications in cervical spine surgery: Prevention and management strategies Speaker: Jiwon Park (Korea)	
12:00-12:10	Anterior Approach in MIS/Endoscopic Cervical Surgery (vs ACDF) Speaker: Zenya Ito (Japan)	
12:10-12:20	Things You must know for posterior cervical foraminotomy Speaker: Kyung-Chung Kang (Korea)	
12:20-12:30	D/Dx of cervical radiculopathy from other musculoskeletal disease Speaker: Byung Wan Choi (Korea)	
12:30-12:40	Discussion	
12:40	**Adjourn & Closing remark**	

August 16 (Sat)

Room B (Crystal Ballroom 2, 3F)

08:00-08:30	**Free paper 18 (MIS Fusion)** Moderators: Naresh Kumar (Singapore), Deuk-Soo Jun (Korea)	190p
08:00-08:05	Clinical and Radiographical Efficacy of Single Prone Position Oblique Lateral Interbody Fusion in Lumbar Degenerative Disease Presenter: Yung-Hsueh Hu (Taiwan) Authors: Yung-Hsueh Hu, Louis Yi Lu, Sz-Huei Li, Yu-Cheng Yeh, Ping-Yeh Chiu, Fu-Cheng Kao1, Ming-Kai Hsieh, Chia-Wei Yu, Tsung-Ting Tsai, Po-Liang Lai, Tsai-Sheng Fu, Chi-Chien Niu, Lih-Huei Chen, and Wen-Jer Chen	
08:05-08:10	Overcoming Age Barriers: Oblique Lateral Interbody Fusion as a Safe Surgical Option for Super-Elderly Patients Presenter: Hee Jung Son (Korea) Authors: Hee Jung Son MD1, Hyoungmin Kim MD, PhD2, Bong-Soon Chang MD, PhD2, Sam Yeol Chang MD2	
08:10-08:15	Perioperative outcomes of octogenarian patients in OLIF surgery Presenter: Jaiwoo Chung (Korea) Authors: Jaiwoo Chung, Tae-Keun Ahn	
08:15-08:20	Self-solidified calcium phosphate artificial bone with rhBMP-2 versus allograft bone for OLIF: a self-controlled, randomized and double-blind study Presenter: Jiancheng Zeng (China) Authors: Jiancheng Zeng, Xiandi Wang, Tianhang Xie, Xingrui Peng	
08:20-08:30	Discussion	
08:30-09:00	**Free paper 20 (MIS Fusion)** Moderators: Jiancheng Zeng (China), Jin Hwan Kim (Korea)	197p
08:30-08:35	Is Intraoperative Force Measurement Effective for Cage Size Selection in Oblique Lateral Interbody Fusion (OLIF)? A Retrospective Study Presenter: Wen-Bo Wei (China) Author: Wen-Bo Wei	
08:35-08:40	A Novel Surgical Approach Using the "Lateral Corridor" for Minimally Invasive Oblique Lumbar Interbody Fusion at L5-S1: A Clinical Series and Technical Note Presenter: Hae-Dong Jang (Korea) Authors: Hae-Dong Jang, Jae Chul Lee, Sung-Woo Choi, Byung-Joon Shin	
08:40-08:45	Single incision MIS-TLIF decompression for lumbar spondylolisthmia Presenter: Lei Kong (China) Authors: Lei Kong , Wen -Zhi Zhang	
08:45-08:50	Validating and Predicting the Impact of Socioeconomic Status on Early Outcomes Following Oblique Lumbar Interbody Fusion Presenter: Xiao Hu (China) Authors: Xiao Hu, Jiancheng Zeng, Tianhang Xie, Xiandi Wang	
08:50-09:00	Discussion	

August 16 (Sat)

Room B (Crystal Ballroom 2, 3F)

09:00-10:00	**Symposium 8 (MIS Fusion)** Moderators: Luthfi Gatam (Indonesia), Chang-Nam Kang (Korea)	98p
09:00-09:10	Minimally invasive TLIF using tubular retractor Speaker: Jaewan Soh (Korea)	
09:10-09:20	Avoiding endplate injuries in OLIF - tip and tricks Speaker: Jacob Oh (Singapore)	
09:20-09:30	OLIF L5-S1 via lateral corridor Speaker: Taekeun Ahn (Korea)	
09:30-09:40	Comparison of MIS-TLIF and Endo-LIF Speaker: Qingbing Meng (China)	
09:40-09:50	OLLIF Speaker: Sunny Kim (USA)	
09:50-10:00	Discussion	
10:00-10:20	Coffee break	
10:20-11:00	**Plenary Lecture 2** Moderators: Seok Woo Kim (Korea), Sang-Bum Kim (Korea)	55p
10:20-10:35	Surgical application of O-arm navigation Speaker: Michael Grevitt (UK)	
10:35-10:50	Sharing experience of cervical total disc arthroplasty Speaker: Michael Grevitt (UK)	
10:50-11:00	Discussion	
11:00-11:40	**Invited Lecture** Moderators: Hyoung-Yeon Seo (Korea), Se-Jun Park (Korea)	58p
11:00-11:15	Ergonomic and spine surgery Speaker: Daniel Park (USA)	
11:15-11:30	Next-Gen Spine Robotics: From prototype to Practice Speaker: Seong Yi (Korea)	
11:30-11:40	Discussion	
11:40-12:40	**Symposium 10 (Endoscopic Surgery: Fusion)** Moderators: Qingbing Meng (China), Jae-Young Hong (Korea)	117p
11:40-11:50	Nerve Protection in Lumbar Endoscopic Fusion Surgery Speaker: Cheng-Li Lin (Taiwan)	
11:50-12:00	Full endoscope assisted lumbar interbody fusion - recommendable indications Speaker: Jae Hung Shin (Korea)	
12:00-12:10	Capability of Alignment Correction of Double-Cage Biportal Endoscopic Transforaminal Lumbar Interbody Fusion Speaker: Jwo-Luen Pao (Taiwan)	
12:10-12:20	Endplate preparation in biportal endoscopic lumbar interbody fusion Speaker: Hyun-Jin Park (Korea)	
12:20-12:30	Biportal endoscopic lumbar interbody fusion with 3D printed double cage: Technical note and preliminary result Speaker: Ju-Eun Kim (Korea)	
12:30-12:40	Discussion	
12:40	**Adjourn & Closing remark**	

August 16 (Sat)

Room C (Pearl room, 3F)

08:00-08:30	**Quick fire 9** Moderators: Ho-Jin Lee (Korea), Joonghyun Ahn (Korea)	244p
08:00-08:03	Early application of L-Unitary Soft Endoscopic anterior cervical discectomy decompression fusion for single-level cervical spondylotic myelopathy Presenter: Qinghao Zhao (China) Authors: Qinghao Zhao Enyi Zhong Qingchu Li	
08:03-08:06	Biportal Endoscopic Thoracic Discectomy Presenter: Seung-Hyun Choi (Korea) Author: Seung-Hyun Choi	
08:06-08:09	Introduction of Pao's Flash sign Presenter: Tali Hsu (Taiwan) Authors: TA LI HSU / Yu-Hao-Huang / Yu-Hung Chen/ Jwo Luen Pao	
08:09-08:12	A Comparative Analysis of Postoperative Imaging and Functional Recovery between Endoscopic and Microscopic Assisted Cervical Discectomy: Evidence from a Retrospective Cohort Study Presenter: Bi Hangchuan (China) Authors: Bi Hangchuan, Shen Xianglin, Guo Xinpeng, Xu Yuan, Jiang Gang, Xue Haiyan, Zheng Hongyu, Wang Zhihua	
08:12-08:15	Cervical confluent root variation Presenter: Myeong-Guk JO (Korea) Author: Myeong-Guk JO	
08:15-08:18	Taking advantages of Unilateral Biportal Endoscopy in Thoracic Spinal Stenosis Decompression Presenter: Ping Liu (China) Authors: Ping Liu, Zhong Xie, Yijun Kang	
08:18-08:30	Discussion	
08:30-09:00	**Quick fire 10** Moderators: Ching Hsiao Yu (Taiwan), Sub-Ri Park (Korea)	250p
08:30-08:33	A New Pilot Hole Preparation System for Percutaneous Pedicle Screw Placement A Randomized Controlled Study Presenter: Haijian Ni (China) Authors: Haoyu Gong, Yunshan Fan,Haijian Ni	
08:33-08:36	The efficacy of biportal endoscopic decompression for thoracic ossification of ligamentum flavum with occupancy ratio ＞60% Presenter: Liang Wang (China) Authors: Liang Wang, Lei Qi	
08:36-08:39	Efficacy and radiographic analysis of oblique lumbar interbody fusion in treating lumbar spondylolisthesis with sagittal imbalance. Presenter: Eun-Min Seo (Korea) Author: Eun-Min Seo	
08:39-08:42	Association of Open Transforaminal Lumbar Interbody Fusion with Increased Postoperative Complications Compared to Minimally Invasive Transforaminal Lumbar Interbody Fusion Presenter: Ching-Yu Lee (Taiwan) Authors: Ching-Yu Lee (Presenter), Sung Huang Laurent Tsai, Meng-Huang Wu, Tsung-Jen Huang	
08:42-08:45	OLIF with Anterolateral screws ：Is it necessary to do Anterior /Posterior Surgery Presenter: K. Karthik Kailash (India) Author: K. Karthik Kailash	
08:45-08:48	Endoscopic Spine Surgery: Our Initial Experience- A Young Surgeon's Perspective Presenter: Sagar Gawali (India) Author: Sagar Gawali	
08:48-09:00	Discussion	

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OP-001	Targeting TSP-1/TGF-β1 Signaling and Oxidative Stress in Ligamentum Flavum Hypertrophy: A Potential Therapeutic Strategy Yu-Chia Hsu, Ruei-jyun Yang, Ting-Yuan Tu, Yan-Jye Shyong, Cheng-Hsiang Kuo, Yuan-Fu Liu, Shu-Shien Shih, Chao-Jui Chang, Cheng-Li Lin	123p
OP-002	Thrombospondin-1 Plays a Role in Intervertebral Disc Aging and Degeneration. Yuan-Fu Liu, Cheng-Li Lin	124p
OP-003	Development of a new treatment for osteoporotic vertebral fractures using adipose-derived stem cell spheroids Yuta Sawada, Shinji Takahashi, Kumi Orita, Akito Yabu, Masayoshi Iwamae, Yuki Okamura, Yuto Kobayashi, Hiroshi Taniwaki, Hiroaki Nakamura, Hidetomi Terai	125p
OP-004	Nucleus pulposus-derived mesenchymal stem cells combining with Pure Platelet-rich plasma applying in Intervertebral disc degeneration treatment Jie Huang, Chenjun Liu, Haiying Liu	126p
OP-005	AI-based analysis highlights the critical role of erector spinae muscle health in predicting outcomes after lumbar spinal fusion Namhoo Kim, Sub-Ri Park, Jae Won Shin, Byung Ho Lee, Si-Young Park, Jin-Oh Park, Kyung-Soo Suk, Seong-Hwan Moon, Hak-Sun Kim, and Ji-Won Kwon	127p
OP-006	FEASIBILITY OF LUMBOPELVIC MUSCLES VOLUME FOR ESTIMATING TOTAL MUSCLE VOLUME ON COMPUTED TOMOGRAPHY: AI-BASED AUTOMATIC IMAGE ANALYSIS Yongoo Choi	128p
OP-007	Risk prediction of osteoporotic vertebral compression fractures in postmenopausal osteoporotic women by machine learning modeling Jun Zou, Xiao Sun, Huilin Yang	129p
OP-008	Automated Measurement of Pelvic Parameters Using Convolutional Neural Network in Complex Spinal Deformities: Overcoming Challenges in Coronal Deformity Cases Dong-Ho Kang; Ye-Jin Jeong; Sung Taeck Kim; Younguk Kim; Bong-Soon Chang; Hyoungmin Kim; Sam Yeol Chang; Du Hyun Ro	130p
OP-009	Hybrid Endoscopic thoracic discectomy using robotic arm and navigation for high migrated calcified disc herniation Yi-Hao Liang, Rohit Akshay Kavishwar, Maria Pedraza, Dimas Rahman Setiawan, Jae-Hwan Kim,Jin-Sung Kim	131p
OP-010	Enhancing Precision in Oblique Lumbar Interbody Fusion: A Clinical Evaluation of O-arm Navigation-Assisted Techniques Hongxun Sang, Jin Zhang, Guofang Fang, Jiachang Wu, Shihao Zhang, Weida Zhuang, Min Chen, Xiuwang Li	132p
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OP-014	Deep learning from X ray to evaluate MRI disc problem Chien-Chun Chang	136p
OP-015	Deep Learning MRI Analysis for Differentiating Malignant from Benign Vertebral Compression Fractures: A Retrospective Multicenter Study Joonghyun Ahn, Young-Hoon Kim, Jun-Seok Lee, Sang-Il Kim, Hyung-youl Park, June Lee, Youjin Shin, Jae Chul Lee	137p
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EP-27	Percutaneous Endoscopic Lumbar Discectomy via Transverse Process Approach for the Treatment of Far Lateral Disc Herniation at L5/S1: A technical note Bin Zheng, Yan Liang	283p
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EP-49	Is Bone Cement Still Useful in Minimally Invasive Spine Surgery for Fragility Fracture: A Brief Review Zairin Noor, Muhammad Iqbal, Sutan Agung Lumban Tobing, Eric Robhets Lovin, Ridma Irsyam Septadi	305p
EP-50	Experience of Full Endoscopic Spine Surgery for Cervical Spondylotic Radiculopathy Tomoyuki Yamakawa	306p

Abstracts

Endoscopic Spine Surgery Video Forum

PASMISS 2025

The 25th Pacific and Asian Society of Minimally Invasive Spine Surgery

Video session 1.

Learning Biportal Endoscopic Spine Surgery from Korean Experts

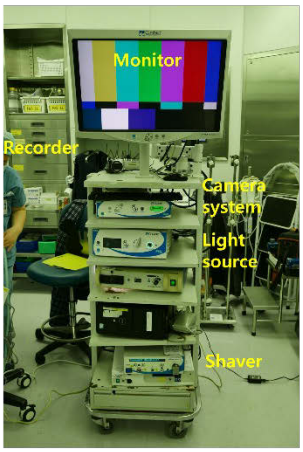
Biportal Endoscopic Interlaminar Approach: Step-by-Step Basics

Sang-Min Park

Department of Orthopaedic Surgery, Seoul National University Bundang Hospital

Biportal endoscopic system

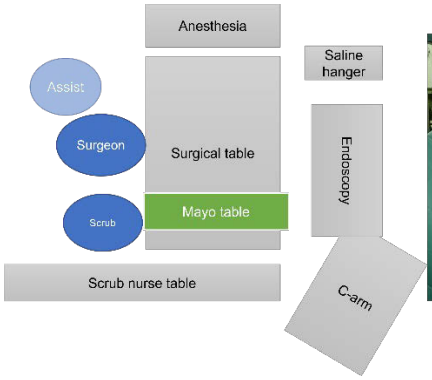






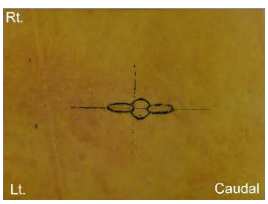
No special systems for BESS

Room Setting





Patients setting



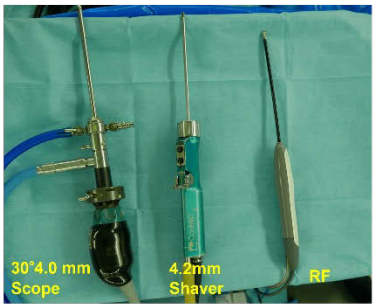




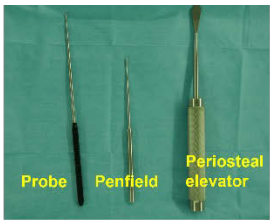


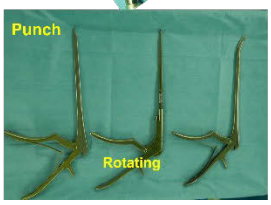


Instruments



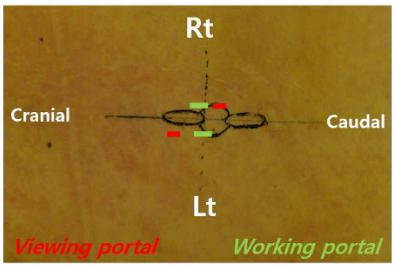


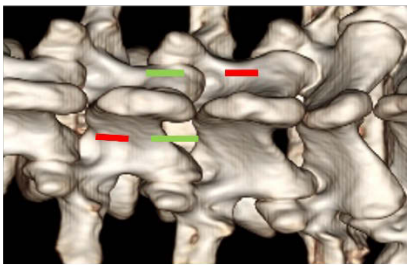






Portals (Interlaminar)



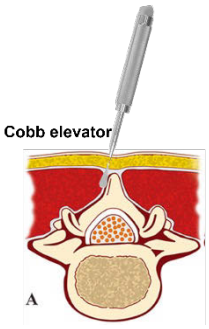


Surgical procedures

Making working space
  Detachment of paraspinal muscles

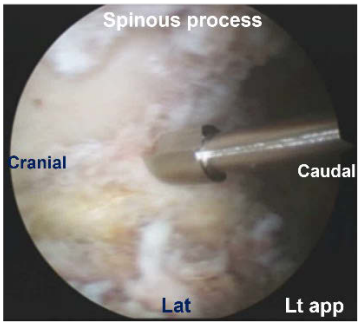
Remove the ragged muscles
  Shave and RF

Laminectomy
  Ipsilateral
    With burr & punches

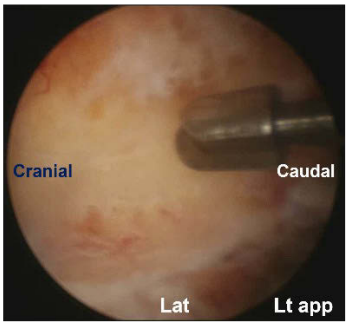




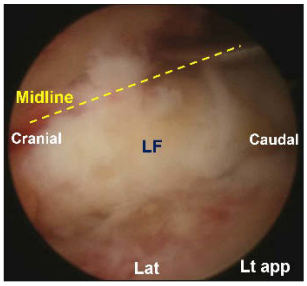
Laminectomy using burr



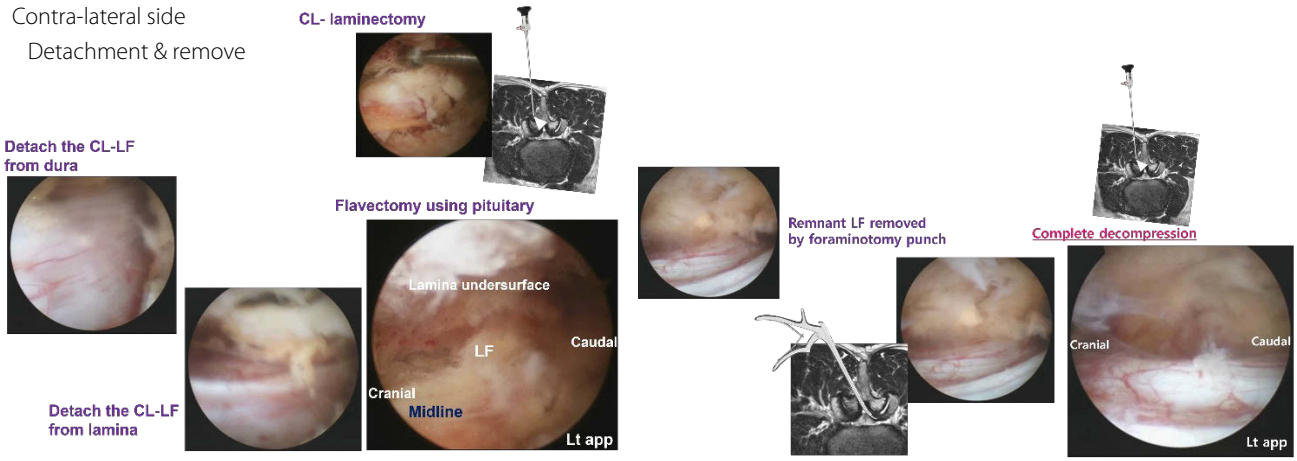
Burring of far cortex



Flavectomy
  Ipsilateral
    With pituitaries & punches



Flavectomy
  Contra-lateral side
    Detachment & remove



Clinical outcomes

vs Microscope
  Similar clinical outcomes

Superiority in
  Short-term VAS improvement
  Slight advantage of fentanyl usage

Controversies
  Muscle injury, operation time, hospital stay, less blood loss (?)

Video session 1.

Learning Biportal Endoscopic Spine Surgery from Korean Experts

Biportal Paramedian Approach for Lumbar Foraminal and Extraforaminal Lesions

Sub-Ri Park

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Yonsei University College of Medicine

Background: The biportal transforaminal endoscopic approach offers targeted decompression of lumbar foraminal and extraforaminal lesions with minimal muscle disruption. However, anatomical variation and deep-seated targets demand precise orientation and careful preoperative planning.

Surgical Technique: For L1–L5, standard portal landmarks are 2 cm lateral to the pedicle margin or ~5 cm from the spinous process, with incisions made at each transverse process (TP) level. A lateral incision is preferred for two reasons:

(1) The TP lacks surrounding bony structures, making it the most reliable tactile landmark.

(2) The facet joint, located at the 12 o'clock position relative to the TP, is optimally visualized with a lateral "skyward" trajectory using a 30° endoscope.

During muscle detachment, the dissection should proceed vertically to palpate the TP; convergence or tilting risks misdirection toward the lamina or lower level. The dissection sequence follows a clockwise path from the upper-level TP to the isthmus and lateral facet capsule.

If the TP is short or poorly visualized on fluoroscopy, preoperative CT review is essential, assessing TP depth (sagittal), length/shape (coronal/axial), foraminal morphology, SAP thickness, and osteophytes. The TP may be obscured due to severe morphological variation or deep positioning. In such cases, skin incision convergence is adjusted based on CT, and the maximum detachment depth is pre-marked on the muscle detacher to avoid overshooting.

Once the TP is confirmed, soft tissue is cleared along the bony contour, the lateral facet capsule is exposed, and partial SAP tip or TP removal (subpediculectomy) secures the exiting root corridor.

At L5–S1, iliac crest obstruction requires side-specific portal modification (Only in beginner):

Left side: distal portal 1 cm lower/1 cm medial to the viewing portal.

Right side: proximal portal between L4 TP and Lt TP, distal portal below L5 TP

Pitfalls: Misorientation from inadequate TP palpation

Over-convergence leading to wrong-level entry

Excessive facet resection causing instability

Unrecognized deep or variant TP delaying exposure

Conclusion: Meticulous TP-based orientation, CT-guided incision planning, and controlled bone removal are critical for safe and effective biportal transforaminal decompression. Awareness of common anatomical pitfalls and level-specific modifications can improve surgical precision and outcomes.

Video session 1.
Learning Biportal Endoscopic Spine Surgery from Korean Experts

Biportal Endoscopic ULBD in Cervical Myelopathy

Seok-Bong Jung

Jinju Bon Hospital in South Korea

Biportal endoscopic ULBD represents an advanced minimally invasive alternative for treating cervical myelopathy. It combines the benefits of endoscopic magnification and tissue preservation with the efficacy of bilateral decompression, offering favorable clinical outcomes with reduced morbidity.

The procedure is performed under general anesthesia with the patient in the prone position on a radiolucent table. The head is fixed in a Mayfield clamp, and slight neck flexion is maintained to open the interlaminar space.

Two skin incisions (approximately 0.7–1 cm) are made—one for the viewing portal and one for the working portal. The portals are typically placed 1–1.5 cm off the midline, centered over the targeted interlaminar space, using fluoroscopic guidance.

After blunt dissection with straight mosquito through the paraspinal muscles, a 0° or 30° endoscope is introduced through the viewing(proximal) portal. Continuous saline irrigation is used throughout the procedure to maintain a clear operative field and control bleeding.

A arthroscopic drill and Kerrison punches are introduced through the working portal. A unilateral laminotomy is performed by drilling the inferior margin of the lamina above and the superior margin of the lamina below the target level. The ligamentum flavum is preserved during bony work to protect the dura.

Once sufficient bone removal is achieved, the ligamentum flavum is carefully resected under direct endoscopic visualization. Using angled curettes and punches, decompression is extended to the contralateral side by undercutting the base of the spinous process and contralateral lamina. The contralateral ligamentum flavum is resected to achieve bilateral decompression.

Neural decompression is confirmed by observing pulsatile dura and free mobilization of the spinal cord and exiting nerve roots.

Hemostasis is achieved with bipolar radiofrequency coagulation. Drain is usually required. The skin incisions are closed

Although biportal endoscopic ULBD is a minimally invasive and anatomically preserving technique, several potential complications must be considered:, Such as

Dural Tear and CSF Leak, Neural Injury, Epidural Hematoma, Inadequate Decompression, Instrument-related Issues

While biportal endoscopic ULBD offers several advantages over conventional approaches, it demands a steep learning curve and precise technique to avoid complications. Thorough anatomical knowledge, adequate surgical experience, and proper patient selection are essential for optimizing outcomes and minimizing risks.

Video session 1.
Learning Biportal Endoscopic Spine Surgery from Korean Experts

Biportal endoscopic Lumbar Interbody fusion : Basic technique and indication

Ju-Eun Kim, M.D.

Baroseomyeon Hospital, Pusan, South Korea, Department of Orthopaedic Surgery

Abstract: Lumbar spine fusion has been widely accepted as a treatment for various spinal pathologies, including the degenerative spinal diseases. Transforaminal interbody fusion (TLIF) using minimally invasive surgery (MIS-TLIF) is well-known for reducing muscle damage. However, the need to use a tubular retractor during MIS-TLIF may contribute to some limitations of instrument handling, and a great deal of difficulty in confirming contralateral decompression and accurate endplate preparation. Several studies in spinal surgery have reported the use of the unilateral bi-portal endoscopic spine surgery technique for decompression or discectomy. 1,2) The purpose of this study is to describe the process of, and technical tips for, TLIF using the BESS technique. Bi-portal endoscopic TLIF (BE-TLIF) is similar to MIS-TLIF except that there is no need for a tubular retractor. It is supposed to be another option for alternating open lumbar fusion and MIS fusion in degenerative lumbar disease that needs fusion surgery.

Key words: lumbar spine fusion, transforaminal interbody fusion, lumbar degenerative disease, Unilateral biportal endoscopy, biportal endoscopic spinal surgery

Video session 2.

Challenging Cases in Endoscopic Spine Surgery: Advanced Solutions and Technical Strategies

Revision Endoscopic Spine Surgery

Hyoung-Bok Kim

National Health Insurance Service Ilsan Hospital

Abstract

Recently, the application of minimally invasive spinal surgery (MISS), including endoscopic techniques, has surged in South Korea. By accessing lesions through small incisions and minimizing soft-tissue damage, MISS enables faster recovery and earlier return to daily activities. A recent meta-analysis of endoscopic spinal surgery complications reported relatively low rates of major adverse events, further fueling spine surgeons' interest.

However, real-world practice often diverges from theory. Misinterpreting MISS as merely a minimal-incision procedure neglects its technical complexity and can lead to either excessive structural disruption or inadequate decompression—both key drivers of suboptimal outcomes and reoperations.

We report a case of a 60-year-old male with a simple compression fracture who initially underwent biportal endoscopic decompression and vertebroplasty at a local clinic without relief. A second procedure also failed, prompting referral to our center.

On admission, imaging revealed cement leakage into the L3/4 disc space, segmental instability at L3/4 from over-decompression, and a recurrent facet cyst at L4/5 due to insufficient decompression. To address these issues, we performed an oblique lateral interbody fusion (OLIF) at L3/4—removing leaked cement with instruments adapted from hip arthroplasty and inserting an interbody cage—and carried out revision decompression at L4/5 via biportal endoscopy, with O-arm navigation guiding real-time intraoperative assessment.

Postoperatively, the patient's symptoms improved significantly. However, initial misjudgment and technical shortcomings resulted in over ten months of unnecessary pain and functional limitation.

This case underscores that the main causes of reoperation in endoscopic spinal surgery are not classic complications but rather over- or under-decompression. It highlights the need for thorough anatomical understanding and precise surgical judgment, even within the constraints of endoscopic visualization.

Video session 2.

Challenging Cases in Endoscopic Spine Surgery: Advanced Solutions and Technical Strategies

Biportal Endoscopic Posterior Cervical Foraminotomy : Key Anatomical Considerations and Technique

Min-Seok Kang, M.D.

Department of Orthopedic Surgery, Konkuk University Medical Center, Konkuk University School of Medicine, Seoul, Republic of Korea

Introduction: Cervical radiculopathy arising from lateral disc herniation, endplate osteophytes, or hypertrophied uncinate processes often necessitates surgical intervention when conservative treatment fails or when significant neurological deficits are present. While anterior cervical discectomy and fusion (ACDF) remains the standard approach, it is associated with complications such as dysphagia, dysphonia, and adjacent segment degeneration. Posterior cervical foraminotomy (PCF) offers a motion-preserving alternative for unilateral lateral pathologies without myelopathy. The biportal endoscopic (BE) technique, by separating the viewing and working portals, provides enhanced visualization and instrument maneuverability, potentially improving safety and outcomes.

Main Body: A thorough understanding of cervical anatomy is critical for safe PCF. The spinous process, lamina, and lateral mass form key surgical landmarks, with the facet joint comprising the inferior articular process (IAP) of the superior vertebra and the superior articular process (SAP) of the inferior vertebra. The "V-point" formed by the IAP, SAP, and ligamentum flavum serves as the starting point for decompression.

Under general anesthesia, the patient is placed in a modified prone position with slight neck flexion. Two independent 0.8 cm incisions, spaced ≥2 cm apart, are created for the viewing and working portals. After muscle detachment and exposure of the lamina and facet joint, partial drilling of the lamina and medial facet is performed, preserving >50% of the facet to avoid instability. The ligamentum flavum is partially resected to expose the exiting nerve root and thecal sac. Disc fragments, if present, are removed with pituitary forceps or curettes.

Conclusion: BE-PCF allows for effective decompression of the cervical nerve root while preserving spinal motion segments. Mastery of key anatomical landmarks, meticulous facet preservation, and controlled bone removal are essential for minimizing complications and achieving favorable outcomes. This minimally invasive approach represents a viable alternative to ACDF in selected unilateral foraminal pathologies.

Video session 2.

Challenging Cases in Endoscopic Spine Surgery: Advanced Solutions and Technical Strategies

Biportal Endoscopic Thoracic Discectomy

Seung-Hyun Choi

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Object: The use of conventional spinal decompression surgery for thoracic disc herniation (TDH) can be limited by technical difficulties and a restricted field of vision. The purpose of this study is to describe the technique for discectomy and/or fusion procedure using unilateral biportal endoscophy (UBE) for TDH and analysis of clinical postoperative results.

To reduce the invasiveness and risk of thoracic disc surgery, a transpedicular endoscopic approach has been created. The surgical technique and outcome of endoscopic transpedicular thoracic discectomy are reported.

Methods: The authors performed laminotomy, foraminoplasty, partial pediculotomy and corpectomy via using UBE posterolateral approach in patients with TDH. Indications of fusion consist of revision case and wide pediclulotomy (> 50%).

From March 2018 to July 2020, twelve patients with thoracic disc herniation (TDH) underwent unilateral biportal endoscopic thoracic discectomy with or without fusion. The authors performed laminotomy, foraminoplasty, partial pediculotomy and corpectomy via using UBE posterolateral approach in patients with TDH. Indications of fusion consist of revision case and wide pediclulotomy (> 50%). 4 patients were men and 8 were women, aged 48 to 73 years (mean: 65 years). Myelopathy, with or without radiculopathy was present in all patients. The follow-up periods ranged from 8 to 60 months (median 27 months). The clinical outcome was evaluated using the visual analogue scale (VAS) and Oswestry disability index (ODI).

The authors enrolled only patients who underwent follow-up for longer than 12 months after UBE.

Fifty-eight patients were enrolled in this study. This approach was based on 2 portals: one portal was used for continuous input and endoscopic viewing and the other portal was used for continuous output and manipulating the instruments used in the decompression procedures.

The surgical technique of posterior transpedicular thoracic discectomy was modified to endoscopic transpedicular surgery. A 1.5-cm trocar was placed in the interlaminar space via a 2-cm transverse paramedian skin incision. At the ventral aspect of the spinal cord discectomy was performed under direct visualization by using a 70°-lens endoscope.

This surgical technique was used in 12 patients. 4 patients were men and 8 were women, aged 48 to 73 years (median 65 years). Myelopathy, with or without radiculopathy was present in all patients. The follow-up periods ranged from 8 to 60 months (median 27 months).

Results: In 11 of the 12 patients with myelopathy excellent improvement was shown postoperatively; One patient who was unable to walk preoperatively was able to ambulate with the use of a cane, but residual spasticity is still present. The average length of hospital stay was one night. Four patients were male and eight were female, aged 48 – 73 years (mean: 65 years). Mean follow-up period was 60 months (8 – 60 months), mean operative time was 81 min. The mean VAS improved from 6.5 to 3.0 for back pain and 5.8 to 2.5 for leg pain at the final follow-up. The mean ODI scores also improved from 58.1 before surgery to 24.5 at the final follow-up. Conversion to an open procedure was not required for any of the patients.

Conclusions: Unilateral biportal endoscopic discectomy was found to be a minimally invasive and effective surgical treatment.

From a surgical point of view, unilateral biportal endoscopy (UBE) is very similar to microscopic spinal surgery, permitting good visualization. The authors suggest that the UBE, which is a minimally invasive procedure, is an alternative treatment option for thoracic TDH.

KEY WORDS • thoracic spine • thoracic disc herniation • unilateral biportal endoscopy • discectomy

Video session 2.

Challenging Cases in Endoscopic Spine Surgery: Advanced Solutions and Technical Strategies

Full-Endoscopic TLIF via Trans-Kambin Apprroach for Indirect Decompression

Jae-Hung Shin, Ki-Tack Kim

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Background and Introduction: Recently, substantial cases of degenerative lumbar spondylolisthesis accompanying spinal stenosis, or foraminal stenosis are solved by EALIF (Endoscope assisted lumbar interbody fusion) instead of conventional surgeries. Especially, indirect decompression without bone resection is feasible with full endoscope. Using Kambin's triangle as an access to the index disc level, indirect decompression and reduction can be possible like OLIF, or LLIF. However, Trans-Kambin's technique has some thresholds compared to posterolateral technique. The access into L5-S1, deep seated L5-6 level is not favorable due to limited trajectory, furthermore, adequate harvesting of autogenous local bone is not feasible. In the cases requiring wide decompression like severe central spinal stenosis, or pathologies located on the lowest disc level, endoscopic TLIF via posterolateral approach can be the better option.

Main body

1. Common Indications of Trans-Kambin's technique

Degenerative, spondylolytic spondylolisthesis accompanying foraminal stenosis, or mild grade spinal stenosis are preferable indications. Some symptomatic degenerative disease following prior decompression can be proper indications for Trans-Kambin's technique. However, the pathologies on the lowest disc level, multi-level pathologies requesting long operation time, or kyphotic, scoliotic deformities requiring static corrective force can be the relative contraindications.

2. Operation technique

Skin incision is usually located on further laterally than posterolateral approach along the guide wire into the Kambin's trianle. Fasciotomy is set on the erector spinae muscle, and finger dissection is usually followed into the SAP and neural foramen. First, bony structures including SAP, pedicle, upper and lower endplate must be detected, then exiting nerve root should be retracted superiorly before disc space preparation. Meticulous endplate decortication is the most important procedure for the reliability of fusion. After adequate endplate preparation, allograft bone is usually packed and substitute(BMP) filled cage is inserted in the disc space.

3. Cautions and Complications

In preparation of disc space, osseous injuries on the vertebral rim or endplate can induce early subsidence of disc space, or cage migration. Thus, surgeons should be cautious not to injure the bony structue in decortication of endplate. Exiting nerve root must be protected safely, and kept pliable during surgery, not to be injured. Therefore, the exiting nerve root should be retracted superiorly, and the subperiosteal dissection beneath nerve root is recommended, sometimes, proximal resection of SAP is needed if the disc space is too narrow.

Concusion: There are two different techniques in full endoscope assisted lumbar interbody fusion, one is posterolateral access, the other is Trans-Kambin's. Trans-Kambin technique has rather narrower indication compared to posterlateral techniques due to the limit on application in the lowest disc level, and inadequate harvesting of autogenous bone. However, It has some merits including the shorter operation time, the sufficient decompression and reduction saving vertebral structures. If the suitable fusion technique is applied or combined, preferable outcome will be achieved.

Key words : Endoscope assisted lumbar interbody fusion, Trans-Kambin approach, Full endoscope.

Video session 2.

Challenging Cases in Endoscopic Spine Surgery: Advanced Solutions and Technical Strategies

Biportal Endoscopic Lumbar Interbody Fusion Using Multiportal Technique for Large Cage Insertion

Hyun-Jin Park

Hallym University Kangnam Sacred Heart Hospita

Abstract

Background: In conventional biportal endoscopic transforaminal lumbar interbody fusion (BE-TLIF), cage size is often limited by the working corridor, potentially restricting fusion surface area and stability. A multiportal technique utilizing a portal located 2 cm lateral to the pedicle's lateral margin (P+2 portal) enables safe insertion of a large, three-dimensional (3D) printed porous titanium cage with wide footprints.

Method: After ipsilateral posterior decompression and contralateral facet release to increase segmental mobility, meticulous endplate preparation is performed under magnified endoscopic visualization. The P+2 portal provides a wider and safer trajectory for cage insertion, allowing the cage to cover both apophyseal rings. Continuous endoscopic monitoring ensures neural protection during insertion, followed by percutaneous pedicle screw fixation.

Result: This approach enables placement of a larger cage without excessive neural retraction, potentially reducing cage subsidence and improving fusion rates, while preserving the minimally invasive benefits of biportal endoscopy.

Conclusion: Multiportal BE-TLIF using the P+2 portal is a safe and effective technical modification for large cage insertion, enhancing biomechanical stability and fusion potential in minimally invasive spine surgery.

Keywords: Biportal endoscopic lumbar fusion, P+2 portal, multiportal technique, large cage, 3D-printed titanium cage

Abstracts

Plenary Lecture

Plenary Lecture1

Pedicle screw fixation: 40 years of development and challenges

Prof Ch. Mazel – EU expert (MDR)

Paris Sorbonne University – Past chairman Orthopedic and Spine Department – Paris - France

Summary: The use of spine pedicle based instrumentation is now part of the daily life of a spine surgeon. However, it is interesting to look back and look at how far we have come since the beginning of this technique.

The understanding of the vertebral pedicle, its anatomical description, and the identification of screw implantation points have revolutionized spine surgery for a little over 40 years.

It was Professor Judet who first implanted a screw in C2 pedicle in 1962.

It was Professor Roy Camille who implanted a screw in the lumbar pedicle in 1967.

This technique quickly matured and developed in Europe. The development to the United States was more complicated since the authorization (FDA) of pedicle screws was only authorized in 2000. Development in Asia-Pacific has been gradual in parallel with these stages.

The surgical technique and the identification of access points to the pedicle were quickly mastered.

The instrumentation has undergone considerable transformations over the years.

The transformations concerned the pedicle screw itself with the development of a tulip allowing the screws to be joined together by means of rods.

The screws from mono axial became poly axial and then at preferred angle. The thread has evolved considerably, reduction screws for the treatment of sagittal deformities such as spondylolisthesis as well as screws for the reduction of coronal deformities (scoliosis) have appeared. This was completed by MIS screws designed to be implanted percutaneous.

The plates initially used were replaced by rods under the influence of Cotrel and Dubousset new instrumentation designed for scoliosis treatment (1983). The first pedicle screw joining roods and screw was implanted in 1985 by Ch Mazel.

The first systems were made of stainless steel (316L) and then cobalt chromium, which were quickly replaced in the early 2000s by titanium (TA6V). Today carbon PEEK being the latest.

The surgical technique itself has evolved considerably, from open surgery to minimally invasive surgery with implants introduced percutaneously.

The knowledge of the vertebral pedicle has not only allowed the creation and evolution of osteosynthesis material, it has also allowed many treatments such as kyphoplasty, vertebroplasty and transpedicular vertebral biopsies.

Conclusion: It is interesting to note that the search for ever more innovative solutions, in particular the use of navigation and robotization systems, continues to improve and make the use of spinal pedicle screw fixation more reliable and popular.

Plenary Lecture1

Oncological aspect of spinal deformities and recurrence

Prof Ch. Mazel – EU expert (MDR)

Paris Sorbonne University –Past chairman Orthopedic and Spine Department – Paris - France

Summary: Spinal deformity occurring in the development of a tumor can be the first sign of the onset of this pathology. The aim of our presentation is to focus only on post-surgical deformities.

Anticipating and avoiding the occurrence of a post-treatment spinal deformity is therefore fundamental because it has an undeniable impact on patient's quality of life, or even survival.

This risk of future instability will worsen the prognosis if it is not taken into account at the time of initial treatment.

Regardless of the proposed treatment, simple decompression, vertebroplasty or kyphoplasty, the tumor will continue to evolve in the majority of cases that can potentially create a deformity.

Conversely, during a surgical resection, the removal of the stability elements of the spine, bone, joint, disc, muscles, are all factors of potential future instability.

The deformity will occur in the sagittal, coronal or combined 360° planes.

Compensating for instability by increasing the volume of the osteosynthesis material and multiplying the number of roods is not necessarily the solution. A too large instrumentation can be a source of serious skin and infectious complications.

All the same time, the evaluation of tumor recurrence is made difficult in relation with local instrumentation artifacts. The use of PEEK carbon may be the solution, but raises the question of their long-term future in these patients, some of whom will live for many years.

Conclusion: It is the understanding of the mechanisms of instability at least as much as the quality of osteosynthesis that will guarantee the non-occurrence of deformity after treatment of a spinal tumor.

Plenary Lecture 2

Surgical application of O-arm navigation

Michael Grevitt

Nottingham University Hospitals NHS Trust, Queen's Medical Centre Campus

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Plenary Lecture 2

Surgical application of O-arm navigation

Michael Grevitt

Nottingham University Hospitals NHS Trust, Queen's Medical Centre Campus

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Abstracts

Invited Lecture

Invited Lecture

Ergonomic and spine surgery

Daniel Park

Orthopaedic Surgery at Oakland Univ School of Medicine

Introduction: Spine surgery, characterized by physically demanding procedures and techniques, presents significant ergonomic challenges that can affect surgeons' musculoskeletal health and operational efficiency. This study investigates the ergonomic practices and associated musculoskeletal impacts on spine surgeons, exploring the differences related to various surgical approaches.

Aims: To discuss ergonomics and spine surgery

To discuss the implication of work place injury

Methods: A survey was conducted among members of the Lumbar Spine Research Society (LSRS). The questionnaire assessed demographics, surgical approaches, ergonomic practices, and the prevalence of musculoskeletal injuries and discomfort during and after surgeries. Statistical analyses included ANOVA and Tukey's HSD tests to evaluate differences in pain scores across surgical methods.

Results: The majority of respondents were male orthopaedic spine surgeons [PL1] with a mean practice tenure of 10.03 years[PL2] . Open surgery was the most commonly used approach, followed by Tubular and Endoscopic methods[PL3] . Surgeons performing open approaches reported the highest levels of pain and discomfort, particularly in the neck, shoulders, and back, both during and post-operation. [PL4] Ergonomic practices varied widely, with only a minority of surgeons using optimal ergonomic setups consistently. The study highlights a significant correlation between surgical approach and the incidence of musculoskeletal symptoms, with less invasive techniques associated with fewer ergonomic issues.

Conclusion: The findings underscore the need for improved ergonomic practices in spine surgery to reduce the risk of musculoskeletal injuries and enhance surgical efficiency. Addressing ergonomic challenges through education, focused surgical equipment design, and procedural adjustments is crucial for improving surgeons' musculoskeletal health and well-being.

Invited Lecture

Next-Gen Spine Robotics: From prototype to Practice

Seong Yi, M.D., Ph.D.

Professor, Department of Neurosurgery, Yonsei University College of Medicine, Korea
Director, Korean Medical Robot Center; KSNS Robotic Spine Surgery Committee

Background: Robotic assistance in spine surgery has evolved rapidly, offering enhanced precision, safety, and workflow efficiency. Despite growing adoption, comparative effectiveness and integration with emerging technologies such as AI and mixed reality remain under investigation. This study presents a comprehensive review of current robotic spine surgery techniques and introduces future directions for integration and automation.

Methods: We reviewed clinical outcomes and surgical workflows at a single academic spine center utilizing robotic assistance for thoracolumbar and cervical procedures. A retrospective, propensity score-matched analysis was conducted comparing robotic, C-arm-guided, and freehand techniques for pedicle screw placement (n=162; 54 in each group). Additionally, cadaveric cervical procedures were assessed using the Gertzbein-Robbins classification. Research involving AI-based segmentation and planning using U-Net models, along with mixed-reality navigation (HoloLens 2), was also included.

Results: Robotic screw placement demonstrated superior accuracy (98.6%) compared to C-arm (90.3%) and freehand techniques (95.4%). In cervical cadaveric models, 75% of screws were Grade A and 97.5% were clinically acceptable. Robotic TLIF procedures showed workflow advantages when compared to microdiscectomy and navigation-only methods. AI-based preoperative segmentation enabled precise, automated screw path planning across multiple vertebral levels. Integration with HoloLens provided real-time, immersive navigation. The Cuvis Spine system achieved high thoracolumbar and cervical accuracy, demonstrating the feasibility of AI-enhanced 3D-2D registration for intraoperative guidance. This presentation categorizes surgical assistant robots into passive mechanical holders, motorized endoscope holders, voice/head-controlled systems, and emerging AI-guided autonomous assistants. It introduces several representative systems from Europe, Asia, and the U.S., highlighting their specific features and clinical applications in spine surgery, such as improved ergonomics, radiation exposure reduction, and real-time control during endoscopic or microscopic procedures. We also explore recent trends in robot-assisted spine surgery, including AI integration, haptic feedback, cloud-based data exchange, and augmented reality (AR) overlay. These features are driving the transition from simple mechanical assistants to intelligent, context-aware surgical collaborators. The development of robots like RoboNurse-VLA, which uses vision-language-action models to assist surgeons during operations, exemplifies the shift toward smart operating rooms.

Conclusion: Robotic spine surgery demonstrates improved precision and workflow efficiency over conventional methods, with expanding applications in complex and cervical procedures. The integration of AI, mixed reality, and autonomous planning marks a paradigm shift toward intelligent surgical systems. Future surgical environments will be characterized by cloud-based automation, autonomous tools, and surgeon-engineer collaboration. These advances highlight the emergence of a new class of professionals—"surgineers"—poised to redefine the boundaries of spine surgery.

Keywords: Robotic spine surgery, navigation, AI, automation, surgical workflow, Assistant robot

Abstracts

Symposium

PASMISS 2025

The 25th Pacific and Asian Society of Minimally Invasive Spine Surgery

Symposium 1 (Cervical & Pediatric Deformity)

Latest Updates of Cervical Deformity Correction

Seok Woo Kim

Hallym University Sacred Heart Hospital

Cervical deformity (CD) can have a significant impact on health related quality of life.

In CD, the cervical spine deviates from its normal alignment and loses the ability to maintain horizontal vision and performance of normal functions of the cervical spine through interaction with other thoracolumbar spine and the pelvis. Thus, efforts are required to evaluate complex CD using various parameters and to treat it effectively by appropriately applying the latest known classification systems.

The first generation International Spine Study Group cervical deformity classifications appear to be a good start as a guide to help define treatment goals, however, they are so diverse and complex that it has been pointed out as a problem which classification method should be used appropriately according to the characteristics of cervical deformity.

Surgical treatment for patients with cervical spine deformities is challenging for both patients and doctors. For successful surgical treatment, mastery of processes is important to objectively evaluate and classify the degree of deformity.

Recently, efforts have been increasing to systematically understand, evaluate, and effectively treat complex cervical spine deformities. Various parameters are being developed to quantify and objectively evaluate the degree of cervical spine deformity, and classification methods are being introduced to help establish the treatment scope by categorizing it according to the degree of deformity. However, a comprehensive and systematic understanding of complex deformities using only the currently introduced classification methods and related knowledge is not easy.

The treatment algorithm proposed here can help effectively understand cervical deformity and determine treatment plans depending on the nature and degree of deformity. Through this presentation, we aimed to provide a basic understanding of the evaluation and classification of patients with cervical spine deformities. This presentation also aimed to aid in the decision-making process for the treatment of cervical spine deformities by presenting a structured treatment algorithm based on recently known classification systems and lay the foundation for efficient treatment.

Symposium 1 (Cervical & Pediatric Deformity)

Cervical Spine Deformity Correction Talk Abstract

Sunny Kim MD

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In this talk I will outline the basic radiologic parameters that pertain to cervical deformity description. The surgical correction of the deformity via following methods will be discussed:

Anterior release and anterior fusion with stand alone cages and posterior fusion and instrumentation

Anterior corpectomy and posterior fusion with instrumentation

Posterior Ponte osteotomy and laminectomy and fusion

Pedicle subtraction osteotomy for chin and chest deformity correction

Details of bivector traction and explanation essential for cervical deformity correction

Unusual complication of delayed quadriplegia with complete recovery after chin and chest deformity correction

Link to power point:
https://www.dropbox.com/scl/fi/65p7zjankmlzuy90nxs23/PASMISS-Cervical-Spine-Deformity-Correction-Talk-Abstract.docx?rlkey=6spr6ras3uskaegu05ixjugin&st=3aayr751&dl=0

Symposium 1 (Cervical & Pediatric Deformity)

Complex cervical deformity surgery in rare genetic disease

Hyoungmin Kim

SEOUL NATIONAL UNIVERSITY HOSPITAL

Symposium 1 (Cervical & Pediatric Deformity)

Solid Rod Tether for Thoracic Scoliosis? An Analysis of Progressive Curve Straightening Behaviour in Bi-Portal Endoscopic Anterior Spinal Fusion.

Hee-Kit Wong

Yong Loo Lin School of Medicine, NUS

Hypothesis: Progressive curve straightening can occur in anterior single rod fusion in skeletally immature patients, similar to growth modulation with vertebral body tethering (VBT) for thoracic adolescent idiopathic scoliosis (AIS).

Study Design: Retrospective clinical study

Introduction: Spinal fusion for deformity correction occurs at the expense of growth post instrumentation while VBT allows non-fusion deformity correction, with risks of revision for tether breakage, curve under- and overcorrection.

Methods: We reviewed AIS Lenke 1 thoracoscopic assisted single rod anterior fusions from 2000-2013 in females aged 11-20 years with minimum 5-year follow-up. Patients with screw pullouts were excluded. Patients with Risser scores 0-3 at time of surgery (Group1) were compared to those with Risser scores 4-5 (Group2) for Cobb angle changes over time, complications and re-operations.

Results: Group1 (n=19) and Group2 (n=20) patients had similar preoperative coronal and sagittal radiological parameters. Preoperative main thoracic curves were 48.6±13.2° (Group1), and 45.3±7.9° (Group2) (p=0.338). Mean Risser grade was 2.4±1.0 in Group1 and 4.0±0.0 in Group2 (p<0.001). Postoperative instrumented thoracic curves were 10.7±4.5° (Group1), and 10.2±5.4° (Group2) (p=0.745).

15 patients (79%) in Group1 and 4 patients (20%) in Group2 had further curve straightening of more than 5° compared to their first postoperative erect radiograph (p<0.001). Mean follow-up was 96 months (range 63-180 months). Curve straightening occurred progressively up to 5 years postoperatively in Group1, and 1 year in Group2. Mean overall curve straightening in these patients was 7.7±2.4° in Group1, and 6.8±2.2° in Group2.

7 patients (6 in Group1, 1 in Group2) had mild overcorrection (p=0.044).

One patient in Group 2 required re-operation for rod breakage. No other rod breakages occurred. Adding-on and loss of correction (>5°) rates were similar between the two groups.

Conclusion: Anterior single rod thoracic fusion behaves like a solid rod tether in skeletally immature patients, showing progressive curve straightening and mild overcorrection. This may be a useful alternative to VBT in growing patients with larger curves to avoid under-correction and tether breakage.

Symposium 1 (Cervical & Pediatric Deformity)

MISS for AIS: Evolving technique and long-term outcomes in the Adolescent Spine

Jae-Hyuk Yang

Korea University Anam Hospital

Symposium 2 (Tumor & Osteoporosis)

Bone Health Optimization

Lt. Gen. Prof. Warat Tassanawipas, M.D.

Department of Orthopaedics, Army Hospital, Bangkok, Thailand.

Introduction: Bone health optimization in spinal surgery is a critical perioperative intervention aimed at improving bone quality to reduce perioperative complications such as implant failure, and revision surgeries. It involves assessing bone status, identifying metabolic deficits, correcting nutritional issues, and initiating targeted treatments like anabolic or antiresorptive therapies before and after spine surgery. Health optimization in spine surgery include: osteoporosis and low bone density are common in patients undergoing spine surgeries; many patients qualify for osteoporosis treatment but often remain untreated and ignored. Bone health optimization requires a multidisciplinary approach involving spine surgeons, primary care, endocrinologists, nutritionists, and other specialists to ensure comprehensive assessment and management.

Methods: Perioperative bone health assessment typically includes bone mineral density testing DXA scans, fracture risk evaluation (FRAX), and sometimes CT imaging and trabecular bone scoring o detect poor bone quality and microarchitecture degradation.
Correcting bone health before surgery involves nutritional supplementation (calcium, vitamin D, protein), addressing metabolic bone disorders, and prescribing medications such as anabolic agents or bisphosphonates to enhance bone strength and reduce the risk of complications.

Results: Evidence suggests that optimizing bone health perioperatively can lower implant-related complications and revision surgery rates, Target populations for bone health optimization include older adults (e.g., Women over 65, men over 70), those with history of fractures, inflammatory conditions, steroid use, or other risk factors for poor bone quality.
The general survival rate for implants in the population is 85-95%, but the second implant failure rate in osteoporotic patients can be as high as 20%, which is substantially higher than typically reported failure rates (usually ranging from 4-29% depending on follow-up duration).
Osteoporosis can negatively affect osseointegration (the process by which the implant bonds with the bone), making early implant failure.

Discussion: Osteoporosis significantly increases the risk of surgical complications Higher rates of perioperative complications such as adjacent segment disease (ASD), cage subsidence or migration, screw loosening, and hardware failure due to impaired bone quality and structural integrity. Increased risk of complications leads to longer hospital stays, higher healthcare costs, Osteoporotic patients related to poor bone fixation and bone healing.
Overall, osteoporosis compromises bone quality, impairs healing, and increases the risk of implant instability and early failure. This underscores the importance of perioperative bone health assessment and optimization in patients who are candidates for implant placement.
Osteoporosis is an independent risk factor for perioperative complications for lumbar spinal stenosis surgery and similar procedures, emphasizing the importance of bone health optimization before and after spinal surgery.

Summary: Bone health optimization seeks to identify and treat poor bone quality before and after spine surgery to improve surgical outcomes, reduce complications, and enhance long-term patient health. It is gaining recognition as a necessary component of comprehensive spinal surgical care.
thereby necessitating careful perioperative assessment and management to minimize adverse outcomes.

Keywords: Bone health optimization, BHO, osteoporosis assessment and perioperative spinal surgery.

Symposium 2 (Tumor & Osteoporosis)

New paradigm in osteoporosis treatment: beyond bisphosphonate

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Introduction: Osteoporosis is a chronic condition, and pharmacological treatments for it can be categorized into three groups: those that inhibit bone resorption (antiresorptive), those that promote bone formation (anabolic), and those with dual action. While currently approved medications effectively lower the risk of fragility fractures in high-risk individuals, they generally do not completely restore bone strength in most patients with established osteoporosis. In particular, bisphosphonates (BPs), which have been classically used in the past, have been criticized for various shortcomings, including lower efficacy in fracture prevention, poor adherence, inconvenience, and safety issues. Therefore, several agents have been developed to overcome the shortcomings of BP, and various studies have been published highlighting the advantages and disadvantages of these new agents. It is now time to apply advanced treatment strategies.

Denosumab: Denosumab is a fully-humanized monoclonal antibody that prevents receptor activator of nuclear factor kappa-B ligand from binding to its receptor, thereby reducing the differentiation of precursor cells into mature osteoclasts and decreasing the function and survival of activated osteoclasts. Denosumab was approved for the treatment of postmenopausal osteoporosis in 2010, based on the FREEDOM study (Fracture Reduction Evaluation of Denosumab in Osteoporosis Every 6 Months Trial), which indicated a benefit in terms of increased bone mineral density (BMD) and reduced risk of major osteoporotic fracture. This study reported progressive increases in BMD at the lumbar spine, total hip, and femoral neck with up to 10 years of denosumab therapy, unique amongst all current osteoporosis therapies. Prolonged therapy was associated with low fracture rates, estimated relative risk for new vertebral fracture at 0.62 [95% confidence interval (CI) 0.47–0.80] and for non-vertebral fracture at 0.54 (95% CI 0.43–0.68) compared with a virtual twin simulation placebo arm.

The treat-to-target strategy for osteoporosis involves achieving and maintaining specific bone density goals to minimize fracture risk. This strategy is similar to those used in managing chronic conditions like diabetes (HbA1c <7%) and hypertension (blood pressure <140/90 mmHg), where specific biomarkers guide treatment goals. The strategy facilitates better patient outcomes by tailoring treatment plans to individual patient risk profiles and adjusting therapies based on periodic BMD assessments. The specific BMD T-score for a treat-to-target strategy in the treatment of osteoporosis remains controversial. However, a T-score of -2.0 has been suggested as an appropriate cutoff value based on realistic policy and clinical research data. Increasing BMD reduces fracture incidence regardless of age and site. In particular, up to a BMD T-score of -2.0, there is a significant association between increasing T-score and reduction of fracture incidence. In patients with a T-score above -2.0, further T-score increases had no significant effect on fracture prevention. Based on these studies, international organizations such as the National Osteoporosis Foundation working group and the Korean Society of Bone and Mineral Research have proposed a T-score of -2.0 as a treatment target.

The discontinuation of osteoporosis treatments poses significant risks. For denosumab, discontinuation can lead to a rapid increase in bone turnover and a subsequent loss of bone density, known as the rebound phenomenon. This can result in rebound-associated vertebral fractures. To mitigate this risk, it is recommended that denosumab not be stopped without transitioning to an alternative treatment, such as intravenous zoledronate or oral BPs, to maintain bone density gains and prevent fractures. In contrast, BPs, due to their long skeletal half-life (when binding to bone), can provide residual protection against fractures even after discontinuation.

Romosozumab: Romosozumab, a monoclonal antibody targeting sclerostin, represents a novel class of anabolic agents with an uncoupling mechanism by simultaneously increasing bone formation and decreasing bone resorption. This mechanism contrasts with traditional antiresorptive therapies and even other anabolic agents like teriparatide, which stimulate bone formation but also secondarily increase resorption. Romosozumab's unique action provides a potent increase in BMD and a rapid reduction in fracture risk, making it especially promising in the context of spine surgery, where bone quality is critical to outcomes. Romosozumab stimulates modeling-based bone formation, a process that is more active during growth and declines with age. Through inhibition of

sclerostin and promotion of the Wnt/β-catenin pathway, it increases osteoblastic activity while suppressing osteoclastic resorption, leading to net bone gain in both trabecular and cortical compartments.

Recent studies suggest that preoperative administration of romosozumab in patients undergoing spinal deformity correction significantly improves Hounsfield unit values at upper instrumented vertebra+1 and reduces the incidence of proximal junctional kyphosis and proximal junctional failure. In animal models, romosozumab enhanced lumbar fusion quality and strength, and finite element modeling confirms improvements in biomechanical parameters relevant to surgical success. Despite promising results, concerns regarding cardiovascular safety persist, warranting cautious patient selection. Romosozumab is contraindicated in individuals with recent myocardial infarction or stroke.

Sequential therapy strategies have also shown that initiating treatment with romosozumab followed by antiresorptives (e.g., denosumab or alendronate) maximizes long-term BMD gains and fracture prevention. For treatment-naive patients, it is generally recommended to initiate therapy with an anabolic agent first, followed by a potent antiresorptive medication whenever feasible. Multiple large-scale studies conducted in diverse populations worldwide highlight the significance of a recent fracture as a strong predictor of subsequent fractures. These studies consistently demonstrate that the risk of another fracture significantly increases within the first two years after an initial fracture, with an elevated annual risk that gradually declines over time. Achieving a target T-score within the first two years of treatment is a critical factor in preventing future fractures. From a sequential treatment perspective, using the most potent drug initially—one that rapidly improves BMD and reduces fracture risk—is essential. In this respect, it is essential to use an anabolic agent first. Anabolic agents primarily stimulate bone formation in the initial phase, followed by increased bone resorption over the next two years. Given that the likelihood of subsequent fracture remains exceptionally high within the first one to two years after index fracture, optimizing this 'anabolic window' is crucial in minimizing fracture risk.

Conclusions: Denosumab is an effective antiresorptive with clear benefits in reduced risk of fracture for patients whilst on treatment, and there evidently is an increased risk of multiple vertebral fractures following its discontinuation. Romosozumab holds significant promise as a perioperative agent in spine surgery, offering enhanced bone quality and reduced rates of perioperative complications. The optimal long-term management strategy for osteoporosis involves starting with an anabolic agent and subsequently transitioning to an antiresorptive medication. Understanding the mechanisms of treatment agents, the implications of discontinuation, and the importance of a treat-to-target strategy are essential for optimizing therapy.

Keywords: Denosuamb, Romosozumab, sclerostin inhibitor, spinal fusion, osteoporosis

Symposium 2 (Tumor & Osteoporosis)

Predicting Survival in Patients with Metastatic Spinal Tumors

Dong-Ho Kang

Samsung Medical Center

Introduction: The Clinical Imperative for Accurate Prognostication

The management of patients with metastatic spinal tumors is critically dependent on an accurate estimation of survival, as this prognosis dictates the entire therapeutic strategy—from the choice between surgical and palliative care to the extent of a surgical intervention. However, the revolutionary paradigm shift in cancer treatment, driven by targeted therapies and immunotherapy, now poses a severe challenge to the accuracy of prognostic models developed in a previous era.

The Quantitative Failure of Existing Prognostic Models

Even contemporary models, such as the SORG nomogram and the OSRI, demonstrate only moderate discriminative power for 1- and 2-year survival, with Area Under the Curve (AUC) values generally ranging from 0.70 to 0.73. More importantly, their clinical utility is severely compromised by critical, quantitatively-proven flaws:

1) Systematic Miscalibration: Recent large-scale validations have shown that virtually no existing model is well-calibrated, meaning the absolute survival probabilities they generate are unreliable for clinical decision-making. A comprehensive 2025 external validation of 12 prediction models concluded that none yielded appropriate calibration [1]. This highlights the need to recalibrate survival prediction models using recent patient data.

2) Temporal Decay and Model Instability: The accuracy of older models degrades significantly over time as cancer therapies improve. For example, the predictive accuracy of the modified Tokuhashi score for 1-year survival showed a substantial drop in the most recent therapeutic era (2017–2022), with its AUC value falling to 0.58 [2]. Furthermore, even modern machine learning models like the SORG-MLA, while often more accurate, can show flawed performance in external validation. In a recent cohort of lung cancer patients, the SORG-MLA showed excellent 1-year predictive accuracy (AUC 0.832) but was poorly calibrated and less accurate for 90-day mortality (AUC 0.714) [1].

3) Subgroup Inapplicability: Models developed primarily in surgical cohorts are not applicable to non-surgical patients. In a cohort of patients with lung cancer spinal metastases treated non-surgivelly, seven major prognostic scores all performed poorly (AUC < 0.7) and were found to be ineffective for guiding treatment [3].

The Paradigm Shift in Prognostic Drivers

This model obsolescence is a direct consequence of a fundamental shift in the factors that now determine survival. First is the revolution in oncology itself. The availability of effective targeted therapy or immunotherapy has emerged as the most dominant independent predictor of survival, overriding many traditional prognostic factors. Second, with improved systemic cancer control, the patient's intrinsic host biology has become paramount. Objective markers of neurological function (Frankel grade), systemic inflammation (WBC count), and nutritional status (serum albumin) have been proven to be powerful, independent predictors of short-term mortality [4].

Conclusion and Future Mandate: Toward a Dynamic Learning Ecosystem

The era of static, score-based prognostication is ending. The immediate, pressing task for clinicians and institutions is the local

recalibration of our best existing tools, like the SORG nomogram, using contemporary patient data to mitigate known biases. However, the ultimate goal must be to move beyond static models entirely and build a dynamic, adaptive prognostic ecosystem. This "living model" must be integrated into our health systems to continuously learn from real-world data, allowing it to evolve in lockstep with the rapid pace of cancer care. Only such a learning system can provide the truly personalized predictions needed to deliver the right treatment, to the right patient, at the right time.

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Symposium 2 (Tumor & Osteoporosis)

Place of non-metallic implants in metastatic spine tumour surgery: past, present and future

Naresh Kumar

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Metastatic Spine Disease (MSD) often requires surgical intervention and instrumentation with spinal implants. Ti6Al4V is widely used in metastatic spine tumor surgery (MSTS) and is the current implant material of choice due to improved biocompatibility, mechanical properties, and compatibility with imaging modalities compared to stainless steel. However, it is still not the ideal implant material due to the following issues. Ti6Al4V implants cause stress-shielding as their Young's modulus (110 gigapascal [GPa]) is higher than cortical bone (17–21 GPa). Ti6Al4V also generates artifacts on CT and MRI, which interfere with the process of postoperative radiotherapy (RT), including treatment planning and delivery. Similarly, charged particle therapy is hindered in the presence of Ti6Al4V. The artifacts on CT and MRI may also result in delayed recognition of tumor recurrence and postoperative complications.

Non-metallic implants are obviously the alternatives. In comparison, polyether-ether-ketone (PEEK) is a promising alternative. PEEK has a low Young's modulus (3.6 GPa), which results in optimal load-sharing and produces minimal artifacts on imaging with less hinderance on postoperative RT. However, PEEK is bioinert and unable to provide sufficient stability in the immediate postoperative period. This issue may possibly be mitigated by combining PEEK with other materials to form composites or through surface modification, although further research is required in these areas. With the increasing incidence of MSD, it is an opportune time for the development of spinal implants that possess all the ideal material properties for use in MSTS.

Our presentation will explore whether there is a current ideal implant material, available alternatives and whether these require further investigation. Of all the non-metallic implants, carbon reinforced PEEK (cfr-PEEK) has the best replacement property to be used in MSTS and osteoporotic surgery. My presentation traces the evolution of cfr-PEEK from its early days to the present. We also some experimental data of the PEEK modified with other additives. There is definitive future for these materials however things are not very clear at present.

Symposium 2 (Tumor & Osteoporosis)

Separation surgery in metastatic spinal tumor

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Separation surgery has emerged as an important treatment strategy for metastatic spinal cord compression (MSCC), particularly since the Bilsky group's 2010 report demonstrating improved local control with high-dose radiotherapy (RT) in tumors resistant to conventional external beam radiotherapy (EBRT). In 2013, the same group formally introduced the term "separation surgery" in a study involving 186 patients, highlighting the benefit of adjuvant hypofractionated high-dose stereotactic radiosurgery (SRS) following surgical decompression.

The goal of separation surgery is to establish a 2–3 mm circumferential margin between the tumor and the spinal cord to facilitate safe delivery of high-dose RT while minimizing radiation exposure to the cord. This involves not only laminectomy but also resection of the posterior longitudinal ligament (PLL) and partial vertebral body to achieve ventral decompression.

According to the NOMS framework, separation surgery followed by SRS is recommended for radioresistant tumors causing high-grade epidural spinal cord compression (Bilsky grade ≥2).

Since 2020, I have been performing separation surgeries and have encountered key technical challenges, particularly in achieving adequate circumferential decompression at the cord level. Intraoperative MRI or ultrasound can be useful, though their application is limited. Recently, I have adopted the use of O-arm imaging combined with placement of thin radiopaque gauze circumferentially around the cord to better assess decompression intraoperatively.

Preoperative planning is crucial, including angiography and embolization for hypervascular tumors to minimize bleeding, and employing EP monitoring for neural safety. Coordination with oncology and radiation specialists preoperatively ensures a seamless transition to postoperative high-dose RT, typically administered 2–3 weeks after surgery following MRI confirmation of decompression.

At Asan Medical Center, we retrospectively analyzed 59 patients who underwent separation surgery between 2020 and 2023. Postoperative MRI was performed 2-3 weeks after surgery using a metal artifact reduction protocol (1.5T) to assess the adequacy of decompression. Patients were classified into the separation success group (n=26) and non-success group (n=33), with an overall success rate of 44%.

The separation success group showed better clinical outcomes:
- Postoperative motor grade: 4.54 vs. 3.67 (P=0.015)
- Ambulation rate: 92.3% vs. 69.7% (P=0.032)
- Hospital stay: 15.8 vs. 23.9 days (P=0.042)
- Follow-up duration: 13.31 vs. 6.02 months (P=0.001)

Survival was significantly longer in the success group (P=0.008, Cox regression), with a 2.63-fold increase in survival time compared to the non-success group. Furthermore, postoperative RT was more frequently performed in the success group (76.6% vs. 48.5%, P=0.026) and contributed to improved outcomes.

In the non-success group, those who received RT showed greater regression of cord compression (43.8% vs. 5.9%, P=0.017) and were younger (60.8 vs. 67.9 years, P=0.032). Symptomatic local recurrence was less frequent in the success group (3.8% vs. 18.2%, P=0.091), possibly due to more active postoperative treatments like RT and slower tumor progression.

These findings emphasize the importance of achieving sufficient circumferential decompression during surgery and the integration of postoperative radiotherapy to enhance neurological recovery, local control, and survival in patients with spinal metastases.

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Symposium 3 (Endoscopic Surgery: Lumbar Disc Herniation)

Autologous mesenchymal stromal cells for repair intervertebral disc defect after discectomy: a prospective controlled study and 5-year follow-up

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Abstract Objective: To evaluate the safety and validity of enriched autologous bone marrow mesenchymal stem cells (BMSCs) and annular suture for repairing defect after lumbar discectomy.

Methods: Enrichment of autologous BMSCs: autologous bone marrow blood was collected from 5 patients undergoing lumbar surgery, and nucleated cells were enriched on gelatin sponge particles by selective cell retention technique. The enrichment multiple of nucleated cells and target cells was 6.4 ± 0.9 and 4.2 ± 0.6 respectively, and BMSCs grew well in vitro. From 2016.10 to 2019.3, 109 patients with lumbar disc herniation underwent discectomy with mobile microendoscopic discectomy technique, including 61 males and 48 females, aged 24-59 years. Discectomy group: 26 cases received simple discectomy; suture group: 39 cases received annular suture after discectomy; BMSCs+suture group: 44 cases received intradisc transplantation of gelatin sponge particles enriched with autologous BMSCs and annular suture after discectomy. The perioperative conditions were recorded, with visual analogue scale (VAS), Oswestry dysfunction index (ODI), Pfirrmann grade of disc degeneration, disc height and degree of herniation evaluated after operation.

Results: The operation time was 35-55 min. 7 cases in the suture group were transferred to the discectomy group and 10 cases in the BMSCs+suture group were transferred to BMSCs group due to unsuccessful suture. There were no significant differences in VAS, ODI, Pfirrmann grade of disc degeneration, disc height and degree of herniation among the groups. There was no significant difference in intraoperative bleeding, postoperative drainage and length of hospital stay. The incision was healed without redness and swelling. 18 patients were followed up for 6 months, and 91 cases were followed up for 2-3 years (25±5.6 months). There was no interbody fusion, heterotopic ossification or infection during follow-up. VAS and ODI scores decreased significantly after operation in all patients. At final follow-up, the VAS improvement rate of BMSCs+suture group (80.2 ± 7.9%) was higher than discectomy group (71.3 ± 8.9%) and suture group (70.2 ± 6.9%); the ODI improvement rate of BMSCs+suture group (65.6 ± 8.8%) was higher than discectomy group (57.8 ± 8.1%) and suture group (59.9 ± 5.5%). According to MRI, the Pfirrmann grade of disc increased 0.7 in discectomy group, 0.6 in suture group, while it did not increased significantly in BMSCs+suture group and BMSCs group, the progress of Pfirrmann grade in BMSCs+suture group and BMSCs group were lighter than discectomy group and suture group. The disc height decreased in each group, the loss rate of disc height in BMSCs+suture group (17.2% ± 4.3%) was less than discectomy group (29.3% ± 6.3%) and suture group (20.6% ± 5.7%); and suture group was less than discectomy group. The degree of herniation was reduced by more than 50% in all groups, while 1 case in discectomy group had herniation without clinical symptoms.

Conclusion: autologous BMSCs and annulus suture are safe and effective in repairing the defect after lumbar discectomy, which may help to slow down the degeneration of intervertebral disc.

Keywords: Intervertebral disc herniation; Disectomy; Bone mesenchymal stromal cells; Cell therapy

Symposium 3 (Endoscopic Surgery: Lumbar Disc Herniation)

Biportal endoscopic surgery: Extracanal lumbar disc herniation

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Biportal endoscopic treatment for extracanal lumbar disc herniation is a minimally invasive surgical technique used to treat lumbar disc herniations that are located outside the spinal canal. This surgical technique has recently gained popularity. Until now there is growing evidence supporting its use in complex and lateral disc herniations.

Practically, approach decisions dependent on the exact position of disc fragments. Several novel techniques using the biportal endoscopy were established and the detail of surgical steps were described thoroughly in a lot of renowned literatures. There are 2 common approaches for the treatment of extracanal disc herniation using biportal endoscopic technique which are interlaminar and paraspinal approaches. To select which is the proper route of approach, nerve root manipulation, risk of instability, muscle trauma, and herniation exposure are the matter of concerns. However, no matter which approach is selected, we should complete the procedure with the endpoint of decompression.

In conclusion, how to access the extracanal area of the lumbar spine remains surgically challenging. However, using biportal endoscopic technique offers a safe, effective, and minimally invasive alternatives for extracanal lumbar disc herniations. Precise surgical steps, technique and surgeon's experience are the matters of this procedure. Although this technique has growing evidence supports its use in complex and lateral disc herniations, it still be needed further prospective randomized trials to validate.

Symposium 3 (Endoscopic Surgery: Lumbar Disc Herniation)

Various biportal endoscopic discectomy approaches customized for different types of lumbar disc herniation

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Lumbar disc herniation (LDH) presents with diverse morphologies depending on the location and migration pattern of the herniated fragment. An individualized surgical approach based on these characteristics is critical for achieving safe and effective decompression in biportal endoscopic spine surgery. This presentation outlines various biportal endoscopic discectomy techniques customized to different LDH types.

For central and paracentral herniations, the interlaminar approach remains the standard due to its direct access to the central canal. In cases of foraminal herniation or mild upward migration, the paraspinal approach offers a more efficient route by providing a direct corridor to the foraminal zone with minimal muscle disruption. At the L5–S1 level, foraminal disc herniations may be challenging due to the high iliac crest; in such cases, the transalar approach can serve as a practical alternative to reach the target area. For highly migrated disc fragments, especially those with very high-grade upward or downward migration, alternative strategies such as the contralateral sublaminar approach may provide safer and more effective access.

Complete removal of the ruptured fragment without leaving remnants is a key goal in discectomy. To take full advantage of the endoscopic technique over microscopic approaches, it is essential to choose an approach that minimizes bone work and maximizes soft tissue preservation.

Keywords : Biportal endoscopy, Lumbar disc herniation, Minimally invasive spine surgery

Symposium 3 (Endoscopic Surgery: Lumbar Disc Herniation)

Biportal endoscopic lumbar discectomy for cauda equina syndrome

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Purpose: Cauda equina syndrome (CES) is a severe neurological condition caused by significant compression of the cauda equina nerve roots. This study evaluates the efficacy of biportal endoscopic (BE) lumbar discectomy in treating CES caused by lumbar herniated intervertebral discs.

Methods: This retrospective case series includes 32 CES patients treated with BE lumbar discectomy from March 2017 to July 2022. Patient demographics, surgical details, and outcomes were analyzed. Clinical outcomes were assessed using the Visual Analog Scale (VAS), Oswestry Disability Index (ODI), and EQ-5D scores at baseline, and at 3, 6, and 12 months postoperatively.

Results: The mean age was 44.44 ± 13.70 years. The average duration from symptom onset to surgery was 44.81 ± 32.69 h. Significant improvements at 12 months were observed in VAS for back pain (5.00 ± 2.82 to 1.28 ± 1.63, $p < 0.01$) and leg pain (7.44 ± 1.79 to 1.16 ± 1.55, $p < 0.01$), ODI (58.25 ± 20.15 to 10.13 ± 14.54, $p < 0.01$), and EQ-5D (0.414 ± 0.175 to 0.859 ± 0.163, $p < 0.01$). Bladder and bowel symptom recovery rates were 86.7% and 85.0%, respectively. Mean operation time was 42.50 ± 17.91 min, with a hospital stay of 3.34 ± 2.59 days. Complications included incidental durotomy (6.3%) and facet joint injury (6.3%).

Conclusion: Biportal endoscopic spine surgery is a feasible and effective option for CES, providing significant decompression with minimal tissue damage and a low complication rate.

Symposium 3 (Endoscopic Surgery: Lumbar Disc Herniation)

Optimizing outcomes of biportal endoscopic lumbar discectomy; from setting to managing complications

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Symposium 4 (Robot & Navigation)

Navigation/Robotic Assistant Degenerative Lumbar Stenosis Surgery

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Abstract: Degenerative Lumbar Spinal Stenosis (DLSS) has emerged as one of the most prevalent conditions in spinal surgery. It affects approximately 102 million patients globally (with prevalence 1.4%), representing the majority patients for lumbar decompression surgery in individuals >65 years. According to contemporary international guidelines, open decompression procedures remain the cornerstone surgical approach for DLSS, particularly when complicated by degenerative scoliosis. However, in patients with DLSS and concomitant degenerative scoliosis, long segmental PLIF/TLIF procedures are associated with persistent risks of decompression inadequacy and pedicle screw malposition with free-hand technique. Consequently, this elevates the likelihood of postoperative complications and revision surgery rates.

O-arm navigation or robotic-assisted pedicle screw placement and decompression procedures significantly enhance surgical precision. This is particularly advantageous for severe degenerative scoliosis when the lumbosacral fixation (e.g., S1, S2AI, or iliac screws) needed. However, conventional PLIF/TLIF techniques are associated with extended operative segments, larger incisions and surgery trauma. In contrast, navigation/robotic-assisted OLIF demonstrates superior outcomes in reduced trauma, intraoperative blood loss, operative duration and hospital stay for such cases. It achieves superior disc height restoration and higher interbody fusion rates postoperatively. Clinical symptom relief and therapeutic efficacy at 1-24 months and long-term follow-up are comparable to posterior approaches. Nevertheless, are there any more minimally invasive alternatives for DLSS? Advances in spinal endoscopy have popularized techniques like Unilateral Biportal Endoscopy (UBE) for lumbar stenosis management. Navigation-integrated UBE further enhances minimally invasive advantages for short-segment decompression and fusion. ULBD or ULBD-LIF yields favorable outcomes in single level or two levels cases. Relatively contraindications including severe lateral recess stenosis, scoliosis (Cobb angle >25°), far-lateral disc herniation, or pathologies spanning more than two levels.

In summary, the surgical treatment of DLSS with concomitant scoliosis remains highly challenging. Individual patient-tailored approach is imperative for optimizing outcomes across diverse clinical scenarios. For cases dominated by spinal stenosis, navigation/robotic-assisted OLIF demonstrates superior minimally invasive, precision and efficiency compared to conventional PLIF/TLIF. For pathologies requiring one or two limited segmental fusion, UBE or ULBD-LIF offers distinct minimally invasive advantages. Regardless of the surgical strategy, AI-enhanced digital technologies significantly elevate procedural accuracy and safety. These innovations merit widespread clinical adoption to optimize patient outcomes.

Keywords: Lumbar Spinal Stenosis; Degenerative Scoliosis ; Navigation; Robot-Assisted Spinal Surgery; Unilateral Bi-portal Endoscopic Spine Surgery (UBE)

Symposium 4 (Robot & Navigation)

The role of navigation for lumber endoscopic spine surgery

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Abstract: Lumbar endoscopic spine surgery has become an increasingly popular minimally invasive alternative for treating degenerative spine disorders, offering reduced tissue disruption, faster rehabilitation, and lower perioperative morbidity. Despite these advantages, the procedure's narrow working corridor, limited visualization, and anatomical variability present significant technical challenges, particularly in complex or revision cases. Navigation technology—combining intraoperative imaging, 3D anatomical mapping, and real-time instrument tracking—has emerged as a valuable adjunct to enhance precision and safety in lumbar endoscopic procedures.

This presentation will discuss the principles, clinical applications, and future directions of navigation-assisted lumbar endoscopic spine surgery. Emphasis will be placed on: (1) optimizing entry trajectory and target localization in uniportal and biportal approaches; (2) expanding the indications for endoscopic surgery to include anatomically demanding or revision cases; (3) improving surgical accuracy while reducing radiation exposure; and (4) integrating navigation with emerging technologies such as robotics and augmented reality. The role of navigation in lumbar endoscopic surgery may improve reproducibility, safety, and patient outcomes to become a new essential technology.

Keywords: Lumbar spine, endoscopic surgery, navigation, minimally invasive surgery, surgical precision

Symposium 4 (Robot & Navigation)

What can we optimize with navigation in uniportal endoscopic lumbar interbody fusion for degeneration lumbar diseases?

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Introduction: The endoscopic spine surgery (ESS) is rapidly developed and Transforaminal lumbar interbody(TLIF) assisted with ESS(endo-TLIF) is the state of art. However. The cons of Endo-TLIF including overdose of radiation, overtime of bony work and steep learning curve become the largest obstacle for development of Endo-TLIF.

Method: Total 132 cases (female was 91) receiving Endo-TLIF at 212 levels were enrolled from Nov. 2022 to Jul. 2025. We utilized robotic 3-D cone beam CT(Philips Azurion) to obtain intraoperative tomographic images and transferred these images to the navigation computer (Brainlab German /Point Taiwan). We registered not only instruments for insertion of pedicular screws (drill-guide, pointer probe) but also instruments for Endo-TLIF(unique pointer, power burr and cage holder). These registered instruments achived fantastic benefits to anatomic identification, disc preparing, bony drilling and fusion procedure under ESS.

Result: The total levels of TransKambin (TK) endoTLIF were 137 and posterolateral (PL) endoTLIF were 75. There was no postoperative neurogenic injury. The exposure of radiation was significantly reducing than non-navigated Endo-TLIF(>100 shots to 20 shots per level). There was no breech of pedicular screws insertion or malposition of cage implantation. The major benefits of navigated TK endoTLIF are assurance of foraminoplasty, creating the safe quadrangular space and precise tract of inserting cage. The dominant benefit of navigated PL endoTLIF is more effective complete facetectomy.

Discussion: Navigated endoTLIF reduces the radiation exposure and consumption of operative time. Registered endoscope instruments offer precise endoscopic docking point, effective bony work and disc preparation.

Conclusions: Navigated EndoTLIF could achieve excellent clinical results and provides accurate intraoperative real-time guidance and precise bony works including TK and PL endoTLIF.

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Symposium 4 (Robot & Navigation)

O-arm Navigation in OLIF

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Abstract: Oblique Lateral Interbody Fusion (OLIF) has emerged as a powerful minimally invasive approach for lumbar spinal fusion, allowing anterior access to the intervertebral disc space without the need for extensive posterior dissection. However, OLIF procedures are not without challenges. Key limitations include the need for patient repositioning during circumferential fusion, suboptimal visualization of anatomical landmarks using conventional fluoroscopy, and the increased risk of cage malposition or subsidence—especially in patients with anatomical variation, obesity, or osteoporosis.

The integration of intraoperative 3D navigation systems, particularly O-arm-based navigation, provides a promising solution to these limitations. This presentation aims to explore the clinical and technical advantages of O-arm navigation in OLIF procedures based on the author's extensive single-center experience. Benefits include improved implant accuracy, the ability to perform true single-position surgery, and significant reduction in radiation exposure to the surgical team compared to conventional C-arm fluoroscopy.

Key technical considerations, including patient positioning, spin protocol, and cage trajectory planning using O-arm navigation, are discussed. The so-called "N+1 dilemma" in multilevel OLIF—where additional navigation spins are often required for each new level—is addressed, and strategies for minimizing workflow disruption while preserving surgical precision are proposed. Clinical cases involving complex pathologies such as infectious spondylitis and severe osteoporosis are presented to demonstrate the utility of navigation in optimizing graft placement, debridement, and anterior reconstruction using strut bone grafts.

Furthermore, preliminary data from an ongoing institutional study analyzing Hounsfield Unit (HU) values across 4,000+ segments are shared to illustrate their potential predictive value for cage subsidence and endplate integrity assessment.

In conclusion, while O-arm navigation may involve higher initial cost and learning curve, its integration into OLIF procedures can significantly enhance surgical precision, workflow efficiency, and radiation safety. Especially in complex and multilevel cases, navigation serves as a critical adjunct to improve outcomes and reduce complications. Future prospective studies are warranted to evaluate long-term clinical benefits and cost-effectiveness.

Keywords: OLIF, O-arm navigation, single-position surgery, cage placement, radiation exposure, multilevel lumbar fusion, surgical workflow, spondylitis, osteoporosis

Symposium 4 (Robot & Navigation)

Application of robotic endoscopic surgery

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Introduction: Endoscopic spine surgery (ESS) represents an ultra-minimally invasive approach utilizing small (<1 cm) incisions with minimal muscle disruption. However, ESS presents significant challenges including a steep learning curve, prolonged operative times, and substantial radiation exposure from fluoroscopy. To address these limitations, robotic systems are increasingly being integrated into endoscopic and minimally invasive spine procedures to enhance surgical precision, stability, and safety while reducing human error and surgeon fatigue.

Body

Technical Enhancements: Robotic assistance significantly improves instrumentation accuracy beyond conventional freehand techniques. Studies demonstrate that robot-guided pedicle screw placement achieves success rates of 92-94% compared to 70% (lumbar) and 45% (thoracic) with conventional methods. In endoscopic procedures, robotic guidance reduces needle puncture attempts from an average of 4.8 to 1.2 attempts and decreases fluoroscopy usage by approximately 40%. Major robotic platforms include Mazor Robotics systems (SpineAssist, Renaissance, Mazor X Stealth Edition), Globus ExcelsiusGPS, and Zimmer ROSA Spine, all designed to provide consistent, pre-planned instrument trajectories crucial for the constrained corridors of ESS.

Clinical Outcomes: Meta-analysis of 20 randomized controlled trials (954 patients) confirms superior instrumentation accuracy with robotic assistance, resulting in lower intraoperative blood loss and reduced radiation exposure. While technical process measures show consistent improvement, patient-reported outcomes (pain scores, functional indices) remain comparable between robotic and conventional approaches in medium-term follow-up. Complication rates are equal or lower with robotic assistance, with multicenter studies reporting intraoperative complication rates of only 3.1% and implant-related revision rates under 1% at 90 days.

Economic and Operational Considerations: Despite high acquisition costs (hundreds of thousands to over one million USD), cost-effectiveness analyses suggest potential long-term savings through reduced complications, shorter operative times, and decreased hospital stays. Learning curves of 20-30 cases are typical, with subsequent improvements in efficiency demonstrated by 24% reduction in setup time per screw and decreased robot abandonment rates from 7% to 1% as experience grows.

Emerging Innovations: Recent developments include AI-driven autonomous spinal decompression systems achieving 84% accuracy within 1mm of planned trajectories, integration with augmented reality navigation, and expansion into tumor surgery and complex deformity cases. Future prospects include semi-autonomous surgical execution, miniaturized robotic endoscopes, and patient-specific AI-powered surgical planning.

Conclusion: Robotic assistance in endoscopic spine surgery demonstrates clear advantages in technical precision, radiation reduction, and procedural consistency while maintaining equivalent clinical outcomes to conventional techniques. Although current systems primarily enhance process measures rather than dramatically improving patient-reported outcomes, the technology shows promise for expanding minimally invasive capabilities and reducing surgeon-dependent variability. As costs decrease and automation advances, robotic systems are positioned to become integral components of modern endoscopic spine surgery, enabling surgeons to push the boundaries of minimally invasive care with enhanced confidence and control. Continued research focusing on long-term outcomes and cost-effectiveness will be crucial for widespread adoption and optimization of this evolving technology.

Symposium 5 (Endoscopic Surgery: Lumbar Spinal Stenosis)

Current Perspectives on Biportal Endoscopic Decompression Alone for Lumbar Spinal Stenosis

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Abstract:

Lumbar spinal stenosis (LSS) is a prevalent degenerative disorder in which fusion surgery has long been utilized, particularly in the presence of spinal instability. Growing concerns over fusion-related complications have prompted renewed interest in decompression-alone strategies. Biportal endoscopic spine surgery (BESS) has emerged as a refined minimally invasive decompression technique, employing two portals with continuous saline irrigation. Compared with traditional open microscopic decompression, BESS offers distinct advantages, including reduced muscle detachment, superior facet preservation, shorter operative time, decreased blood loss, and faster postoperative recovery, while maintaining equivalent clinical outcomes. Landmark randomized trials, most notably the SLIP, Försth, and Austevoll studies, have established that fusion does not consistently outperform decompression alone in degenerative spondylolisthesis (DSL). In the context of BESS, recent comparative studies indicate that, in low-grade DSL, decompression alone can yield outcomes comparable to fusion, without a significant increase in postoperative instability, and with greater preservation of facet structures than microscopic approaches. For isthmic spondylolisthesis (ISL), available evidence is limited to small-scale investigations reporting favorable short-term results in carefully selected stable cases; however, the definition of stability in ISL and its suitability for decompression alone remain to be clearly defined. Determining which patients with DSL or ISL can safely undergo BESS decompression without fusion is essential, as the minimally invasive nature of this technique may support broader indications than conventional open approaches. Further high-quality, large-scale studies are warranted to refine patient selection criteria and confirm the long-term stability and durability of this approach.

Symposium 5 (Endoscopic Surgery: Lumbar Spinal Stenosis)

The role of biportal endoscopic surgery in severe lumbar stenosis and cauda equina syndrome

Pawin Gajaseni

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Symposium 5 (Endoscopic Surgery: Lumbar Spinal Stenosis)

Full-Endoscopic Decompression Surgery for the Treatment of Lumbar Stenosis: Focusing on Surgical Indication, Surgical Approach and Clinical Outcome

Ching-Hsiao, Yu

Taovuan General Hospital

In recent years, endoscopic spine surgery (ESS) has gained popularity in the treatment of lumbar degenerative diseases due to its least minimal invasiveness.

Regarding lumbar stenosis, ESS has also been demonstrated in the literature to be a safe and effective surgical technique. In this presentation, we share our surgical indications, approaches, and clinical outcomes using full-endoscopic spine surgery (FESS) for treating various types of lumbar stenosis.

The are three major types of surgical approaches of FESS, including transforaminal (TF), interlaminar(IL) and paraspinal (Para). Central stenosis is most suitable using interlaminar-unilateral laminotomy bilateral decompression (IL-ULBD) or percutaneous stenotic lumbar decompression(PSLD). Lateral recess stenosis can be managed with either the IL approach (preferred) or the TF approach. For foraminal stenosis, we could perform TF approach or interlaminar contralateral foraminotomy(IL-CLF). In L5/S1 foraminal stenosis with high iliac crest, we preferred using ipsilateral Para- or IL-CLF approach. Most patients present with combined lesions, so the choice of surgical approach should be carefully tailored on a case-by-case basis. In addition, other factors such as age, medical condition, the presence or absence of a herniated disc, and whether the surgery is a revision procedure should also be taken into consideration.

Based on our experience, full-endoscopic spine surgery (FESS) for lumbar stenosis could produce good and satisfactory clinical outcomes in carefully selected patients. At our institute, FESS has become our first-line treatment for lumbar stenosis.

Symposium 5 (Endoscopic Surgery: Lumbar Spinal Stenosis)

Adjacent segment disease after lumbar Spine Fixation managed by Destandau Endospine using 4K-3D Endovision

Paresh Chandra Dey

Dep. Orthopaedics, Kims's Bhubaneswar

Background: Destandau endoscopic Spine Surgery (DESS) is an established treatment for lumbar disc herniation (LDH) and Lumbar Canal stenosis. This is the study to evaluate the effectiveness of DESS in treating adjacent segment disease (ASD) like Disc Herniation and Lumbar canal Stenosis after lumbar Spine fixation(LSF) using 4K-3D Endovision.

Method: Between October 2010 and October 2024, a total of 32 patients with symptomatic ASD after LSF underwent DESS. Discectomy in lumbar disc herniation and Bilateral over the top Decompression with Bilateral Foraminotomy were performed for treating Lumbar Canal stenosis without disturbing the previous instrumentation . Results were evaluated using Numerical Rating Scale (NRS) and the Modified Japanese Orthopedic Association (mJOA) scores.

Result: The patients mean age was 56years; there were 14 male and 18female patients. 8 Disc herniation and 24 stenosis cases. All ASD disc herniations were single level , 6 were L5-S1 level ,2 were L3-4 Level . Among the ASD Stenosis Cases one patient was 3 Level (L1-2,L2-3 & L5-S1), 2pts were two level (L3-4 &L5-S1) and 21pts single level (L2-3) 9cases ,L4-5 2 cases and 10 were L5-S1). The mean operative time was 46 min. The mean pre- and postoperative NRS scores were 7.6 and 1.1, respectively. The mean pre- and postoperative mJOA scores were 10.5 and 17.1, respectively. There were no postoperative complication like insufficient decompression and recurrence LDH but one patient was superficial infection ,healed with dressing for 10 days and one patient (over weight women) developed little wound gaping and treated by skin stapler,healed and stapler removed after 10 days.

Conclusion: DESS is a safe and effective minimally invasive treatment for ASD after LSF and a potential alternative to extend the Lumbar Spine Fixation to the adjacent vertebra or sacrum.

Keywords: Destandau Endoscopic Spine Surgery (DESS), Adjacent Segment Disease (ASD), Lumbar Spine Fixation (LSF), Foraminotomy , Minimally Invasive

Dr Paresh Chandra Dey

Symposium 5 (Endoscopic Surgery: Lumbar Spinal Stenosis)

Preoperative planning for FESS and UBE in spinal endoscopic surgery using 3D-MR/CT fusion imaging.

Jiro Hirayama

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Minimally invasive spinal endoscopic surgery offers considerable advantages, including reduced postoperative pain, preservation of anatomical structures, effective neural decompression, and targeted discectomy. These benefits are equivalent to, or even surpass, those of conventional open or microscopic surgery. However, as the degree of minimal invasiveness increases, the endoscopic field of view becomes more restricted, making meticulous preoperative planning essential for surgical success.

Since 2014, we have implemented 3D CT/MRI fusion imaging for preoperative planning in full-endoscopic discectomy via the interlaminar approach (FED-IL), particularly to preoperatively assess the necessity of bone resection, which was traditionally determined by the surgeon's experience and intra-operative findings. This technique facilitates decision-making regarding whether the yellow ligament can be fenestrated with a punch to allow access.

Subsequently, in the transforaminal approach, we employed 3D CT/MRI fusion imaging to three-dimensionally evaluate Kambin's triangular working zone, aiming to prevent exiting nerve injury. We reported that performing foraminoplasty in patients with a narrow working zone enables more efficient surgical approach selection.

Since 2019, we have adopted unilateral biportal endoscopic (UBE) or biportal endoscopic spine surgery (BESS) for all indicated cases, creating 3D CT/MRI fusion images for every patient. By observing the images from multiple angles and rendering bony structures semi-transparent, we can fully understand the spatial relationships between bone and nerve structures prior to surgery. This is particularly important in foraminal lesions at the L5/S1 level, where the exiting nerve alters its course from lateral to ventral, posing a technical challenge for novice surgeons and necessitating thorough preoperative image-based training. Additionally, intraoperative reference to the images helps prevent disorientation.

UBE/BESS is rapidly gaining popularity due to its versatility and procedural freedom, now accounting for approximately 70% of all spinal endoscopic surgeries performed at our institution. On the other hand, in cases where the sole objective is disc herniation removal, the full-endoscopic discectomy via the transforaminal (FED-TF) approach remains a highly minimally invasive and effective technique with an important role even today. In this symposium, we will also introduce an algorithm for selecting between FED and UBE/BESS approaches using 3D CT/MRI fusion imaging.

Symposium 6 (Adult Spinal Deformity)

Surgical Tips for OLIF51

Byung-Joon Shin

SOONCHUNHYANG UNIVERSITY HOSPITAL

Symposium 6 (Adult Spinal Deformity)

Minimally Invasive Surgery for Optimal Surgical Outcomes in the treatment of adult spinal deformity

Dong-Gune Chang

Inje University Sanggye Paik Hospital, Seoul, Korea.

Adult spinal deformity (ASD) presents significant surgical challenges, particularly in elderly patients with multiple comorbidities and a high risk of complications. Given this complexity, surgical approaches must be carefully tailored, considering factors such as the patient's perioperative functional status. Posterior-based bony osteotomies are well-established, powerful techniques for correcting severe and rigid deformities in the coronal and sagittal planes. However, these procedures are associated with substantial morbidity. Recently, combined anterior-posterior (A-P) approaches utilizing lateral lumbar interbody fusion (LLIF) have emerged as viable alternatives to posterior-only strategies.

The primary goal of surgical intervention for ASD is to restore age-appropriate spinal alignment and thereby improve health-related quality of life (HRQoL), while minimizing risks associated with the patient's comorbidities and potential complications—ranging from minor to catastrophic. LLIF, including techniques such as oblique lateral interbody fusion (OLIF), offers several advantages over conventional posterior approaches for accessing the anterior spinal column. It enables better disc space access, facilitates the insertion of larger interbody cages, and improves fusion rates. The use of larger cages helps restore disc height, contributing to the correction of coronal and sagittal deformities, and provides indirect decompression of neural elements. Moreover, the anterior column realignment (ACR) technique has emerged as a powerful alternative to traditional three-column osteotomies performed via posterior-only methods. In cases of severe deformity, supplementary osteotomies may still be required during second-stage posterior surgery. Additionally, postoperative MRI following anterior procedures can help guide decisions regarding the extent of posterior fusion, potentially allowing for a reduction in fusion levels.

Combined A-P surgery incorporating LLIF is an effective strategy for managing ASD, offering reliable correction of both coronal and sagittal deformities. It also allows for indirect neural decompression, reduced fusion levels, and lower perioperative morbidity.

Symposium 6 (Adult Spinal Deformity)

New Surgical Strategy in Treating Adult Degenerative Scoliosis to Prevent the Post-operative Coronal Imbalance.

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Adult scoliosis can be classified into three subgroups: primary degenerative scoliosis, progressive idiopathic scoliosis in adult life, and secondary degenerative scoliosis. Correction of the major curve is a key treatment principle for scoliosis. However, 30.4% of surgically treated adult degenerative scoliosis (ADS) patients experienced postoperative coronal imbalance despite following this principle. To reduce the incidence of postoperative coronal imbalance, several surgical techniques have been developed. However, these techniques are primarily based on the experience of adolescent idiopathic scoliosis and posterior correction methods.

In this study, we developed a new concept and surgical strategy for correcting ADS in order to prevent postoperative coronal imbalance. Degenerative scoliosis differs from idiopathic scoliosis in both curve pattern and curve magnitude. Given these differences, the treatment approach should also differ. In degenerative scoliosis, identifying and correcting the "driver" of the coronal imbalance is crucial. We define the "driver" as the lowest vertebra that tilts in the direction of the truncal shift.

The surgical procedure is divided into two stages. The first stage involves correcting the driver and a portion of the vertebrae in the major curve using OLIF or ALIF. The second stage is performed one week later and involves posterior instrumentation with or without decompression and Smith-Petersen osteotomy (SPO). The residual curve should be corrected using the translation technique, rather than the compression-distraction technique, during posterior instrumentation.

In our series of 13 cases, there were two minor complications (postoperative ileus), no major complications, and no revision surgeries. Coronal imbalance improved postoperatively in all cases, with no deterioration of the C7–CSVL alignment in type C patients.

Conclusion: The new strategy of treating the driver (rather than the major curve) with OLIF/ALIF and posterior instrumentation can achieve satisfactory correction and clinical outcomes in ADS without resulting in postoperative coronal imbalance.

Symposium 6 (Adult Spinal Deformity)

Microstructural and Biomechanical Changes in Spinal Degeneration: Potential Implications for Degenerative Spinal Deformity

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Purpose: Degenerative spinal deformity (DSD) results from progressive structural deterioration in spinal tissues, including the intervertebral disc (IVD) and ligamentum flavum (LF). Identifying early degenerative changes may improve prognosis and guide surgical decision-making. This study integrates multi-modal analysis - magnetic resonance imaging, Raman spectroscopy, and nanoindentation - to explore the microstructural and biomechanical alterations in IVD and LF tissues and their potential relationship to spinal malalignment.

Methods: This work synthesizes clinical, spectroscopic, and mechanical data from human cadaveric and patient-derived lumbar spine samples. For the IVD, nucleus pulposus and annulus fibrosus tissues were examined for hydration, glycosaminoglycan (GAG) content, and mechanical stiffness. The LF was analyzed for fibrosis, elastic fiber degradation, and increased collagen deposition. Spatial mapping of Raman biochemical markers was performed alongside nanoindentation to assess localized stiffness. Data were interpreted in the context of established radiographic deformity patterns.

Results: Degenerated IVDs demonstrated decreased hydration and GAG content, alongside reductions in stiffness and elasticity. LF tissues showed increased stiffness, fibrosis, and mineralization, particularly in cases presenting with stenosis or sagittal imbalance. The combination of Raman spectroscopy and nanoindentation enabled fine-scale detection of region-specific degeneration that correlated with clinical imaging and deformity type. Integrated findings suggest that microstructural deterioration of both IVD and LF contributes to the development of DSD.

Conclusion: Our integrative approach highlights distinct yet synergistic degenerative changes in spinal soft tissues that may predict radiographic deformity. These findings support the future development of composite imaging and biomechanical biomarkers for early identification and risk stratification of DSD. A better understanding of these microstructural and mechanical alterations may inform more targeted interventions and improve surgical outcomes.

Symposium 6 (Adult Spinal Deformity)

How can we apply LDI in our practice? A nonsystematic review

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Backgrounds and introduction: Lordosis distribution index (LDI), defined as the ratio of lower lumbar lordosis (L4-S1) to total lumbar lordosis (L1-S1), is a metric that describes the shape of lumbar lordosis in conjunction with segmental lordosis angle or Roussouly classification.1 Adult spinal deformity (ASD) surgery has focused on restoring the magnitude of total lumbar lordosis based on the patient's pelvis incidence (PI). However, this approach have shown limitation in satisfactory outcome. Cosequently, increasing attention has been pain on age-adjusted alignment goals and the shape of lumbar lordosis.

Main body:

1. normal lordosis distribution
Roussouly analyzed lumbar lordosis based on functional lumbar lordosis, dividing it into four types according to the shape of the upper and lower arcs relative to the horizontal vertebra. However, lower arc value is not useful in our practice because the horizontal vertebra cannot be identified intraoperatively. Anatomical L4-S1 lordosis was reported as 30° to 40°: Lee2 and Chung al3 examined L4-S1 lordosis according to the shape of lordosis such as Roussouly type.

2. Does LDI matter?
Although conflicting, many studies supported the significance of LDI in ASD surgery. Jain et al4 reported that the mean L4-S1 lordosis in reoperation group was 24°, which was significantly smaller than that of non-reoperation group of 30°. Park et al5 also reported that LDI of 53% was a risk factor for pelvic nonresponder after ASD correction surgery.

3. How to obtain distal lordosis?
To increase LDI, deformity correction should be performed at the distal lumbar segment. Recent studies on pedicle subtraction osteotomy (POS) at L4 or L5 showed LDI improvement and subseuqnt better radiological and clinical outcome. Anterior surgery also should be performed at L4-S1 level.

Conclusion: In ASD surgery, it is important not only to restore the magnitude of lumbar lordosis according to the PI, but also to reconstruct the shape and distribution of lumbar lordosis based on the patient's PI.

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Symposium 7 (Endoscopic Surgery: Cervical)

Unilateral Biportal Endoscopic Surgery for Degenerative Cervical Spine Diseases

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The unilateral biportal endoscopic (UBE) technique is an emerging minimally invasive approach that offers significant advantages in the surgical management of degenerative cervical spine disorders. By utilizing two independent portals—one for endoscopic visualization and the other for instrumentation—UBE enables flexible triangulation, continuous saline irrigation, and precise decompression within a magnified operative field.

This technique facilitates safe access to the cervical spine with minimal disruption to surrounding soft tissue structures. Under high-definition endoscopic guidance, UBE allows for targeted decompression of the spinal cord and nerve roots, effective resection of hypertrophied ligaments or osteophytes, and preservation of the facet joints. Indications include cervical spondylotic radiculopathy, foraminal stenosis, and select cases of myelopathy.

Clinical experience at our center demonstrates that UBE achieves favorable outcomes in terms of neurological recovery, neck and arm pain relief, and functional restoration. Early data also suggest reduced blood loss, shorter operative time, and rapid postoperative recovery compared to traditional anterior or posterior cervical approaches. Complications such as dural tears, infection, or instability remain rare with proper case selection and surgical technique.

This presentation outlines the key procedural steps, indications, advantages, and limitations of UBE for cervical spine surgery, supported by clinical cases and surgical video documentation. With its steep yet manageable learning curve and compelling clinical benefits, UBE is poised to play an increasingly prominent role in the modern minimally invasive management of cervical degenerative pathology.

Symposium 7 (Endoscopic Surgery: Cervical)

Endoscopy-Assisted Cervical Arthroplasty for Cervical Myelopathy due to Disc Herniation and Spondylosis

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Introduction: The traditional anterior cervical approach for addressing cervical myelopathy resulting from disc herniation or spondylosis often presents significant challenges, including limited surgical space, restricted visibility, and difficulties in achieving hemostasis. These limitations can impede the clear visualization of critical anatomical structures, complicating the decompression of the spinal cord and nerve roots. To overcome these obstacles, we have integrated endoscopic spine surgery techniques into the anterior cervical approach, followed by artificial disc placement, aiming to enhance surgical efficacy and patient outcomes.

Methods: We developed an endoscopy-assisted anterior cervical technique designed to improve decompression effectiveness for cervical spondylotic myelopathy with radiculopathy, followed by arthroplasty. This minimally invasive approach closely resembles a traditional mini-open anterior cervical procedure but is executed endoscopically.

Results: A retrospective analysis was performed on eight patients who underwent endoscopic anterior cervical discectomy followed by arthroplasty between January 2020 and August 2024. The cohort consisted of seven males and one female, with an average age of 42.5 years (range: 35-54). Preoperative arm pain, assessed via a visual analogue scale, significantly decreased from a mean of 6.5 to 1.8 postoperatively. JOA score improved from 6.7 to 15.6. Additionally, the Oswestry Disability Index (ODI) score improved from 67.2 to a mean of 15.1 at the final follow-up. The median hospitalization duration was 2.3 days, and all patients exhibited satisfactory outcomes at the last assessment.

Discussion: The endoscopy-assisted anterior cervical approach provides enhanced visualization for precise decompression, particularly advantageous for patients with significant stenosis or large disc herniations. Following complete decompression, the placement of an artificial disc is deemed appropriate. The results from our study are promising.

Conclusions: This study demonstrates the feasibility and safety of anterior cervical endoscopy-assisted discectomy and decompression, effectively addressing limitations associated with previous percutaneous techniques and advancing the conventional open approach into a more refined endoscopic procedure for cervical arthroplasty.

Symposium 7 (Endoscopic Surgery: Cervical)

Endoscopic cervical spine surgery- Destandau's technique

Shrinivas Rohidas

Prakruti clinic Dr. Rohidas's centre for Minimally Invasive Spine & Neurosurgery

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Symposium 7 (Endoscopic Surgery: Cervical)

Recent Techniques in Posterior Cervical Endoscopic Spine Surgery: A Literature Review

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Introduction: Posterior cervical endoscopic spine surgery has rapidly evolved as a minimally invasive alternative for treating cervical spine pathologies. With technological advances and growing clinical experience, novel techniques such as posterior cervical inclinatory foraminotomy, multilevel foraminotomy, endoscopic laminoplasty, laminectomy and posterior decompression with interbody fusion, have emerged. This review summarizes current evidence and technical developments in posterior cervical endoscopic spine surgery, with a focus on efficacy, safety, and expanding indications.

Main Body

1. Posterior Cervical Inclinatory Foraminotomy & Multilevel Foraminotomy

Recent studies have introduced biportal endoscopic posterior cervical inclinatory foraminotomy (BE-PCIF) as an alternative to traditional posterior cervical foraminotomy, enabling effective neural decompression with minimal facet joint resection. A sliding technique has also been proposed to perform two-level foraminotomies through a single biportal approach, achieving favorable outcomes without additional incisions. Modified inclined trajectories further enhance foraminal expansion and reduce facet damage, especially in osseous stenosis.

2. Posterior Cervical Laminoplasty

The application of biportal endoscopy in open-door laminoplasty offers improved visualization and reduced soft tissue damage. A recent case series demonstrated successful outcomes using mini-plate fixation under endoscopic guidance, with preservation of paraspinal musculature and satisfactory decompression. This approach may reduce axial symptoms and enhance recovery.

3. Posterior Cervical laminectomy

Posterior endoscopic cervical laminectomy has been adapted for multilevel cervical spondylotic myelopathy using a floating spinous process technique and circumferential marginal drilling to minimize dural handling. While it preserves musculoligamentous structures, complications such as delayed spinous process fractures—especially in ≥3-level decompressions—can cause neck instability and restenosis. For cases requiring ≥3 levels, authors recommend conventional laminoplasty or laminectomy with fusion, and rigid cervical orthosis for at least 6 weeks postoperatively.

4. Posterior Cervical Decompression and Interbody Fusion

A novel posterior endoscopic technique combining decompression and interbody fusion with an double cage has shown biomechanical feasibility and radiographic decompression in cadaveric and model-based studies. This suggests a potential shift toward fusion-capable endoscopic solutions in the posterior cervical spine.

Conclusion: Posterior cervical endoscopic techniques have significantly expanded in recent years, offering minimally invasive alternatives for decompression, fusion, and multilevel disease management. Innovations such as inclinatory foraminotomy, sliding biportal approaches, and endoscopic laminoplasty are promising in terms of safety and effectiveness. However, further prospective studies with long-term follow-up are essential to validate these techniques and guide future clinical application.

Symposium 7 (Endoscopic Surgery: Cervical)

Optimal and Relative Indications for Biportal Endoscopic Cervical Surgery

Seok-Bong Jung

Jinju Bon Hospital

Biportal endoscopic cervical surgery (BECS) has recently gained attention as a minimally invasive technique for the management of various cervical spine disorders. Utilizing two independent portals for viewing and working, this approach provides superior visualization, precise decompression, and minimal soft tissue damage compared to traditional open or even uniportal endoscopic procedures. Despite its advantages, appropriate indication and careful patient selection remain critical for ensuring optimal surgical outcomes and minimizing complications.

The optimal indications for BECS include patients with unilateral cervical radiculopathy due to soft disc herniation, foraminal stenosis, or lateral recess stenosis, particularly when the pathology is localized and accessible via a posterior approach. These cases typically allow for safe and effective decompression with minimal neural manipulation and faster recovery.

The relative indications include more complex conditions such as bilateral radiculopathy, mild to moderate cervical spondylotic myelopathy (CSM), multilevel stenosis, calcified herniated discs, or revision surgery. These situations demand greater surgical expertise and intraoperative adaptability. In such cases, BECS may still be feasible and beneficial, but the decision to proceed must be carefully weighed against potential risks, the degree of decompression required, and the surgeon's experience.

As the technique evolves, the indications for BECS are gradually expanding. However, establishing clear criteria for optimal and relative indications is essential to avoid overuse or inappropriate application. This review provides a comprehensive overview of patient selection strategies for biportal endoscopic cervical procedures and aims to support safe and effective adoption of this technique in clinical practice.

Symposium 8 (MIS Fusion)

Minimally invasive TLIF using tubular retractor

Jaewan Soh

SOONCHUNHYANG UNIVERSITY CHEONAN HOSPITAL

Symposium 8 (MIS Fusion)

Avoiding endplate injuries in OLIF - tip and tricks

Jacob Oh

Tan Tock Seng Hospital

Symposium 8 (MIS Fusion)

OLIF L5-S1 via lateral corridor

Tae-keun Ahn

CHA University

Background: Traditionally, oblique lateral interbody fusion (OLIF) at the L5–S1 level has been considered technically challenging or contraindicated due to anatomical constraints such as a high iliac crest and the presence of the iliocaval confluence. The conventional belief is that these barriers limit access to the disc space via the lateral corridor. However, recent anatomical studies and device innovations have prompted reevaluation of the feasibility of this approach. Preoperative vascular mapping and modified insertion techniques now offer new surgical corridors even at the lumbosacral junction.

Main Body: A growing body of anatomical and clinical evidence supports the potential for lateral access at L5–S1. Berry et al. demonstrated that, in select cases, three different lateral corridors—left pre-psoas, right pre-psoas, and intra-bifurcation—can be safely accessed without increasing complication rates. In addition, Jang et al. reported successful clinical cases using the Perimeter® cage via the lateral corridor at L5–S1, highlighting the role of precise imaging and individualized surgical planning.

The anatomical feasibility of this approach is reinforced by Davis et al., who conducted a cadaveric study of 20 specimens to define the minimally invasive retroperitoneal oblique corridor from L2 to S1 in the lateral decubitus position. They demonstrated that a measurable L5–S1 corridor exists in all specimens, with mean transverse and vertical diameters of 14.75 mm and 23.85 mm, respectively, and that gentle retraction of the iliac vessels can consistently allow access without traversing the psoas. This work established that OLIF at L5–S1 can be anatomically feasible without table break or patient repositioning, minimizing manipulation of the lumbar plexus.

Chung et al. further classified vascular barriers at the lumbosacral level, introducing a grading system for the iliocaval junction that predicts corridor feasibility. Their study of 200 patients revealed that a lateral window is present in over 90% of cases, even in the presence of lumbosacral transitional vertebrae (LSTV). Importantly, they demonstrated that the morphology of the iliocaval confluence varies significantly between individuals, underscoring the necessity of patient-specific planning.

The development of angle-adjustable cages has expanded the feasibility of OLIF at L5–S1. These devices allow the surgeon to insert the cage obliquely and then rotate it into a more orthogonal position relative to the disc space. This is particularly beneficial in patients where direct orthogonal access is limited by the iliac crest or vascular structures. Moreover, the ability to correct segmental lordosis intraoperatively without extensive endplate damage contributes to biomechanical stability.

While long-term clinical outcomes are still under investigation, early reports—including clinical series of OLIF at L5–S1 using anterior to psoas(ATP) approach — indicate comparable fusion rates and complication profiles to traditional anterior approaches in well-selected patients. Importantly, the lateral or ATP approach avoids the morbidity associated with anterior exposure, such as high-risk vascular mobilization or retrograde ejaculation, and may allow for single-position surgery in multi-level constructs.

Conclusion: Oblique lateral interbody fusion at L5–S1 via the lateral corridor is anatomically feasible in a majority of patients, provided that appropriate preoperative vascular evaluation is conducted. Cadaveric evidence confirms the presence of an accessible oblique window at this level, and large-scale clinical data support the safety of this approach when performed with meticulous surgical technique. The use of angle-adjustable cages facilitates cage placement and alignment, even in anatomically restricted spaces, making this technique a promising alternative to traditional anterior approaches. Further prospective studies are warranted to validate long-term clinical outcomes and define clear patient selection criteria.

Symposium 8 (MIS Fusion)

Comparison of MIS-TLIF and Endo-LIF

Qingbing Meng

Dep.Orthopedics, Shanghai First Hospital

Symposium 8 (MIS Fusion)

Oblique Lateral Lumbar Interbody Fusion Talk

Sunny Kim MD

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More than 3000 cases have been performed via Kambin's triangle. This is truly minimally invasive basically interventional radiology procedure analogous to vascular stent placement. At least three times faster than conventional lumbar fusion. Essentially zero infection rate and very minimal blood loss. Even applicable to patients with severe medical comorbidities that are not amenable to conventional fusion surgery. Also applicable to extremely high BMI patients. Author's record is BMI of 68! Many lumbar fusions are carried out as outpatient basis and patients are discharged within hours of the surgery. Will provide detailed explanation of the surgery and outcomes and complications.

Symposium 9 (Cervical Spine)

Recent advances in AI for cervical spine disease: A comprehensive review

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Recent advances in artificial intelligence (AI) have opened new horizons in the diagnosis and management of cervical spine diseases, a domain traditionally challenged by complex anatomy and subtle clinical presentations. This comprehensive review explores the multifaceted applications of AI in enhancing clinical decision-making—from early screening to individualized therapeutic strategies.

In the diagnostic domain, AI models—particularly convolutional neural networks (CNNs), transformer-based models, and radiomics—have been widely adopted for interpreting cervical spine imaging. Notably, a growing body of research has focused on using plain X-rays for initial screening, where deep learning algorithms have demonstrated high sensitivity in detecting loss of cervical lordosis, traumatic fractures, cervical instability, and even early signs of spinal cord compression. These tools can assist in identifying patients who require further imaging (e.g., CT or MRI), thus reducing unnecessary advanced imaging and shortening time to diagnosis. Automated systems have also been shown to minimize inter-reader variability and support decision-making in emergency and outpatient settings.

In terms of advanced imaging, AI-driven analysis of CT and MRI has further improved diagnostic precision for conditions such as cervical spondylotic myelopathy (CSM), disc herniation, and cervical trauma. By extracting and analyzing subtle patterns, AI reduces interpretation time and increases consistency, particularly in resource-limited or high-volume clinical environments.

From a therapeutic perspective, AI enables the development of personalized treatment plans. Predictive models incorporating imaging, clinical, and demographic data can forecast surgical outcomes, neurological recovery, and postoperative complications such as hardware failure or adjacent segment disease. These tools guide optimal treatment selection and enhance shared decision-making between patients and physicians.

AI is also being increasingly integrated into surgical planning and simulation, where 3D reconstructions and predictive algorithms assist in choosing fusion levels, implant types, and surgical approach. This precision-driven planning holds the potential to improve operative safety and reduce complications.

Despite these advancements, limitations remain, including the need for external validation, standardization of datasets, and interpretability of models. Ethical concerns and regulatory frameworks must also evolve to accommodate AI's growing role in spine care.

In summary, AI is transforming the landscape of cervical spine disease management—starting with efficient X-ray-based screening, extending to sophisticated diagnostic imaging, and culminating in tailored treatment strategies. As research continues, multidisciplinary collaboration will be essential to ensure the responsible and effective implementation of AI in clinical practice.

Symposium 9 (Cervical Spine)

Complications in cervical spine surgery: Prevention and management strategies

Jiwon Park

Seoul National University Hospital

Cervical spine surgery has become increasingly common with advancing surgical techniques and expanding indications. However, the complex anatomy of the cervical region, with its proximity to vital neurovascular structures, poses significant risks for both intraoperative and postoperative complications. This comprehensive presentation will address the most clinically significant complications encountered in cervical spine surgery, categorized into intraoperative and postoperative events, along with prevention and management approaches.

Intraoperatively, surgeons face the constant threat of vertebral artery injury leading to massive hemorrhage and stroke, esophageal perforation resulting in mediastinitis and sepsis, iatrogenic spinal cord injury causing permanent quadriplegia, dural tears predisposing to meningitis and cerebrospinal fluid complications, and epidural bleeding creating compressive hematomas with acute neurological deterioration. The postoperative period presents equally formidable challenges, including respiratory compromise from prevertebral soft tissue swelling that can progress to acute airway obstruction requiring emergency intubation or tracheostomy, postoperative hematomas causing rapid neurological decline and airway compromise within hours of surgery, and C5 palsy resulting in permanent shoulder dysfunction and disability. These complications represent a catastrophic spectrum ranging from temporary morbidity to permanent paralysis, respiratory failure, and death, underscoring the critical importance of meticulous surgical technique, comprehensive prevention strategies, and immediate recognition and management protocols to minimize the potentially devastating consequences of cervical spine surgery.

I. Intraoperative complications
1. Vertebral artery injury
2. Esophageal injury
3. Dural tear
4. Iatrogenic spinal cord injury
5. Epidural bleeding

II. Postoperative complications
1. Respiratory difficulty due to prevertebral soft tissue swelling
2. Postoperative hematoma
3. C5 palsy

Based on extensive clinical experience, effective management of cervical spine surgery complications requires specific evidence-based techniques: dural tear repair using autologous fat graft provides superior sealing compared to synthetic materials, epidural bleeding control with Gel-bin hemostatic agent offers rapid, biocompatible hemostasis, iatrogenic spinal cord injury prevention during laminoplasty demands precise plate placement with careful attention to anatomical landmarks and drill trajectories, and airway patency maintenance through strategic mouth and head positioning effectively prevents respiratory compromise from prevertebral swelling. Most critically, vertebral artery injury management must avoid simple tamponade-style compression techniques, as clinical data demonstrates that approximately 48% of cases develop pseudoaneurysm formation when managed with compression alone, necessitating immediate vascular consultation and definitive repair rather than temporary hemostatic measures to prevent delayed catastrophic hemorrhage or thromboembolism.

III. How to manage cervical spine surgery related complications?
1. Dural tear management: Fat graft
2. Epidural bleeding control: Gel-bin
3. Avoidance of iatrogenic spinal cord injury: how to place laminoplasty plate?
4. How to enhance airway patency? Mouth and head position
5. Vertebral artery injury

Symposium 9 (Cervical Spine)

Anterior Approach in MIS/Endoscopic Cervical Surgery (vs ACDF)

Dr. Zenya Ito

Chair of Aichi Spine Hospital, Japan

Background: Several treatments for cervical disc herniation (CDH) exists, usually in Japan anterior cervical decompression and fusion(ACDF) is common. However, pseudarthrosis, loss of ROM and adjacent segment disease is seen. Anterior or posterior approach in MIS/Endoscopic Cervical Surgery develop nowadays, so patient's quality of life keeps growing. The indication of anterior approach is for center and intracanal herniation and posterior for intraforamen without instability. We report our experience of anterior procedure.

Materials and Methods: We operated 448 cases of CDH for herniation including 175 anterior (165 transdiscal, 10 transvertebral) and 273 posterior approach in MIS.

Also, we operated 129 ACDF for CDH with instability or local kyphosis.

Anterior-approach: Cannula inserted between esophagus and carotid artery, then into disc space. Prolapsed nucleus removed by forceps. When there is osteophyte or migrated herniation, we select percutaneous trans-vertebral decompression method using a small diamond-burr.

ACDF: The conventional microsurgical ACDF was performed with the known standardised technique using a microscope. A polyetheretherketone (PEEK) cage was used as the intervertebral implant; there was no additional ventral plating. The exam items were VAS, Macnab score and complication. Statistical analysis was using student t-test and repeated measure anova.

Results: Anterior-approach in MIS: Initial operation results satisfactory (excellent, good) in 86% of patients, and unsatisfactory in 14%. The seven poor cases were insufficient osteophyte removal, recurrence, transient C7 palsy, aggravated myelopathy and residual numbness. Anterior-posterior dural shrinkage averaged 42.1% preoperatively, recovering to 75.8% post-operation, then increased to 86.5% after one year using anterior approach. Disc height decreased on average by 12.6% one year later, without significant new symptoms.

VAS score decreases from 7 to 2.4 within 1 month. ($p<0.05$)
However, after three months, patients who had returned to work or were able to work was better than ACDF. (85%: MIS vs 60%: ACDF) ($p<0.05$)

ACDF: Initial operation results satisfactory (excellent, good) in 83% of patients, and unsatisfactory in 17%. Transient difficulty swallowing occurred in 5 cases and there were two surface haematomas in the ACDF group. One was a vegetable-like state.
VAS score decreases from 8 to 2.3 within 1 month. ($p<0.05$)

Conclusion: MIS is a sufficient and safe alternative to conventional procedures when the indication criteria are fulfilled. At the same time, it offers the advantages of a minimally invasive intervention.

Symposium 9 (Cervical Spine)

Things You must know for posterior cervical foraminotomy

Kyung-Chung Kang

KYUNG HEE UNIVERSITY MEDICAL CENTER

Symposium 9 (Cervical Spine)

Things You Must Know for Posterior Cervical Foraminotomy

Kyung-Chung Kang

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Introduction: The minimally invasive posterior cervical foraminotomy(PCF) procedure has become a common and successful procedure for the treatment of cervical radiculopathy. Specifically, the minimally invasive approach including endoscopic surgery allows for decreased postoperative pain, blood loss, and length of hospitalization by preserving the surrounding soft tissue as compared with the traditional open approach.

Main body: Indication for PCF are single-level or multilevel unilateral foraminal/paracentral herniated nucleus pulposus, foraminal stenosis secondary to isolated facet hypertrophy, persistent radicular symptoms following an anterior cervical discectomy and fusion or anterior cervical disk arthroplasty and contraindications to anterior approach. Contraindications are central disk herniation or anterior osteophytes, myelopathy secondary to central canal stenosis, posterior longitudinal ligament ossification. Kyphosis / Instability. Advantages of PCF area decompress nerve root - minimal bone resection, do not fuse segment -preservation of segmental motion, less invasive & multiple level, and avoid anterior approach related complication. Meanwhile, disadvantages are postoperative kyphosis or instability, recurrence & central disc herniation, limitation for anterior pathology. There are two techniques. One is 'Open posterior cervical foraminotomy' and the other is 'Minimally invasive cervical foraminotomy'. To compare posterior cervical foraminotomy with anterior discectomy and fusion, there are some reports that showed similar results between two techniques, but average cost is less (89%) in foraminotomy technique than anterior cervical fusion technique. The posterior cervical foraminotomy is also considered to have an advantage in Cost-Effectiveness. Posterior cervical foraminotomy showed improvement of health related quality of life in long term results. Some studies with more than 10 years follow-up showed good results for pain relief and re-operation rate.

Conclusion: Posterior cervical foraminotomy is thought to be a technique that requires a technical learning curve, but if the indication is chosen well, it is a technique that has the advantages of satisfactory results, cost-effectiveness aspects, long-term prognosis and low complications without fusion. In this presentation, we would like to look at the need for posterior cervical foraminotomy, technical aspects, points of attention, etc.

Key words: posterior cervical foraminotomy, indication, advantage/disadvantage

Symposium 9 (Cervical Spine)

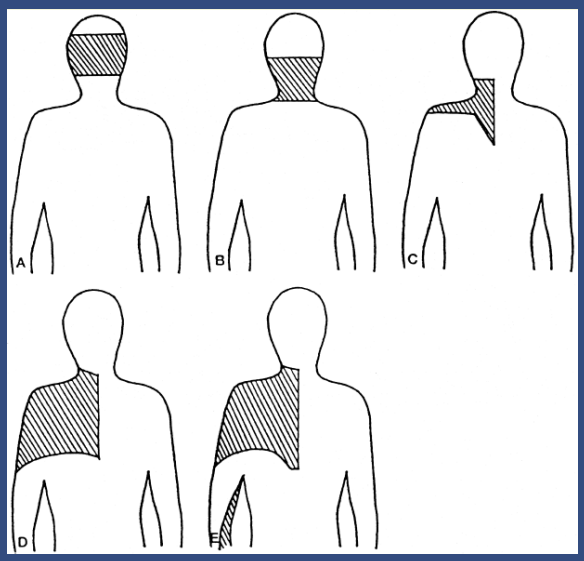
Spondylogenic Axial Neck Pain

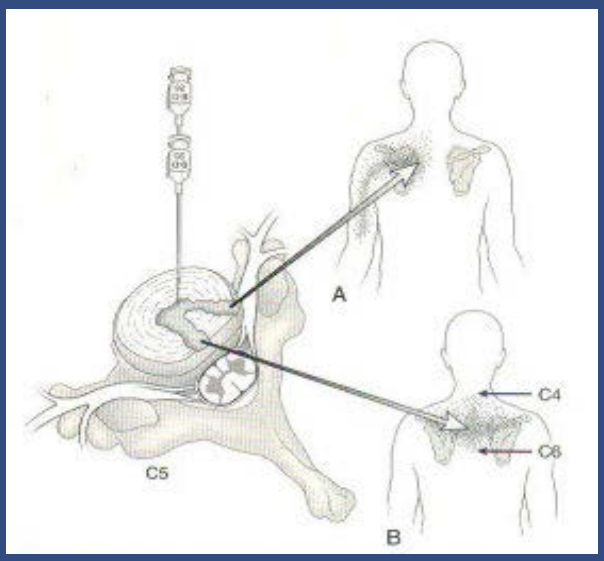
Cervical disc

Facet joint

Nerve root

Axial Neck Pain Patterns Provoked during Discography





Pain referral pattern from posterolateral and central discs
(Cloward RB et al, Ann Surg, 1959)

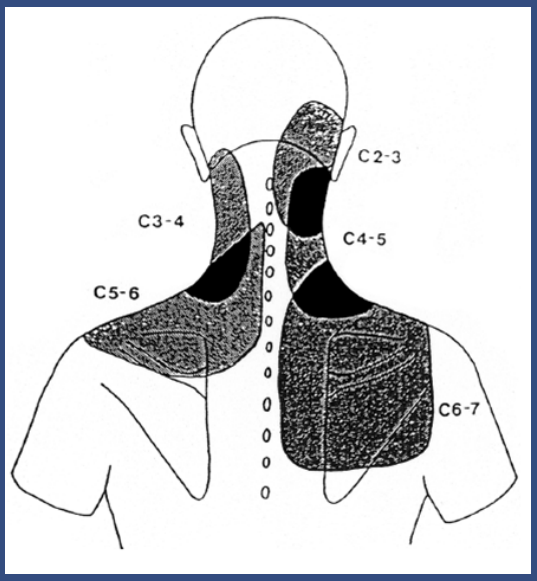
Symposium 9 (Cervical Spine)

Suggestive of cervical discogenic pain:

axial neck pain associated with
headaches,
unilateral or bilateral shoulder pain,
non-radicular arm pain,
ocular and vestibular dysfunction,
anterior chest wall pain

coughing, lifting, or applying pressure on the cervical spinous processes -aggravate discogenic pain
lying supine - relieve pain

Axial Neck Pain Patterns Provoked during Facet Joint Injection



(Dwyer A et al, Spine, 1990)

atlanto-occipital, and atlanto-axial joint :
occipital and posterior auricular pain

C2-3 or C3-4 facet joints :
occipital and suboccipital regions

C4-5 or C5-6 facet joint :
radiating into the shoulder

C6-7 and C7-T1 joints :
mid-back and scapular regions

Symposium 9 (Cervical Spine)

Axial Neck Pain Associated with Radiculopathy

- **Radiculopathy**

  Clinical presentation with

  – arm pain 99 %

  – sensory deficit 85 %

  – neck pain 80 %

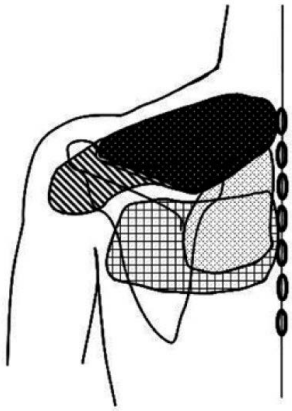
  – 52 % scapular pain

  – headache 10 %

  – 18 % anterior chest pain

  – 1 % cervical angina(left side chest and arm pain)

Periscapular pain

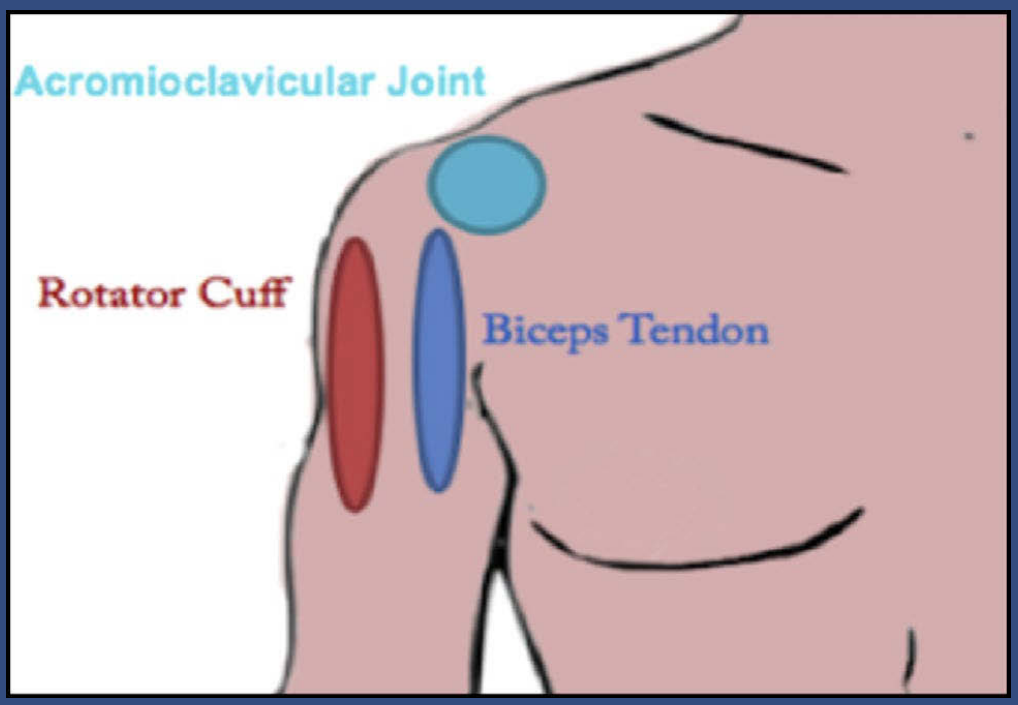


Pain characteristics	Radiculopathy			
	C5	C6	C7	C8
Pain at posterior deltoid	-	+	-	-
Superficial pain at suprascapula	+	-	-	-
Deep pain at suprascapula	+	+	-	-
Deep pain at interscapula	-	-	+	-
Deep and superficial pain at interscapula and scapula	-	-	-	+

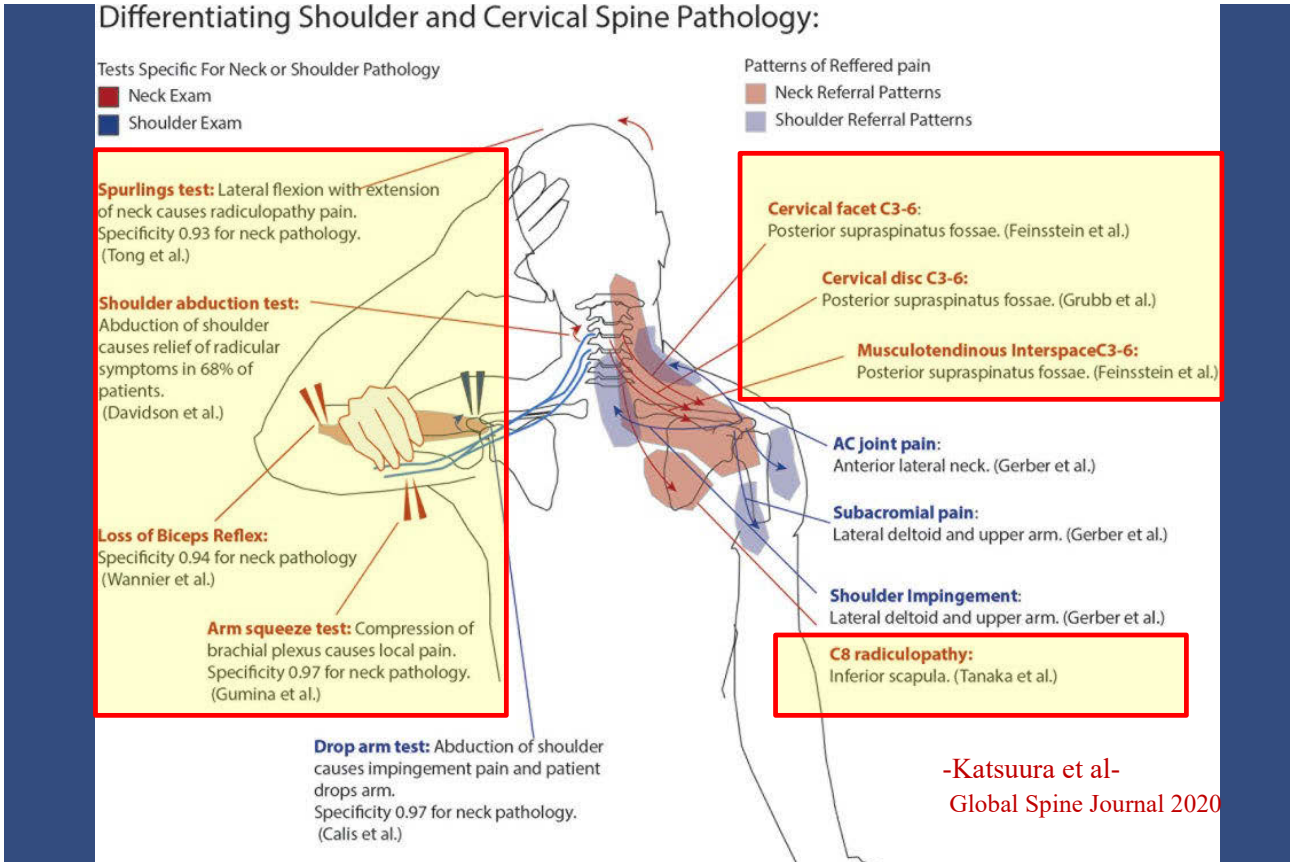
Symposium 9 (Cervical Spine)

D/Dx from the symptom

1. Axial neck pain
2. Shoulder pain
3. Radicular symptom

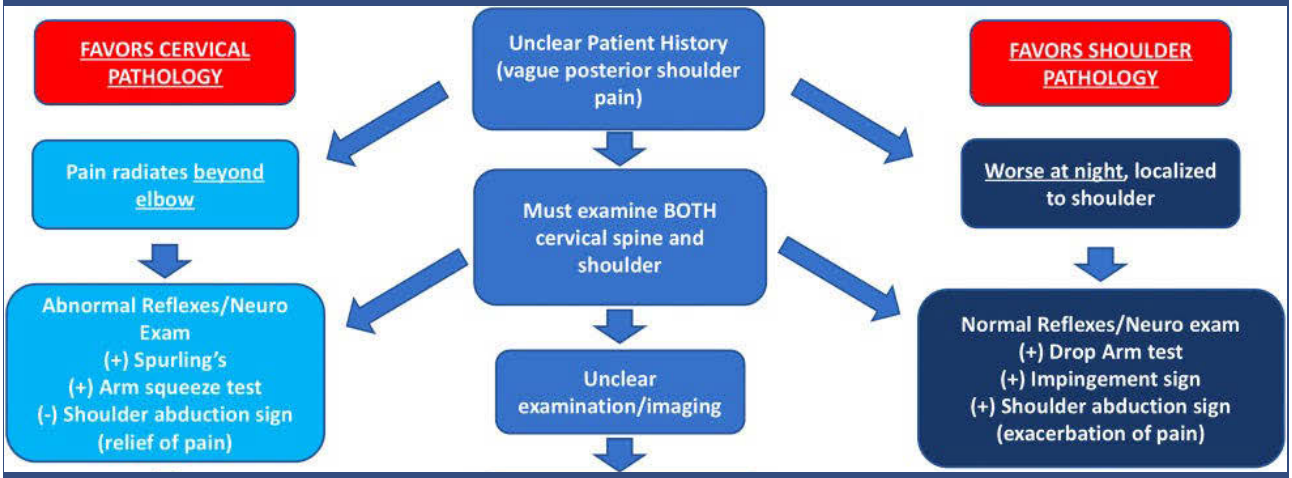


Symposium 9 (Cervical Spine)



-Katsuura et al-
Global Spine Journal 2020

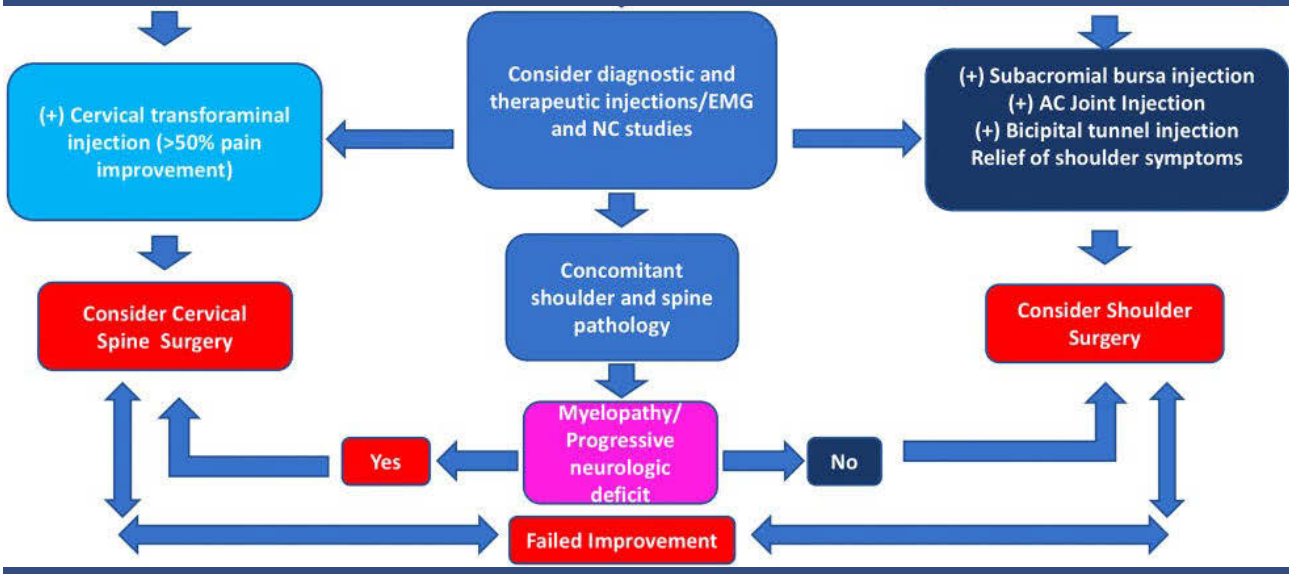
Algorithm for diagnosis and treatment



-Katsuura et al-
Global Spine Journal 2020

Symposium 9 (Cervical Spine)

Algorithm for diagnosis and treatment



-Katsuura et al-
Global Spine Journal 2020

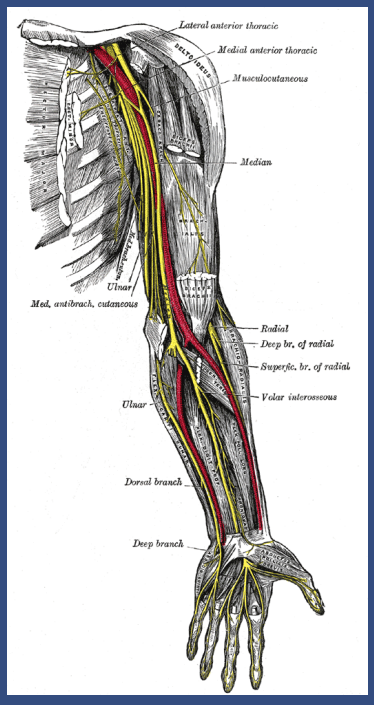
D/Dx from the symptom

1. Axial neck pain
2. Shoulder pain
3. Radicular symptom

Symposium 9 (Cervical Spine)

- Herniated disc
- Carpal tunnel syndrome
- Cubital tunnel syndrome
- Thoracic outlet syndrome
- Ulnar tunnel syndrome
- Pronator syndrome
- Anterior interosseous nerve syndrome
- Radial tunnel syndrome
- Posterior interosseous nerve syndrome

Median nerve



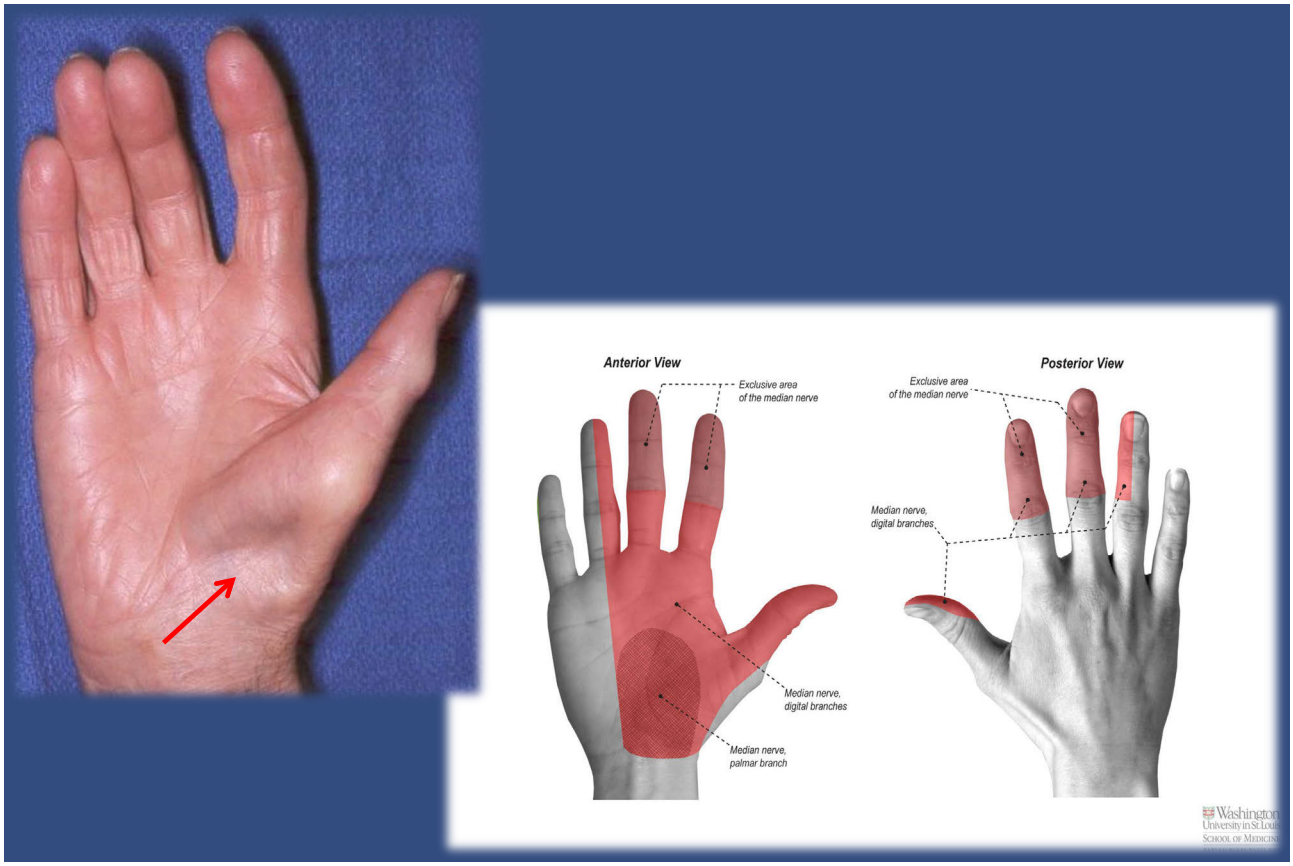
C5 & C6 (lateral cord) &
C8 & T1 (medial cord)

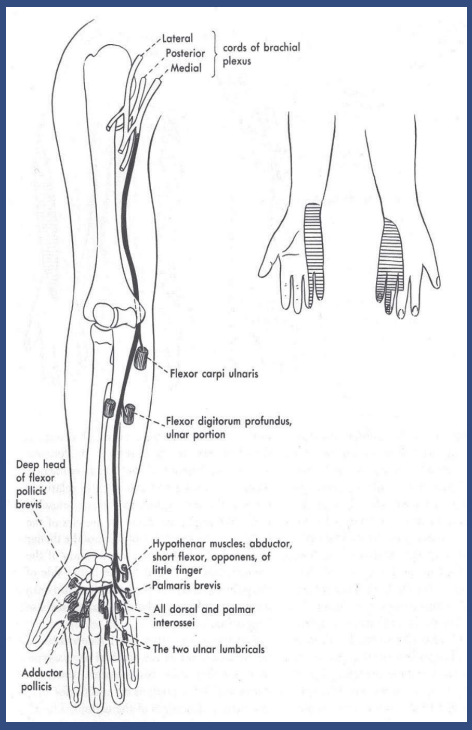
Pronator syndrome

AIN syndrome

Carpal tunnel syndrome

Symposium 9 (Cervical Spine)





Ulnar Nerve

Cubital tunnel syndrome

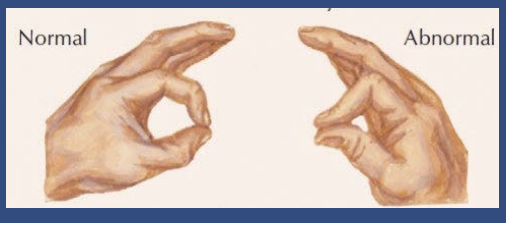
Ulnar tunnel syndrome

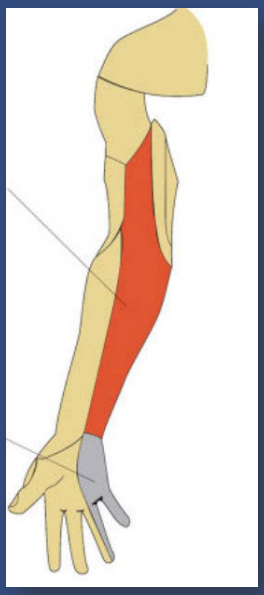
Symposium 9 (Cervical Spine)

C8 radiculopathy – D/Dx.

ulnar nerve entrapment

C8 (median, radial, ulnar)	Ulnar nerve
Thenar muscles (APB, OP, FPB-superf., Adductor pollicis 제외) 1 & 2nd lumbricales	Hypothenar muscles (ADM, ODM, FDMB) Adductor pollicis FPB-deep 3 & 4th lumbricales All interossei (Froment sign)





Summary

1. **Axial neck pain:** possibility of cervicogenic
2. **Shoulder pain** : ROM, location, provocation test
3. **Radicular symptom:** pain, muscle atrophy

Symposium 10 (Endoscopic Surgery: Fusion)

Nerve Protection in Lumbar Endoscopic Fusion Surgery

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National Cheng Kung University Hospital, Tainan, Taiwan

The growing adoption of uniportal full-endoscopic lumbar transforaminal interbody fusion (FE-TLIF) has brought increasing attention to the need for effective nerve protection strategies. This presentation highlights both anatomical and clinical evidence supporting tailored approaches to reduce neurological complications in two distinct techniques: facet-sparing (FE fs-TLIF) and facet-resecting (FE fr-TLIF) fusion.

A cadaveric study involving 16 procedures was conducted to examine the spatial relationships between nerve roots and endoscopic instruments. The results revealed significantly different distances between the cage entry points and adjacent nerve roots in FE fs-TLIF versus FE fr-TLIF, underscoring the importance of technique-specific protective measures. For FE fr-TLIF, we recommend the use of a two-bevel tip cage glider to shield the traversing root during insertion. In contrast, for FE fs-TLIF, a single-bevel tip glider positioned caudally helps prevent exiting root injury.

Complementing the anatomical insights, a retrospective clinical study of 45 patients compared the conventional sentinel pin technique with the novel GUARD (Glider Used As a Rotary Device) technique, which features a delayed ligamentum flavectomy to reduce neural irritation. Patients in the GUARD group showed significantly less postoperative radicular pain at six weeks and a markedly lower incidence of neurapraxia, with comparable radiographic outcomes at one year.

This combined anatomical-clinical analysis provides evidence-based recommendations for optimizing surgical technique, glider design, and intraoperative workflow to enhance nerve protection in uniportal endoscopic lumbar fusion procedures.

Symposium 10 (Endoscopic Surgery: Fusion)

Full endoscope assisted lumbar interbody fusion - recommendable indications

Jae-Hung Shin, Ki-Tack Kim

Department of Spine surgery, Dongtan City hospital

Background and Introduction: As of late, lots of surgeons prefer endoscopic surgeries to conventional operations in solving commonplace spinal pathologies. Full endoscopic spine surgery has developed swiftly up to endoscope assisted lumbar interbody fusion. Full endoscope can serve substantial benefits to surgeons and patients as well, including minimal skin, muscle injury, less bleeding, improved postoperative pain, and early rehabilitation, There are two different approaches for full endoscope assisted lumbar interbody fusion. One is posterolateral approach which is applied more widely for degenerative pathologies including central spinal stenosis, the other is trans-Kambin's access. Posterolateral technique aims at direct decompression of neural tissues, however, trans-Kambin approach is appropriate for indirect decompression of neural tissues such as OLIF and LLIF.

Main body

1. Posterolateral technique

Posterolateral approach is applied more commonly in endoscope assisted lumbar interbody fusion. It has merits in viewing vertebral structures including bony structures such as spinous process, facet joint, laminar window, and neural tissues like dura mater and nerve roots. It helps surgeon to locate the target precisely and reduce surgeon's oversights. It is appropriate for direct and wide decompression of neural tissue bilaterally. Further more, it is proper for harvesting adequate local bone used for fusion material. In some cases, additional complements are not needed in packing the disc space. However, posterolateral technique requires rather long operation time, about 120-150 minutes for a level.

The operation time mainly depends on the patient's condition such as muscle mass, the thickness of bony structures and ligaments, the height of disc space, the toughness of dis material, and bleeding tendency.

2. Trans-Kambin's technique

Trans-Kambin technique is suitable for indirect decompression in cases like foraminal stenosis and unstable spondylolisthesis accompanying spinal stenosis. It is applied in limited indications compared to posterolateral technique. The access is located on the Kambin's triangle through the erector spinae muscle. It can salvage facet and lamina stabilizing the vertebral structure, and reduce the chance of dural tear. Furthermore, meticulous decortication of end plate is easier compared to posterolateral technique, thus it can reduce the operation time substantially (about 90-120 minutes for a level). However, trans-Kambin technique has some thresholds. It is not favorable in the L5-S1, or deep seated L5-6 level due to the limited trajectory. Sometimes, exiting nerve root injury can occur during surgery if the disc space is too narrow, in addition, adequate obtaining of autogenous bone is not feasible in trans-Kambin technique.

Conclusion: There are two different approaches for endoscope assisted lumbar interbody fusion by full endoscope. One is postrolateral access applied more widely, the other is trans-Kambin access. Posterolateral approach aims at direct decompression, and is suitable for almost pathologies including central spinal stenosis, foraminal stenosis, high grade spondylolisthesis regardless of disc level. Trans-Kambin approach aims at indirect decompression, and has a limited indications and level. However, trans-Kambin's technique can widen spinal canal and neural foramen without resecting bony structures like OLIF, LLIF, and requires shorter operation time. If the suitable fusion technique is applied or combined, preferable outcome will be achieved.

Key words : Endoscope assisted lumbar interbody fusion, Trans-Kambin approach, Full endoscope.

Symposium 10 (Endoscopic Surgery: Fusion)

Alignment Correction in Double Cages Biportal Endo-LIF

Jwo-Luen Pao, MD

Department of Orthopedic Surgery, Far-Eastern Memorial Hospital, New Taipei, Taiwan

Biportal endoscopic lumbar interbody fusion (biportal endo-LIF) is an advanced minimally invasive fusion technique that enables precise decompression, radical discectomy, and meticulous endplate preparation through dual working portals and continuous saline irrigation. By directly introducing a 6-mm endoscope into the disc space, surgeons can achieve excellent visualization of the cartilage endplate while preserving the subchondral bone, thereby minimizing cage subsidence and enhancing initial segmental stability.

Our technique emphasizes the sequential insertion of two interbody cages—strategically placed to increase the cage footprint, restore disc height, and facilitate robust correction of coronal and sagittal malalignment. Reduction of spondylolisthesis is achieved via modern pedicle screw instrumentation, and large volumes of autograft and bone substitutes are packed under direct vision to promote fusion.

From 2019 to 2024, over 350 patients underwent biportal endo-LIF at our institution. Clinical outcomes demonstrated significant improvements in VAS, ODI, and JOA scores, with a fusion rate of 93.3% and cage subsidence rate of only 5.5% at one year postoperatively on CT evaluation. Complication rates were low.

Biportal endo-LIF represents a safe and effective MIS strategy not only for neural decompression and fusion but also for sagittal and coronal alignment correction. This presentation highlights key planning and surgical techniques that optimize alignment outcomes through precise cage placement and endoscopic control.

Symposium 10 (Endoscopic Surgery: Fusion)

Endplate preparation in biportal endoscopic lumbar interbody fusion

Hyun-Jin Park

Hallym University Kangnam Sacred Heart Hospital

Abstract

Background: Successful spinal fusion heavily depends on the condition of endplate preparation in transforaminal lumbar interbody fusion (TLIF). The microscopic tubular (MT) approach offers a fixed surgical field outside the body and primarily relies on tactile feedback for endplate preparation. In contrast, the biportal endoscopic (BE) approach offers a flexible surgical field of view inside the body, allowing for direct visualization of the entire process of endplate preparation. These differences may affect the adequacy and completeness of endplate preparation. We aimed to evaluate the adequacy and completeness of endplate preparation in BE- and MT-TLIF.

Methods: We conducted an anatomical study of human cadavers. A quantitative assessment was performed using digital imaging software to calculate the percentage of the prepared endplate area (Prep %), which evaluated the adequacy of endplate preparation by comparing the prepared endplate cross-sectional area to the total endplate area. The entire endplate was divided into a grid of 6×8 pixels to evaluate the completeness of endplate preparation. Each pixel was qualitatively scored on a 4-point scale (0–3 points) based on the extent of bony endplate exposure and was counted based on its score. The percentage relative to the total number of pixels (Pixel%) was calculated. Four cadaveric torsos were procured for the study. Three lumbar segments were prepared using BE- and MT-TLIF techniques in each cadaver, totaling twelve intervertebral discs and twenty-four endplates. After completing endplate preparations using each approach, the lumbar spines were excised from the cadaveric torsos. Each disc space of the lumbar spine was dissected and split open in the axial plane at the center to expose the cranial and caudal endplates. These endplates were digitally photographed, followed by a quantitative and qualitative assessment of endplate preparation. The difference between the two approaches was then evaluated.

Results: In terms of adequacy of endplate preparation, the Prep% was significantly larger with the BE than with the MT approach (55.10%; 44.94%; p=0.001). Notably, when the entire endplate was divided into quadrants for analysis, the BE approach had significantly larger Prep% in the contralateral anterior and contralateral posterior quadrants (p<0.001). In evaluating the completeness of endplate preparation, the Pixel% with complete endplate exposure (3 points) was significantly higher with the BE approach than with the MT approach (15.60%; 5.93%; p<0.001). There was no significant difference in the Pixel% scored as 0, 1, or 2 points (p>0.05).

Conclusion: The results of this study indicate that the BE approach provides significantly better adequacy and completeness of endplate preparation than the MT approach in TLIF surgery.

Keywords: Endplate preparation, Biportal endoscopic, Microscopic tubular, Transforaminal lumbar interbody fusion

Symposium 10 (Endoscopic Surgery: Fusion)

Biportal endoscopic Lumbar Interbody fusion with 3D printed double cage: Technical note and preliminary result

Ju-Eun Kim, M.D.

Baroseomyeon Hospital, Pusan, South Korea, Department of Orthopaedic Surgery

Background context: Numerous papers regarding minimally invasive spinal surgery using biportal endoscopic technique have been published. Furthermore, few technical reports and small case series of biportal endoscopic transforaminal interbody fusion (BE-TLIF) have been recently reported. However, as with open surgery, complications such as delayed union or subsidence occurred. Therefore, we assumed 3D printed double cage technique would result in subsidence and favorable fusion rate.

Purpose: Our aim was to introduce the surgical technique of BELIF using 3D printed double cage that were originally designed for posterior lumbar interbody fusion and investigate the outcome including clinical and radiological outcome besides technical feasibility of which.

Study design: A retrospective study.

Method: Between Jan 2023 and Mar 2024, 30 patients who underwent single-level BE-TLIF for degenerative or isthmic spondylolisthesis as well as spinal stenosis patient who were recured that were followed up for at least a year were enrolled. For cage selection, 3D printed cages that were designed for PLIF were used. Visual Analog Scale (VAS) of back and leg and Oswestry Disability Index (ODI) were collected perioperatively, and modified Macnab criteria were collected at the final follow-up. The length of hospital stay, time to ambulation, and fusion rate, perioperative complications were collected. Fusion was assessed using computerized tomography (CT) scans and determined based on the Bridwell grading system. Spino-pelvic parameters were measured preoperatively and postoperatively using whole-spine anterior-posterior plain radiographs.

Result: ODI scores improved from 64.1±4.4 preoperatively to 16.3±4.1 at the final follow-up ($p<0.001$). VAS scores of the leg decreased from 7.23±0.94 to 1.26±0.51 at the final follow-up ($p<0.001$). Per the modified Macnab criteria, 90% of the patients improved to good/excellent. The fusion rate at one-year follow-up was 94.5% pelvic tilting was improve from preoperative 19.68±8.57 to 17.90±9.17 postoperatively ($p=0.043$) , a dura tear occurred as a complication in one case and a cage subsidence with cage pulled out occurred as a complication in one case.

Conclusion: BELIF using a 3D printed double cage can be safely performed with decreased risk of subsidence. A cage with a larger footprint is assumed to be advantageous in

Abstracts

Free Paper

PASMISS 2025

The 25th Pacific and Asian Society of Minimally Invasive Spine Surgery

Free Paper 1

OP-001

Targeting TSP-1/TGF-β1 Signaling and Oxidative Stress in Ligamentum Flavum Hypertrophy: A Potential Therapeutic Strategy

Yu-Chia Hsu, Ruei-jyun Yang, Ting-Yuan Tu, Yan-Jye Shyong, Cheng-Hsiang Kuo, Yuan-Fu Liu, Shu-Shien Shih, Chao-Jui Chang, Cheng-Li Lin

Department of Orthopedic Surgery, National Cheng Kung University Hospital, Taiwan

Purpose: Ligamentum flavum hypertrophy (LFH) is a major contributor to degenerative lumbar spinal stenosis, primarily driven by excessive fibrosis mediated through TGF-β1 signaling. However, the upstream mechanisms responsible for TGF-β1 activation remain unclear. Hypoxia has been proposed as a potential trigger of fibrosis, ultimately contributing to LFH. Thrombospondin-1 (TSP-1), a known activator of latent TGF-β1 and a molecule responsive to hypoxic conditions, has not been thoroughly explored in LFH. This study aimed to investigate the role of TSP-1 in the hypoxia–TGF-β1–fibrosis axis in LFH.

Methods: Health and hypertrophic LF tissues were examined for TSP-1 and TGF-β1 expression using immunohistochemistry and western blotting. In vitro, primary LF cells were cultured under hypoxia-mimicking conditions using FG-4592 with evaluation of hypoxia-related effect on TSP-1 and oxidative stress expression. The effects of TSP-1 activation and inhibition (via LSKL peptide or antioxidant N-acetylcysteine [NAC]) on TGF-β1 signaling and fibrosis markers were also evaluated.

Results: Hypertrophic LF tissues exhibited significantly elevated TSP-1 and TGF-β1 levels. In vitro, hypoxic stimulation increased TSP-1 expression and oxidative stress in LF cells. Besides, TSP-1 activation enhanced TGF-β1 signaling and fibrotic gene expression. Conversely, both LSKL and NAC treatment suppressed these effects.

Conclusion: Hypoxia upregulated TSP-1, which subsequently activated latent TGF-β1 and promoted fibrosis in LFH. Targeting the TSP-1/TGF-β1 pathway and oxidative stress might represent a novel and effective therapeutic strategy for the treatment of LFH.

Free Paper 1

OP-002

Thrombospondin-1 Plays a Role in Intervertebral Disc Aging and Degeneration

Yuan-Fu Liu, Cheng-Li Lin

Department of orthopedic, National Cheng Kung University Hospital , Tainan, Taiwan.

Purpose: Intervertebral disc degenerative disease (IVDD) is a leading cause of chronic back pain and disability, with aging recognized as a critical pathogenic factor. Thrombospondin-1 (TSP1), a multifunctional matricellular protein, has been implicated in various degenerative diseases; however, its specific role in IVDD remains unclear. This study aims to elucidate the role of TSP1 in intervertebral disc aging and degeneration, focusing on three key pathways: oxidative stress, fibrosis, and inflammation. The ultimate goal is to provide new insights for potential therapeutic strategies targeting TSP1.

Methods: Nucleus pulposus (NP) tissues were collected from surgical patients and categorized into young (<30 years) and aged (>60 years) groups. Immunohistochemistry and protein assays were used to analyze TSP1 expression. An NP cell aging model was established through serial passaging, simulating the aging process. The effects of TSP1 on oxidative stress, fibrosis, and inflammation were examined in vitro.

Results: Elevated TSP1 expression was observed in aged NP tissues, along with increased levels of oxidative stress markers (e.g., Nox1), fibrosis markers (e.g., TGF-β, collagen I), and inflammatory cytokines (e.g., TNF-α, IL-1). Treatment with TSP1 antibodies significantly reduced these aging-related markers in vitro.

Conclusions and Significance: This study demonstrates the pivotal role of TSP1 in intervertebral disc aging and degeneration and elucidates its molecular mechanisms in oxidative stress, fibrosis, and inflammation. These findings provide new directions for IVDD research and establish a foundation for future TSP1-targeted therapeutic strategies.

Free Paper 1

OP-003

Development of a new treatment for osteoporotic vertebral fractures using adipose-derived stem cell spheroids

Yuta Sawada, Shinji Takahashi, Kumi Orita, Akito Yabu, Masayoshi Iwamae, Yuki Okamura, Yuto Kobayashi, Hiroshi Taniwaki, Hiroaki Nakamura, Hidetomi Terai

Department of Orthopedics, Osaka Metropolitan University Graduate School of Medicine

Purpose: Osteoporotic vertebral fractures (OVF) contribute to disability and often require surgical intervention. However, complications such as implant failure, recurrent fractures, and nonunion remain challenges. Adipose-derived stem cells (ADSCs) are promising for regenerative therapy because they are easily obtained and highly proliferative even in elderly population with osteoporosis. ADSC spheroidization has been reported to enhance repair ability. Furthermore, osteogenic differentiation may optimize bone repair. This study aimed to evaluate the combined effects of osteogenic ADSC spheroids and β-tricalcium phosphate (β-TCP) on vertebral bone regeneration in a rat OVF model.

Methods: Osteoporosis was induced in 33 rats (11 per group) by ovariectomy, and defects were created in the L4 and L5 vertebrae, thereby establishing the rat OVF model. GFP-labeled ADSCs were differentiated into osteoblasts, spheroidized, and mixed with β-TCP scaffolds. Groups included osteogenic spheroids, undifferentiated spheroids, and β-TCP alone. Bone regeneration was assessed using micro-computed tomography, histology, and biomechanical testing at 4 and 8 weeks after implantation. Furthermore, apoptosis assays and quantitative real-time reverse-transcription PCR (qRT-PCR) analysis were conducted in vitro.

Results: The osteogenic spheroid group showed significantly higher bone mass, fusion score than the other groups at both time points. Histological analysis revealed enhanced new bone formation and β-TCP integration. In the compression test, the breaking strength of the osteogenic spheroid group was significantly higher than that of the control group. Gene expression analysis revealed upregulation of osteogenic markers (ALP, OCN, and Runx2) and regenerative factors (BMP-7, IGF-1, HGF-1, and Oct4). Additionally, Apoptosis assay confirmed the decrease in apoptosis. Furthermore, GFP staining verified ADSC survival at the repair site. These results indicate that osteogenic ADSC spheroids contribute to bone regeneration through two key mechanisms: (1) direct differentiation of osteogenic ADSC spheroids and (2) paracrine effects of bone formation mediated by growth factor secretion.

Conclusion: Combining osteogenic ADSC spheroids with β-TCP scaffolds effectively promotes vertebral bone regeneration in OVF. Moreover, a simple and effective method for preparing bone differentiation spheroids was established. This approach is a promising strategy for improving osteoporotic fracture repair with potential clinical applications.

Free Paper 1

OP-004

Nucleus pulposus-derived mesenchymal stem cells combining with Pure Platelet-rich plasma applying in Intervertebral disc degeneration treatment

Jie Huang, Chenjun Liu, Haiying Liu

Peking University People's Hospital

Background: Nucleus pulposus-derived mesenchymal stem cells (NPMSCs) possess self-renewal capabilities, a high expansion potential, and the ability to adapt to the intervertebral disc (IVD) microenvironment. Consequently, these cells exhibit a superior regenerative capacity, making them promising for the treatment of intervertebral disc degeneration (IDD). Platelet-rich plasma (PRP) is a promising strategy for IDD due to its multi growth factors. This study is aimed at investigating the effect of injection with P-PRP combined with NPMSCs for the treatment of IDD in rats.

Methods: NPMSCs isolated from rat nucleus pulposus tissues were treated with PRP in vitro, followed by examination for cell proliferation and expression of stem cell markers, proinflammatory cytokines (TNF-α, IL-1β), production of extracellular matrix-related protein. In vitro, the biocompatibility, microstructure, and induced differentiation effect on NPMSCs of the P-PRP were studied. In vivo, the regenerative effect of P-PRP combined with NPMSCs on degenerated nucleus pulposus in a rat model was evaluated.

Results: The results showed that NPMSCs was biocompatible and able to induce differentiation under stimulation by P-PRP in vivo. The disc height index of the composition of P-PRP and NPMSCs group was significantly higher than those of other groups at 8 weeks after injection. Histological staining, immunohistochemical, and immunofluorescence showed that the P-PRP combined with NPMSCs also partly restored the structure and ECM content of degenerated nucleus pulposus after 8 weeks. Moreover, the P-PRP could support long-term NPMSCs survival and decrease cell apoptosis rate of the rat IVD.

Conclusion: In contrast to L-PRP, P-PRP can prevent the inflammatory and catabolic responses from being activated. Thus, in the rat model, the injection of P-PRP and the transplantation of NPMSCs may postpone the onset of IDD and encourage the regeneration of the degenerative IVD.

Keywords: Intervertebral disc degeneration; Mesenchymal stem cell; Nucleus pulposus-derived stem cells; Platelet-rich plasma; Cell transplantation.

Free Paper 2

OP-005

AI-based analysis highlights the critical role of erector spinae muscle health in predicting outcomes after lumbar spinal fusion

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Purpose: This study aimed to investigate the relationship between preoperative muscle health and postoperative outcomes in patients undergoing lumbar spinal fusion.

Methods: A retrospective analysis was conducted on 135 patients (mean age: 68.12±8.49 years; 51 males [37.8%] and 84 females [62.2%]) who underwent lumbar spinal fusion. The mean number of fusion levels was 1.82±1.01. Preoperative erector spinae and psoas muscle volumes were measured using AI-based volumetric segmentation of body composition on CT images. Metrics included total volume, BMI-adjusted volume, and muscle quality (mean Hounsfield Units). Postoperative outcomes assessed at six months included back and leg pain Visual Analog Scale(VAS), Oswestry Disability Index (ODI), and EuroQol-5 Dimension (EQ5D). Univariate and multivariate linear regression analyses were performed, adjusting for age, sex, BMI, preoperative ASA score, operative duration, estimated blood loss, alcohol use, smoking status, number of fusion levels, and DEXA T-score.

Results: Univariate analysis revealed significant associations between total erector volume and reduced postoperative back pain VAS (β=−4.62×10−6, p<0.001), leg pain VAS (β=−4.27×10−6, p<0.001), ODI (β=−4.61×10−5, p<0.001), and improved EQ5D (β=4.36×10−7, p<0.001). BMI adjusted erector volume showed similar associations with back pain VAS (β=−1.01×10−4, p<0.001) and ODI (β=−9.20×10−4, p=0.027). Total psoas volume was associated with reduced back pain VAS (β=−6.28×10−6, p<0.001) and ODI (β=−5.84×10−5, p<0.001).

Multivariate analysis confirmed that total and BMI-adjusted erector volumes remained significant predictors of reduced back pain VAS (β=−8.30×10−5, p=0.033, R2=0.192), lower ODI (β=−9.20×10−4, p=0.027, R2=0.208), and improved EQ5D (β=8.70×10−6, p=0.032, R2=0.217. Psoas metrics were not significant in multivariate models.

Conclusion: Higher preoperative erector spinae muscle volume and BMI-adjusted volume are associated with better postoperative outcomes, including reduced back pain, lower disability, and improved quality of life. These findings highlight the critical role of erector spinae muscle health in predicting lumbar spinal fusion outcomes.

Free Paper 2

OP-006

Feasibility of Lumbopelvic Muscles Volume for Estimating Total Muscle Volume on Computed Tomography : AI-Based Automatic Image Analysis

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Background: Bone mineral density measurements for osteoporosis are typically performed in central body regions, such as the lumbar spine and hip. For sarcopenia diagnosis, skeletal muscle mass is often assessed in the thigh. This study aimed to evaluate the validity of skeletal muscle volume in various anatomical regions, including the abdomen, thorax, abdomen and pelvis, thigh, and torso, as representative indicators of total skeletal muscle mass.

Methods: A cloud-based artificial intelligence tool (Recomia.org) was used to segment skeletal muscle from whole-torso CT scans of 100 cases performed between 2016 and 2024 for various clinical indications. Linear regression analysis was utilized to assess the correlation between the skeletal muscle volume of specific anatomical regions and the total torso muscle volume.

Results: The mean age of cases was 58.5 years, with 72 male and 28 female cases. Skeletal muscle volume in the abdomen and pelvis region, defined as the area extending from the bottom of the hip bone to the bottom of the heart, exhibited the highest correlation with total skeletal muscle volume(R^2 = 0.934), outperforming other regions such as the thigh(R^2 = 0.750), torso(R^2 = 0.880), thorax(R^2 = 0.887), and abdomen(R^2 = 0.927), respectively($P < 0.01$). Akaike Information Criterion(abdomen and pelvis=1327, thigh=1754, torso=1396, thorax=1390, abdomen=1347) and Root Mean Squared Error(abdomen and pelvis=905, thigh=1468, torso=1217, thorax=1178, abdomen=947) showed the same order of correlation as R-squared (R2). A scatterplot of each measure against total trunk muscle volume in a Bland-Altman plot showed identical results.

Conclusions: This study demonstrates that skeletal muscle volumes in the abdomen and pelvis region can be reliably segmented using automated image analysis tools for diagnosis of sarcopenia. Clinically, evaluating the lumbopelvic muscles volume provides a meaningful and representative measure of total skeletal muscle mass. These findings suggest that the lumbopelvic muscle assessment is a valuable tool for understanding spinal and pelvic balance in the diagnosis and management of sarcopenia.

Keywords: Sarcopenia, Body Composition, Image Analysis, Artificial Intelligence

Free Paper 2

OP-007

Risk prediction of osteoporotic vertebral compression fractures in postmenopausal osteoporotic women by machine learning modeling

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Purpose: Osteoporosis in postmenopausal women is characterized by significant bone mass loss due to reduced oestrogen, leading to an increased risk of osteoporotic vertebral compression fractures (OVCF). Comprehensive risk prediction models for diagnosing and predicting fracture risk in this population are still lacking. This study aims to identify key risk factors for OVCF in postmenopausal osteoporotic women and develop a machine learning model to predict OVCF risk by integrating clinical, biological, and musculoskeletal data.

Methods: This retrospective case-control study included 486 postmenopausal women diagnosed with osteoporosis between 2015 and 2018. The patients were divided into a non-fracture group (Group A) and a vertebral fracture group (Group B) based on whether they developed OVCF during the subsequent 5 years of treatment and follow-up. Univariate and multivariate logistic regression analyses were performed to identify independent risk factors for OVCF. Furthermore, a comprehensive risk prediction model was constructed using multiple machine learning algorithms.

Results: Among the 486 postmenopausal women, 269 (55.35%) experienced OVCF. Low bone mineral density (BMD), chronic inflammation, and sarcopenia were identified as independent risk factors, while regular anti-osteoporotic treatment was associated with a reduced fracture incidence. The Balanced Bagging machine learning model demonstrated an accuracy of 98.98%, a sensitivity of 98.24%, a specificity of 100.00%, and the model's F1 score was 0.99.

Conclusion: The development of OVCF in postmenopausal osteoporotic women is influenced by a combination of bone metabolism, inflammatory processes, and muscle health. The machine learning model developed in this study provides a reliable and accurate tool for personalized OVCF risk prediction, allowing clinicians to optimize prevention and treatment strategies. Future large-scale prospective studies are required to validate these findings and enhance the model's predictive capabilities.

Free Paper 2

OP-008

Automated Measurement of Pelvic Parameters Using Convolutional Neural Network in Complex Spinal Deformities: Overcoming Challenges in Coronal Deformity Cases

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Purpose: Accurate measurement of sagittal spinal alignment is essential in patients with spinal deformities, especially in cases with severe coronal deformities such as degenerative lumbar scoliosis (DLS). Manual measurements often lack consistency due to complex anatomical variations. This study aimed to develop and validate an artificial intelligence (AI)-based system for the automated measurement of key sagittal parameters—lumbar lordosis (LL), pelvic incidence (PI), pelvic tilt (PT), and sacral slope (SS)—with robust performance in severe deformity cases.

Methods: This retrospective study included 1,011 standing lumbar lateral radiographs from a single institution, encompassing various spinal deformities including DLS. A deep-learning pipeline was developed using U-Net for segmentation and Keypoint R-CNN for anatomical landmark detection. The model was trained and evaluated using expert-annotated ground truth data. Validation was performed on 113 radiographs, including subgroup analysis for patients with Cobb angles ≤10° and >10°. Performance was assessed using intraclass correlation coefficients (ICC), interclass CC, mean errors, and Bland–Altman plots. A 5-fold cross-validation was also conducted to confirm robustness.

Results: The AI model achieved perfect consistency with an ICC of 1.00 across all parameters. Interclass CCs comparing AI to ground truth ranged from 0.96 to 0.99, outperforming human raters. Mean errors were minimal (e.g., PI: 0.23°, LL: 0.05°), with RMSE values within clinically acceptable ranges. Subgroup analysis confirmed robust performance even in the >10° Cobb group. Bland–Altman analysis demonstrated no significant systemic bias. The model classified PI-LL categories with >92% accuracy and completed measurements significantly faster than human raters (35 seconds vs. 40.2 minutes). 5-fold cross-validation confirmed consistent performance with interclass CCs ranging from 0.96 to 0.99.

Conclusion: The AI system provides accurate, efficient, and consistent measurement of sagittal pelvic parameters, even in patients with complex spinal deformities. Its performance exceeds that of experienced orthopedic surgeons in some metrics, supporting its potential for clinical application in preoperative planning and radiographic assessment of spinal deformities.

Free Paper 3

OP-009

Hybrid Endoscopic thoracic discectomy using robotic arm and navigation for high migrated calcified disc herniation

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This video provides a step-by-step guide for performing the hybrid endoscopic thoracic dis¬cectomy using navigation and robotic arm for addressing high migrated calcified disc her¬niation. With the development of techniques, endoscopic spine surgery has emerged as a reliable treatment for thoracic myelopathy. This approach offers high-resolution, off-axis visualization of the surgical field. The field is poised to advance further as endoscopic instru-ments are refined, becoming less invasive and more precise through the integration of navi¬gation and robot-assisted systems. A 62-year-old woman presented to us with chief com¬plaints of both legs weakness. She had difficulty standing and walking after squatted due to weakness in her legs and her Oswestry Disability Index score was 66. On examination her both side knee extension and ankle dorsiflexion were grade 4 without dysesthesia. The im¬aging examination confirmed the diagnosis of thoracic myelopathy caused by a highly mi¬grated calcified disc herniation at T5–6 level. The patient underwent an endoscopic thoracic discectomy using robotic arm and navigation for addressing highly migrated calcified disc herniation, resulting in an excellent outcome. The continuous development of navigation and robotic systems in endoscopic thoracic surgery enhanced accuracy in surgical incisions and instrument placement, as well as improved efficiency in locating pathology and achiev¬ing precise decompression. Endoscopic thoracic discectomy combines full-endoscopy and unilateral biportal endoscopic (UBE) techniques to leverage the benefits of both approaches, including the cross-viewing of full-endoscopy cannula and the use of larger Kerrison ron¬geurs under UBE.

Keywords: Spinal surgery, Endoscopy, Herniated disk, Thoracic, Surgical navigation sys¬tems, Robotics

Free Paper 3

OP-010

Enhancing Precision in Oblique Lumbar Interbody Fusion: A Clinical Evaluation of O-arm Navigation-Assisted Techniques

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Objective: This study aims to outline the key techniques and operational details of Oblique Lumbar Interbody Fusion (OLIF) using three-dimensional navigation and to analyze complications associated with the procedure.

Methods: A retrospective analysis was conducted on OLIF procedures performed with O-arm navigation from 2017 to 2023. Clinical data, including demographics, comorbidities, diagnosis, operative details, and complications, were collected. Surgical outcomes were assessed through Visual Analog Scale (VAS) and Numeric Rating Scale (NRS) scores, along with cage subsidence measurements.

Results: A total of 59 patients (18 males, 41 females) were included, with an average age of 62.54 years. Diagnoses included lumbar spinal stenosis (57.63%), discogenic low back pain (30.51%), degenerative lumbar spondylolisthesis (8.47%), and scoliosis (3.39%). Surgical procedures involved one-level (45.76%), two-level (50.85%), and three-level (3.39%) fusions. Three intraoperative navigation-related complications occurred. At the final follow-up, the fusion rate was 80.65%. Subsidence occurred in 48.39% of segments, with Grade I subsidence considered part of the stabilization process. VAS and NRS scores improved postoperatively in both subsidence and non-subsidence groups, though the difference between the groups was not significant.

Conclusion: OLIF with O-arm navigation is a safe and effective approach for treating adult spinal deformities, improving surgical precision and reducing complication risks.

Keywords: Oblique lumbar interbody fusion, Surgical navigation, Surgical robots, Surgical techniques, Clinical efficacy, Surgical complications

Free Paper 3

OP-011

Safer Robotic Spine Surgery and Its Cost : A Retrospective Study of 1,200 Cases

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Purpose: Robotic-assisted surgery can be used in minimally invasive spine surgeries and for complex spine procedures. This study aims to evaluate the safety, efficacy, and cost of robotic spine surgery.

Methods: A total of 1,200 spine surgeries performed using the Mazor Renaissance robotic system at Kaohsiung Medical University Hospital from 2013 were reviewed. Procedures were conducted by both orthopedic and neurosurgeons. Data included surgical approach, patient demographics, screw placement accuracy, and complications.

Results: Of the 1,200 cases, 768 were minimally invasive surgeries (MIS) and 432 were open surgeries. Patient ages ranged from 10 to 89 years, with 395 men and 815 women. The screw placement accuracy was 98.3%. No major neurologic or vascular complications were associated with robotic use.

Conclusion: The small robot is durable and reliable. The benefits is significant outweigh their costs.

Free Paper 3

OP-012

Educational Utility and Screw Insertion Accuracy of Robotic-Assisted Spine Surgery Among Young Residents

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Background: Robotic-assisted spine surgery is an innovative approach increasingly applied to conditions such as adolescent idiopathic scoliosis and lumbar degenerative disease. Although its accuracy in pedicle screw insertion is well reported, its educational benefit for junior surgeons remains unclear. This study aimed to evaluate both the insertion accuracy of pedicle screws and the educational suitability of robotic-assisted surgery among junior orthopedic residents using a validated usability assessment.

Methods: Three junior residents (PGY3 and PGY4; two males, one female) with no prior experience in pedicle screw insertion participated in this study. Under supervision, they inserted a total of 28 screws using a robotic system (Cirq®, Brainlab). Postoperative CT scans obtained one week after surgery were evaluated using the Gertzbein & Robbins classification. To evaluate whether the proposed system is suitable for use in education, a System Usability Scale (SUS)—a ten-item questionnaire assessing effectiveness, efficiency, and satisfaction—was administered following the procedures.

Results: Among a total of 906 pedicle screws inserted with robotic assistance at our institution, 28 were placed by the junior residents. The overall screw placement accuracy for Grade A and B was 96%, with 87.0% achieving Grade A (completely within the pedicle). All residents reported increased interest in spine surgery following early exposure to screw insertion. They also reported that the tactile experience during robotic-guided insertion enhanced their understanding of safe pedicle screw trajectory and could be applied to conventional fluoroscopic techniques. The female resident noted reduced radiation exposure and physical workload compared to traditional methods. SUS scores averaged 67.9 among residents and 72.5 among attendings, suggesting the system is generally user-friendly, though confidence levels differed.

Conclusion: Robotic-assisted spine surgery enables junior residents to safely and accurately insert pedicle screws, even with minimal prior experience. The SUS evaluation confirmed that the system demonstrates educational usability, supporting its integration into surgical training programs. Robotic assistance provides an effective platform for early on-the-job training, promoting safety, inclusivity, and skill acquisition—particularly beneficial for female trainees in the spine surgery field.

Free Paper 4

OP-013

Evaluation of Deep Learning for Scoliosis Pre-Screening Using Preprocessed Chest X-ray Images

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Introduction: Scoliosis is a three-dimensional deformation of the spine that is a deformity induced by physical or disease related causes as the spine is rotated abnormally. Early detection has a significant influence on the possibility of nonsurgical treatment.

Material and Methods: To train a deep learning model with preprocessed images and to evaluate the results with and without data augmentation to enable the diagnosis of scoliosis based only on a chest X-ray image. The preprocessed images in which only the spine, rib contours, and some hard tissues were left from the original chest image, were used for learning along with the original images, and three CNN(Convolutional Neural Networks) models (VGG16, ResNet152, and EfficientNet) were selected to proceed with training.

Results: The results obtained by training with the preprocessed images showed a superior accuracy to those obtained by training with the original image. When the scoliosis image was added through data augmentation, the accuracy was further improved, ultimately achieving a classification accuracy of 93.56% with the ResNet152 model using test data.

Conclusion: Through supplementation with future research, the method proposed herein is expected to allow the early diagnosis of scoliosis as well as cost reduction by reducing the burden of additional radiographic imaging for disease detection.

Key Words: Scoliosis, Chest X-ray, Deep learning model, Preprocessed image, Data augmentation

Free Paper 4

OP-014

Deep learning from X ray to evaluate MRI disc problem

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Purpose: This study proposes an automated disc abnormality detection model for lumbar spine X-ray images using deep learning technology, which can shorten the waiting time for patients and for MRI examination evaluation.

Methods: The segmented image is divided into three overlapping regions, L1~L3, L2~L4 and L3~L5, which are used as inputs to the detection network. These modules work synergistically to enhance the model's ability to extract features of disc degeneration diseases.

Results: The experimental results show that the EADC-Net model achieved scores of 0.8041 for accuracy, 0.8522 for precision, 0.7379 for recall, and 0.7502 for F1_score. These evaluation results surpass previous related studies.

Conclusion: The EADC-Net model demonstrates the ability to detect degenerative disc disease on lumbar spine X-ray images,

Free Paper 4

OP-015

Deep Learning MRI Analysis for Differentiating Malignant from Benign Vertebral Compression Fractures: A Retrospective Multicenter Study

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Purpose: This study is to apply and evaluate the performance of various object detection algorithms in detecting benign vertebral compression fractures and malignant tumors on lumbar spine magnetic resonance imaging (MRI). By improving the early detection of pathological fractures caused by metastatic cancer, this study aims to enhance diagnostic efficiency for medical professionals and contribute to better treatment planning.

Methods: Patients diagnosed with vertebral compression fractures or spinal metastases based on MRI results from the six affiliated hospitals of the institution from March 2013 to February 2023 were included in the study. The MRI scans included sagittal views of the lumbar spine, with T1- and T2-weighted images. Vertebral bodies with compression fractures or malignant metastasis were annotated according to the reports of radiologists. The dataset was divided into training, validation, and test sets in a 7:2:1 ratio. The object detection models used were YOLOv8, YOLOv11, and DETR. To mitigate differences in MRI resolution across the different exams, the HAT SRx2 model was applied to standardize resolution.

Results: Among the included total of 2,165 patients, 1,742 had benign fractures, and 423 had malignant metastasis. A total of 15,975 MRI images were included, containing 19,058 vertebral bodies with fractures and 8,485 vertebral bodies with malignant tumors. The best-performing model was YOLOv11, which achieved a precision of 91.2, a recall of 92.7, an F1-score of 91.9, and a mean average precision (mAP) of 95.9.

Conclusions: Deep learning algorithms show excellent performance in automatic differential diagnosis between vertebral malignant metastasis and benign compression fracture in MRI, which can help with screening diagnosis.

*** Keywords:** Object detection, Vertebral compression fracture, Malignant metastasis, Deep learning

Free Paper 4

OP-016

Automated detection of vertebral fractures from X-ray images : A novel machine learning model and survey of the field

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Purpose: Compression and burst fractures are the most common types of vertebral fractures. Burst fractures, often resulting from high-energy trauma such as falls and traffic accidents, are typically unstable and accompanied by neurological symptoms and spinal instability. Accurate diagnosis using computed tomography (CT) or magnetic resonance imaging (MRI) is essential, and immediate surgery may be required. However, CT and MRI screenings are costly and time-consuming, and timely diagnosis may be challenging for resident or emergency room physicians who may struggle to identify thoracolumbar fractures or differentiate between burst and compression fractures using X-ray images. These challenges can worsen patient prognosis. Therefore, artificial intelligence (AI) methods for diagnosing burst fractures are needed. Existing deep learning methods for vertebral fracture detection are limited to processing either X-ray, CT, or MRI data. Machine learning methods for differentiating between burst and compression fractures in the thoracolumbar region based on X-ray images are lacking. To address these issues, we developed a machine learning model that can detect compression and burst fractures and differentiate between the two using X-ray images, a first in the literature, and tested our model on CT and MRI data.

Methods: Our method detects fractures and distinguishes between compression and burst fractures using X-ray images. We applied our method to lateral X-ray images of the thoracolumbar region. X-ray images are preprocessed, YOLO version 4 (YOLOv4) is used for preliminary segmentation, and ResUNet is used for actual segmentation. The random forest approach is then used to determine whether the image shows no fracture, a burst fracture, or a compression fracture.

Results: Our model achieved precision scores of 99%, 74%, and 94% for identifying no fractures, compression fractures, and burst fractures, respectively. For determining the presence or absence of a fracture, our model had an accuracy, precision, recall, and F1-score of 92.0%, 93.2%, 95.7%, and 94.4%, respectively.

Conclusion: It demonstrates the clinical utility of our model, and indicates that the quality and quantity of training data are key to model performance. Thus, multivariate data or large datasets can be used to improve our model.

Free Paper 5

OP-017

Application of Uni-portal Non-coaxial Spinal Endoscopic Surgery (UNS) in Lumbar Interbody Fusion

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Objective: To evaluate the efficacy of uni-portal non-coaxial spinal endoscopic surgery (UNS) in single-level lumbar interbody fusion.

Methods: This retrospective study reviewed 81 single-level lumbar fusion cases (2022–2024), comparing unilateral decompression (Group A, n=34) and full canal decompression (ULBD, Group B, n=47). All patients presented with back pain (76 had lower limb symptoms) and met imaging criteria. The UNS technique was uniformly applied. Data included surgical duration, blood loss, complications, hospital stay, and serial VAS/ODI assessments (preoperative to 12-month follow-up).

Results: Surgical time: Group A (89.2 ± 7.3 min) vs. Group B (106.3 ± 5.6 min). Complications: No nerve root injury or dural sac rupture occurred. Outcomes:VAS/ODI/SF-36: All improved postoperatively ($p < 0.05$). VAS: No difference between immediate postop and 1/3/6/12 months ($p > 0.05$). ODI/SF-36: Immediate postop differed from 1/3/6/12 months ($p < 0.05$), but no differences between 1/3/6 months ($p > 0.05$). Blood loss: Group A lost 20.8 ± 3.4 mL less than Group B. Hospital stay: Group A (4.1 ± 1.3 days) vs. Group B (4.5 ± 1.1 days), no significant difference.

Conclusion: The UNS technique for single-level lumbar interbody fusion offers advantages such as a larger operative space, extensive decompression, and minimal tissue disruption, making it worthy of clinical promotion. Particularly in cases of bilateral nerve root compression, it allows for a broader visualization of the contralateral nerve root up to the exit zone and targeted decompression. Additionally, all screws can be placed under endoscopic guidance, reducing the need for fluoroscopy.

Keywords: Uni-portal non-coaxial spinal endoscopic surgery (UNS); Lumbar interbody fusion; Spinal disorders; Minimally invasive

Free Paper 5

OP-018

Clinical and Radiologic Outcomes of Biportal Endoscopic Lumbar Interbody Fusion Using a Single Expandable Cage : A Single-Center Study with Minimum 1-Year Follow-up

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Purpose: This study aimed to evaluate the radiologic and clinical outcomes of biportal endoscopic transforaminal lumbar interbody fusion (BE-TLIF) using a single expandable cage. We hypothesized that even with a single cage construct, solid fusion, alignment restoration, and clinical improvements could be achieved, supporting the biomechanical and clinical validity of this technique.

Methods: We retrospectively reviewed 29 patients (38 operated levels) who underwent single level or multi-level BE-TLIF using a single expandable cage between June 2023 and April 2024. All patients were followed for at least 12 months postoperatively. Radiologic assessments included anterior and posterior disc height, segmental and lumbar lordosis, disc wedge angle, pelvic tilt (PT), and pelvic incidence–lumbar lordosis mismatch (PI–LL). Clinical outcomes were evaluated using the VAS for back and leg pain, ODI, SF-36 (physical and mental components), and EQ-5D. Fusion status was assessed using dynamic radiographs and CT at 6 and 12 months. Statistical analyses were performed using parametric or non-parametric methods based on normality testing.

Results: Radiologic alignment significantly improved postoperatively: anterior disc height increased by 3.97 ± 2.66 mm, posterior disc height by 4.22 ± 1.45 mm, segmental lordosis by 3.13 ± 1.19° (all $p < 0.001$). Lumbar lordosis increased by a median of 5.0°, and PI–LL mismatch improved by –5.0° (both $p < 0.001$). Solid fusion was confirmed in 92.1% at 12 months. All clinical parameters showed significant improvement: VAS scores for back and leg pain decreased by 3.74 and 5.25 points, respectively ($p < 0.001$); ODI improved by 12.8 points; and both SF-36 and EQ-5D scores significantly increased (all $p < 0.001$). Subgroup analysis revealed that patients with preoperative PI–LL mismatch experienced the most significant improvements in alignment and clinical scores. In contrast, those with residual postoperative PI–LL mismatch demonstrated significantly worse physical function (SF-36 physical: 31.06 ± 6.83 vs. 35.75 ± 6.38, $p = 0.008$) and greater disability (ODI: 15.22 ± 6.60 vs. 10.53 ± 5.06, $p = 0.008$). Abnormal postoperative PT was also associated with higher VAS back scores ($p = 0.036$).

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Conclusion: BE-TLIF using a single expandable cage demonstrated high fusion rates, significant radiographic correction, and excellent clinical outcomes at 1-year follow-up. These results support the feasibility and effectiveness of a single-cage strategy in BE-LIF without compromising alignment or functional recovery.

Free Paper 5

OP-019

Radiological and Clinical Outcomes of PEEK cage Versus 3D-Printed Titanium cage in Biportal Lumbar Interbody Fusion : A Retrospective Comparative Study

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Purpose: This study aimed to compare the radiological and clinical outcomes of two different interbody cages—conventional PEEK cages and 3D-printed porous titanium angled cages—used in biportal endoscopic lumbar interbody fusion (BE-LIF).

Methods: A retrospective review was conducted on 182 patients who underwent single-level BE-LIF from January 2022 to August 2024 by a single surgeon using a standardized technique. Patients were divided into two groups based on the type of interbody cage used: PEEK (n = 131) and 3D-printed titanium (n = 51). All procedures were performed using a 30° endoscope with four-portal access, and local autobone harvested via chisel and osteotome was used as graft material. Clinical outcomes were assessed using the Visual Analog Scale (VAS) for back pain at 6 months and 1 year postoperatively. Radiological outcomes were evaluated using Bridwell fusion grades and subsidence rate on a spine CT at 1 year post-op.

Results: Back pain VAS scores at 6 months and 1 year were significantly lower in the 3D titanium group (2.6 and 1.7, respectively) compared to the PEEK group (3.6 and 2.2). Fusion rates (Bridwell grade I/II) were 76.5% (39/51) in the 3D titanium group versus 32.8% (43/131) in the PEEK group. Pseudoarthrosis (grade III/IV) was significantly more common in the PEEK group (88/131) than in the 3D titanium group (12/51). Subsidence occurred in 24.4% of the PEEK group and 11.8% of the 3D titanium group.

Conclusion: The use of 3D-printed porous titanium angled cages in BE-LIF was associated with superior clinical and radiological outcomes compared to conventional PEEK cages, including improved fusion rates, reduced postoperative back pain, and lower rates of cage subsidence. These findings suggest that cage material and design play a critical role in the success of minimally invasive lumbar fusion procedures.

Free Paper 5

OP-020

Uniportal Endoscopic Fusion versus Endoscope-Assisted Oblique Lateral Lumbar Interbody Fusion for Degenerative Spondylolisthesis: A Comparative Efficacy Study

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Purpose: To compare the clinical efficacy, radiographic outcomes, and complication profiles of uniportal endoscopic fusion and endoscope-assisted oblique lateral lumbar interbody fusion (OLIF) for degenerative lumbar spondylolisthesis, informing clinical decision-making.

Methods: Multicenter retrospective and prospective data from over 200 patients were analyzed. Participants were stratified into uniportal endoscopic fusion or OLIF groups. Outcomes assessed included operative time, intraoperative blood loss, postoperative hospital stay, visual analogue scale (VAS) scores for back/leg pain, Oswestry Disability Index (ODI), disc height restoration rate, fusion rate, and complications. Uniportal fusion employed posterior/transforaminal approaches for direct decompression and fusion. The OLIF group utilized a retroperitoneal corridor for large interbody cage placement and indirect spinal alignment correction.

Results: The uniportal group demonstrated reduced blood loss but longer operative times. Both groups exhibited significant improvements in VAS and ODI scores postoperatively ($P<0.05$). At 1-year follow-up, the OLIF group showed superior leg pain VAS improvement and greater disc height restoration. Fusion rates at 12 months were comparable between groups. Uniportal fusion carried a higher risk of dural tears, while OLIF was associated with potential vascular injury and transient psoas weakness.

Conclusion: Uniportal endoscopic fusion offers minimal invasiveness and rapid recovery, suitable for mild-to-moderate spondylolisthesis requiring direct neural decompression. OLIF provides superior biomechanical reconstruction and alignment correction, favoring complex cases with disc space collapse or coronal imbalance. Surgical selection should integrate spondylolisthesis severity, spinal alignment, and patient-specific factors.

Keywords: Uniportal endoscopic fusion; Oblique lateral interbody fusion (OLIF); Degenerative spondylolisthesis; Clinical outcomes; Radiographic assessment

Free Paper 6

OP-021

Surgical Correction of Degenerative Lumbar Scoliosis

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Purpose: Most patients with degenerative lumbar scoliosis (DLS) suffered from mild back pain, combined with claudication and/or root signs, which usually can be solved with decompression. However, some cases need surgical correction to regain the quality of life. Surgical correction of degenerative lumbar scoliosis is always challenging due to its various manifestations and unpredictable complications. Many advanced surgical techniques and treatment concepts evolved in the past 20 years such as trunk balance, correction philosophy, spinopelvic parameters. These improved surgical and clinical outcomes. However, there were still controversies about the fusion levels, scales of operation, time to intervene and the ideal curves restoration. We would like to present our experiences in this study.

Methods: Our indication of surgical correction of DLS confined to those who had intractable back pain and cannot sustain long sitting, long standing and walking with kyphotic postures. We divided into 4 groups according to trunk balance (coronal and sagittal). The definition of imbalance was larger than 5 cm. In every group, we maximize the lordosis correction. The fusion level was decided by thoracolumbar flexibility and Harringtons' rule. We spare the L5-S1 fusion.

Results: In this study, 32 patients (F:M= 24:8) of surgical correction of degenerative lumbar scoliosis were consecutively collected in this study. The average age was 65.5 yrs (from 52 to 80). As for the levels of fusion, it is very spread wide. (13 levels:2; 10 levels:2; 9 levels:6; 8 levels:6; 7 levels:2; 6 levels:2; 5 levels:7; 4 levels:5). Op time averaged 4 hours; Blood loss averaged 650 cc. Most cases had much improvement in clinical symptoms and satisfactory spinopelvic parameters. All can walk without walking aids. Only 2 patients still walk with kyphotic posture. Lumbar lordosis improved from PreOP : 130 (-200 ~300) to PostOp 280 (50 ~420). PI-LL mismatch is from 380 to 240 SVA was from 4.1 to 2 cm; Trunk tilt was from 2.7 to 1.2. Cages were important for the correction of lumbar lordosis and trunk balance.

Conclusion: Our strategy of correction simplified decision-making of treating DLS. Maximizing the lumbar lordosis esp. over L3 to L5 is crucial for the ideal correction of sagittal balance. Conventional surgeries are still the best way to reach satisfactory correction due to the complex anatomies originated from aging such as listhesis, hypertrophied facet joints, stiff disc et al. Surgical correction of DLS is of shared decision between the needs of patient (Customization) and surgeon's planning (Personalization).

Free Paper 6

OP-022

The changes of muscle character during treatment of adolescent idiopathic scoliosis

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Background: The treatment of adolescent idiopathic scoliosis (AIS) is exercise, brace, and operation depend on age and Cobb's angle. During the treatment, the muscle character can be change like more soft or spastic.

Objective: The purpose of this study was to evaluate the changes in the muscle elasticity during AIS treatment.

Methodology: This study was a prospective study. Seventy-six patients with AIS were recruited and thirty-four patients were dropped. Finally, fifteen patients in operation and brace groups and fourteen patients in exercise group were included. The elasticity was measured at thoracolumbar junction at initial, 6 months and 12 months on both convex and concave side by one radiologist.

Results: There was no difference in the elasticity between groups and each side, except the concave side at 6 months. The elasticity was lower in the operation group (13.1±6.8, p=0.014) compared with the brace (21.5±10.1) and exercise (29.0±12.9) groups. In the linear mixed model, only the convex side in the operation group at 6 months showed a significant change in the elasticity compared with the initial value (p=0.046) during 1 year.

Conclusion: After deformity correction and fusion for AIS, the muscle elasticity is recovered after postoperative 6 months. However, the brace or exercise did not affect to the muscle elasticity.

Free Paper 6

OP-023

Apical Vertebral Rotation Correction at the Lumbosacral Curve : A Key to Enhancing Coronal Alignment in Degenerative Lumbar Scoliosis

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Background: Degenerative lumbar scoliosis (DLS) affects quality of life in geriatric populations. Coronal correction of the lumbosacral fractional curve is key to improving alignment and outcomes. However, the association between apical vertebral rotation (AVR) correction at the lumbosacral curve and global coronal alignment in DLS patients is controversial. This study aimed to evaluate the correlation between the AVR correction at the lumbosacral fractional curve and overall coronal alignment in DLS patients.

Materials and Methods: We analyzed 44 consecutive DLS patients who underwent spinal fusion surgery. Coronal malalignment was assessed through coronal balance distance (CBD), thoracolumbar/lumbar curve apex directionality, spinopelvic parameters, thoracolumbar/lumbar and lumbosacral fractional Cobb angles, and L4/L5 tilt angles. The pre- and post-operative apical vertebral rotation (fAVR) at the lumbosacral fractional curve and its correlation with global coronal alignment were also evaluated.

Results: The fAVR showed a strong correlation with coronal alignment correction ($r = 0.6$, $p < 0.05$) and a moderate correlation with Cobb angle and L4/L5 tilt correction ($r = 0.51$, 0.417, and 0.403, respectively; $p < 0.05$). low pelvic incidence (PI) patients exhibited a strong correlation between ΔfAVR and coronal alignment correction, while high PI patients demonstrated a moderate correlation. Bao type C patients showed the highest correlation ($r = 0.87$), followed by type B ($r = 0.656$) and type A ($r = 0.506$) ($p < 0.05$).

Conclusion: This is the first study demonstrates that AVR correction at the lumbosacral curve is significantly correlated with global coronal alignment improvement in DLS patients, offering a valuable metric for optimizing surgical outcomes.

Keywords: coronal malalignment, degenerative lumbar scoliosis, apical vertebral rotation, lumbosacral fractional curve

Free Paper 6

OP-024

The Influence of Pelvic Sagittal Parameters on the L5/S1 Intervertebral Foramen Size

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Objective: This study aims to investigate the impact of pelvic sagittal parameters, including Pelvic Tilt (PT), Sacral Slope (SS), and Pelvic Incidence (PI), on the dimensions of the L5/S1 intervertebral foramen.

Methods: A retrospective analysis was conducted on the imaging data of 220 patients who underwent full-spine stitching radiography at Xinhua Hospital between August 2019 and July 2024. Basic demographic information was gathered. PT, SS, PI angles, L5/S1 foraminal height, L5/S1 foraminal width, and L5/S1 foraminal area were measured on lateral full-spine radiographs. The correlation between these pelvic parameters and the L5/S1 foraminal size was subsequently analyzed.

Results: The mean L5/S1 foraminal height was 15.87 mm, the mean width was 8.05 mm, and the mean area was 124.57 mm^2. Significant correlations were identified between PT and PI with foraminal height (p=0.0001 and p=0.003, respectively). SS showed a significant correlation with foraminal width (p=0.002). Body weight exhibited a negative correlation with the L5/S1 foraminal area, while body height, PT, SS, and PI demonstrated positive correlations. Notably, PI displayed the most significant correlation with the L5/S1 foraminal area (r=0.286, p=0.004).

Conclusion: This study reveals that pelvic sagittal parameters play a crucial role in determining L5/S1 intervertebral foramen size. PT, SS, and PI exhibit a significant positive correlation with the L5/S1 foraminal area.

Keywords: Pelvic Tilt; Sacral Slope; Pelvic Incidence; L5/S1 Foramen Size

Free Paper 7

OP-025

Clinical Spectrum, Efficacy, and Safety of Biportal Endoscopic Spine Surgery for Lumbar Disorders: A Retrospective Analysis

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Purpose: Biportal endoscopic spine surgery (BESS) is increasingly adopted for lumbar pathologies. This study evaluates its clinical spectrum, efficacy, and complications across diverse degenerative and complex lumbar conditions.

Methods: A retrospective analysis was conducted on 136 patients (72 male, 64 female; mean age 63.6 ± 14.5 years) undergoing BESS at 183 lumbar levels (L1-2: 2, L2-3: 18, L3-4: 45, L4-5: 88, L5-S1: 30) from June 2023 to January 2025. Diagnoses included spinal stenosis (135 cases), disc herniation (54 cases, including 9 extraforaminal), epidural cyst-induced radiculopathy (6 cases), spondylolisthesis (4 cases: 2 degenerative, 2 isthmic), degenerative scoliosis (4 cases), cauda equina syndrome (8 cases), and adjacent segment disease (6 cases). Outcomes were assessed using the Visual Analog Scale (VAS, 0–10) for pain and Oswestry Disability Index (ODI, 0–100) preoperatively and at 3-month follow-up, with comparisons performed using paired t-tests. Complications and reoperations were recorded.

Results: BESS yielded significant improvements in pain and function. Mean VAS scores decreased from 8.2 ± 1.6 preoperatively to 2.3 ± 1.1 at 3 months (p=0.002), and ODI scores improved from 56.7 ± 10.8 to 18.5 ± 7.6 (p=0.001). Intraoperative complications included four dural tears (2.2%), with two managed via conversion to microscopic repair using TachoSil and Tisseel, and two addressed endoscopically. No postoperative cerebrospinal fluid leaks occurred. Four patients (2.9%) required reoperation: three at the index level (hematoma evacuation, residual disc fragment, recurrent herniation) and one for wrong-level surgery due to refusal of preoperative MRI re-evaluation. Three patients experienced transient postoperative radicular pain, with one requiring hematoma evacuation and drain repositioning, and two resolving with bedside drain adjustment.

Conclusion: BESS provided significant pain relief and functional improvement across spinal stenosis, disc herniation, cauda equina syndrome, and cyst-induced radiculopathy, with efficacy in complex cases (spondylolisthesis, degenerative scoliosis, adjacent segment disease) without fusion. These findings position BESS as a versatile, minimally invasive option for diverse lumbar pathologies, including revision scenarios. Further comparative studies are warranted to validate its efficacy in deformity-associated cases against traditional approaches.

Free Paper 7

OP-026

Clinical efficacy of UBD-TLIF versus transforaminal lumbar interbody fusion in the treatment of grade 1 lumbar spondylolisthesis

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Background: Lumbar spondylolisthesis is a common condition, and transforaminal lumbar interbody fusion (TLIF) is a surgical technique used to treat spondylolisthesis. Over the past few decades, surgical approaches for spondylolisthesis treatment have evolved from open decompression alone to minimally invasive (MI) procedures. Our uni-portal bi-channel & dual-media spinal endoscopy (UBD) system, first reported in 2021, has been successfully employed for treating various spinal disorders. In this study, we aimed to compare the clinical efficacy of UBD and TLIF for single-level lumbar spondylolisthesis.

Methods: We analyzed data from 46 patients with grade 1 lumbar spondylolisthesis who underwent UBD or TLIF in our hospital. Collected clinical data included the Oswestry Disability Index (ODI) and numeric rating scale (NRS) scores for leg pain (NRS-LP) and back pain (NRS-BP). We also assessed clinical and radiological findings.

Results: Forty-six patients with grade 1 lumbar spondylolisthesis underwent UBD or TLIF. Preoperatively, the mean ODI was 42.3 ± 6.8, with mean NRS-LP of 7.6 ± 1.2 and NRS-BP of 6.4 ± 1.5. At final follow-up (average 14.2 months), ODI improved to 21.5 ± 5.9 ($p < 0.001$), NRS-LP to 2.1 ± 1.0, and NRS-BP to 1.8 ± 0.9 (both $p < 0.001$). No significant differences were observed between UBD and TLIF in clinical improvement ($p > 0.05$). Radiological assessment showed stable alignment and adequate decompression in both groups. Two UBD patients required revision surgery, and one TLIF patient developed adjacent segment degeneration.Overall, both UBD and TLIF provided significant functional improvement in patients with grade 1 lumbar spondylolisthesis.

Conclusion: The original design of the UBD appears to be a more effective and feasible technique for treating grade 1 lumbar spondylolisthesis compared to the traditional TLIF procedure.

Keywords: Grade 1 lumbar spondylolisthesis, Uni-portal Bi-channel & Dual-media Spinal Endoscopy system, Interbody fusion, Clinical efficacy, minimally invasive spinal surgery.

Free Paper 7

OP-027

Full-Endoscopic Trans-Kambin Triangle Lumbar Interbody Fusion with Reverse Insertion of an Oblique Lateral Cage: A Case Series

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Background: Full-endoscopic lumbar interbody fusion (FE-LIF) offers a minimally invasive approach but typically utilizes smaller cages, which may compromise biomechanical stability. In contrast, the oblique lateral interbody fusion (OLIF) technique allows for the insertion of larger cages that provide superior structural support. To integrate the advantages of both, we employed a reverse insertion technique to place standard OLIF cages via a full-endoscopic trans-Kambin triangle approach. This case series presents our initial clinical experience.

Materials and Methods: From March 2024 to January 2025, five patients with single level lumbar spondylolisthesis or degenerative disc disease underwent uniportal, facet-preserving full-endoscopic trans-Kambin lumbar interbody fusion using reverse insertion of an OLIF cage. All patients received preoperative imaging to confirm anatomical suitability for the approach. Percutaneous pedicle screws and rods were placed first to achieve anterolisthesis reduction, followed by endoscopic disc preparation through the trans-Kambin triangle. After mobilizing and protecting the exiting nerve root, a 22x40x8-12 mm OLIF cage was inserted in reverse orientation under fluoroscopic guidance. Cage position and endplate integrity were confirmed intraoperatively.

Results: All five procedures were completed successfully without intraoperative complications, nerve injury, or dural tear. At final follow-up (mean 6.4 months), all patients demonstrated significant improvement in low back pain and radicular symptoms. Lower limb muscle strength returned to baseline in all cases, and all patients were ambulatory without assistive devices. Radiographic and CT follow-up confirmed proper cage placement, restoration of disc height and segmental lordosis, and preservation of the facet joints. Axial imaging demonstrated adequate decompression of the spinal canal, and importantly, no evidence of cage migration or subsidence was observed in any patient.

Conclusions: This case series highlights the technical feasibility and clinical safety of reverse OLIF cage insertion via a full-endoscopic trans-Kambin triangle approach. The method combines the minimal invasiveness of endoscopic fusion with the biomechanical benefits of extra-large interbody cages. Importantly, no cage subsidence was observed, supporting the structural soundness of this technique in the short- to mid-term.

Free Paper 7

OP-028

Two-Year Radiological Fusion Outcomes Following Biportal Endoscopic Transforaminal lumbar interbody fusion using kidney Bean-Shaped Interbody Cages

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Purpose: The use of biportal endoscopic spine surgery (BESS) has expanded rapidly, including its application in transforaminal lumbar interbody fusion (BESS-TLIF), which combines endoscopic cage insertion with percutaneous pedicle screw fixation. This study aimed to evaluate the 2-year fusion rate on computed tomography (CT) following BESS-TLIF using a kidney bean-shaped cage inserted and rotated via track-guided technique.

Methods: Between March 2023 and the present, 51 patients with grade I or lower spondylolisthesis and foraminal stenosis underwent BESS-TLIF. A kidney bean-shaped EIT Cellular Titanium® TLIF Cage (DePuy Synthes, Raynham, MA, USA) was used. Fusion materials included autograft combined with demineralized bone matrix (DBM), I-factor, or bone morphogenetic protein (BMP). CT scans were performed at 3, 6, 12, and 24 months postoperatively. Fusion was assessed in coronal (right, left, intra-cage) and sagittal (anterior, posterior, intra-cage) planes. Each site was graded: 0 (no fusion), 1 (partial fusion), or 2 (complete bony bridging). At each time point, cases were classified as complete (≥1 site with grade 2), incomplete (maximum grade 1), or non-union (all grade 0).

Results: Complete fusion rates at 3, 6, 12, and 24 months were 11.8%, 43.1%, 82.4%, and 88.2%, respectively. No non-unions were observed after 12 months. Incomplete fusion occurred in 11.8% and 17.6% at 12 and 24 months. At 24 months, fusion was most frequent anteriorly (58%) in the sagittal plane and on the right side (66%) in the coronal plane. Higher BMD and younger age were significantly associated with increased fusion ($p = 0.009$ and $p = 0.038$). L5–S1 level showed significantly lower complete fusion (70%, $p = 0.038$). There was no significant difference in fusion rate between single- and multi-level surgeries. Additionally, cage height, angle, and position did not significantly affect fusion outcomes.

Conclusion: Fusion rate is a key concern in BESS-TLIF. In this study, the 2-year CT-based fusion rate was 88.2%, which is within the range reported for conventional open TLIF. Although further studies with larger cohorts and longer follow-up are needed, these results suggest that BESS-TLIF may be a feasible and effective alternative for lumbar interbody fusion.

Free Paper 8

OP-029

Different characteristics between acute and delayed proximal junctional failure in adult spinal deformity surgery

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Purpose: While numerous studies have been conducted on proximal junctional failure (PJF), the clinical significance of acute and delayed PJF remains poorly understood. The primary object of this study is to investigate the risk factors separately for acute and delayed PJF. Secondly, we aim to assess the incidence of each failure mode and their clinical consequences in relation to acute and delayed PJF.

Materials and methods: Retrospective comparative study was performed for patients aged ≥60 years who underwent deformity correction with ≥5-level fusion to sacrum. PJF was defined as proximal junctional angle (PJA) ≥ 20°. Acute PJF is defined as PJF occurring within 6 months, while delayed PJF occurring after 6 months. Risk factors were analyzed by comparing various clinical and radiographic parameters among three groups: no, acute, and delayed PJF groups. The failure modes, including soft tissue failure, vertebral fracture, fixation failure, and myelopathy, were compared among these groups. The clinical subsequences after PJF development were evaluated by assessing the change in PJA, revision rate, and patient-reported outcome measure (PROM).

Results: A study cohort of 363 patients was included in the analysis. Among them, 156 patients experienced PJF, with 87 patients (55.8%) in the acute PJF group and 69 patients (44.2%) in the delayed PJF group. Multivariate analyses revealed that older age (Odds ratio [OR] = 1.057), osteoporosis (OR=2.149), high American Society of Anesthesiology ASA score (OR=2.150), and overcorrection relative to the age-adjusted pelvic incidence - lumbar lordosis target (OR=4.031) were identified as risk factors for the development of acute PJF. On the other hand, a high body mass index (OR=1.150) and an uppermost instrumented vertebra located at ≤ T10 (OR=2.267) were found to be associated with delayed occurrence of PJF. No radiographic parameters were found to be related to the development of delayed PJF. In terms of failure modes, vertebral fracture and fixation failure were more commonly observed in acute PJF, while soft tissue failure and myelopathy were more predominant in delayed PJF. The clinical course was more aggressive in the acute PJF group compared to the delayed PJF group, as evidenced by a greater increase in PJA, a higher revision rate, and worse PROM.

Conclusion: This study demonstrated different risk factors, failure modes, and clinical consequences between acute and delayed PJF. Therefore, a different surgical strategy needs to be established to mitigate both acute and delayed PJF.

Keywords: Adult spinal deformity; proximal junctional failure; acute; delayed; risk factor; failure mode; clinical consequence; overcorrection

Free Paper 8

OP-030

Efficacy of Proximal Junctional Tethering in Spinal Fusion Surgery for Preventing Proximal Junctional Kyphosis and Proximal Junctional Failure: A Meta-analysis

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Objective: Spinal fusion surgery is effective for treating various adult spinal deformities. However, spinal fusion surgery is associated with the risk of adjacent segment disease (ASD; 5%-30%), particularly proximal junctional kyphosis (PJK) and proximal junctional failure (PJF). Proximal junctional tethering (PJT) has become a popular technique owing to increasing evidence that it can decrease the rate of PJK or PJF.

Methods: A literature search was conducted using PubMed, Embase, and Cochrane Library. Twelve eligible studies were identified. These studies were predominantly retrospective in nature and compared the incidence of PJK or PJF in adults undergoing spinal fusion surgery with or without PJT. Risk of bias was assessed using the Newcastle-Ottawa scale. All outcomes were analyzed using R software (version 4.4.1).

Results: We included 9 retrospective cohort studies and 3 propensity-score-matched analyses; these studies comprised 1500 patients. PJT was associated with a significant decrease in the rates of PJK (risk ratio [RR] = 0.58, 95% CI = 0.46-0.73) and PJF (RR = 0.45, 95% CI = 0.26-0.78) compared with control. Subgroup analysis results revealed no significant difference in ASD rates between geographical locations, between surgical indications, between tethering with and without crosslinks, and between specific tethering techniques.

Conclusions: PJT significantly reduces the rates of both PJK and PJF in adults undergoing spinal fusion surgery.

Free Paper 8

OP-031

One-Stage Posterior Minimally Invasive Surgery in Adult Spinal Deformity

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Purpose: As the aging population grows, the incidence of adult spinal deformity (ASD) continues to rise, presenting substantial challenges for traditional open surgery due to its invasiveness and risk. Posterior minimally invasive surgery (MIS) has emerged as a promising alternative. This study investigates the radiographic correction, clinical outcomes, and complication of one-staged posterior MIS in patients with ASD.

Methods: A retrospective analysis was carried on 49 patients with ASD who underwent one-staged posterior MIS between June 2017 and September 2023. Demographic data, surgical parameters, radiographic alignment (Cobb angle, lumbar lordosis [LL], pelvic incidence [PI], pelvic tilt [PT], PI–LL mismatch, T1 pelvic angle [TPA], and sagittal vertical axis [SVA]), Oswestry Disability Index (ODI), and visual analog scale (VAS) for back pain were evaluated preoperatively and at a minimum follow-up of 6 months.

Results: The mean age was 68.3 years. Mean operative time and blood loss were 332 minutes and 309 ml, respectively. Significant radiographic improvements were noted in Cobb angle (17.84° to 9.66°, p <0.0001), TPA (32.28° to 24.76°, p= 0.0024), and SVA (78.97 mm to 47.54 mm, p= 0.0063). ODI improved from 35.1 to 23.6 and VAS from 8.4 to 3.4. Complications occurred in 27 patients (55.1%), including 6 medical (12.2%) and 21 surgical (44.9%) events; most were managed conservatively without revision surgery.

Conclusion: One-staged posterior MIS for ASD demonstrates favorable outcomes in sagittal alignment correction and patient-reported improvements. Although the complication rate is notable, most issues did not necessitate reoperation, supporting the procedure's role as an effective and less invasive alternative to traditional open surgery.

Free Paper 8

OP-032

The risk factors for mechanical complications after deformity correction in degenerative lumbar scoliosis patients with sagittal imbalance

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Purpose: To identify risk factors of mechanical complications (MCs) occurring after deformity correction using long level fusions in patients with degenerative lumbar scoliosis (DLS) and sagittal imbalance (SI).

Methods: DLS patients who underwent deformity corrective surgery were retrospectively analyzed. We divided the patients into Group I with SI (n=68) and Group II without SI (n=46) and compared the surgical outcomes including radiographic parameters and MCs. SI was defined as satisfying two or more of the following three criteria: Preoperative PT >20°, PI-LL >11°, and SVA >50 mm. MCs included proximal junctional kyphosis/failures (PJK and PJFs) and rod fractures (RFs). To identify risk factors for the occurrence of MCs, additional statistical analysis was performed only in Group I patients.

Results: The incidence of MCs was significantly higher in Group I than Group II (Group I: 41.1% vs Group II: 21.7%). Within Group I, patients in group A who developed MCs were significantly older and had lower BMDspine than patients in group B who did not develop MCs. The fusion levels (A: 7.12 vs B: 5.35, p= 0.022) of group A patients were significantly greater than those of group B patients. The preoperative C7 sagittal vertical axis (C7SVA, A: 132.1mm vs B: 95.2mm, p= 0.032), T1 pelvic angle (T1PA, A: 41.25° vs B: 31.89°, p= 0.041), lumbar lordosis (LL, A: -3.01° vs B: -20.52°, p= 0.018), and pelvic incidence - LL mismatch (PI-LL, A: 59.41° vs 39.72°, p= 0.015) of group A was significantly greater than group B. There was significant difference in the postoperative change values between the two groups according to the preoperative differences. In cox proportional hazard model, fusion levels (hazard ratio [HR]= 1.909, confidence interval [CI]= 1.293-2.818, p= 0.002), BMD (HR= 0.034, CI= 0.004-0.264, p= 0.001), postperative LL (HR= 0.735, CI= 0.593-0.912, p= 0.005), and preoperative PI-LL (HR= 1.108, CI= 1.011-1.178, p= 0.011) were identified as factors associated with the occurrence of postoperative MCs.

Conclusions: In DLS patients, the occurrence of MCs increases after deformity corrective surgery when sagittal imbalance is combined, and risk factors include higher fusion levels, lower BMD, higher preoperative LL, and higher preoperative PI-LL.

Free Paper 9

OP-033

Long-Term Benefits of Minimally Invasive Discectomy: Reduced Risk of Spinal Fusion and Insights Across Patient Subgroups

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Purpose: The choice between Percutaneous Endoscopic Lumbar Discectomy (PELD) and Open Lumbar Discectomy (OLD) for managing lumbar disc herniation (LDH) remains debated. While both techniques achieve comparable short-term outcomes, their long-term effects, particularly regarding the progression to spinal fusion, are under-explored. This study evaluates the risk of subsequent spinal fusion associated with PELD versus OLD and examines how patient demographics and comorbidities influence these outcomes.

Methods: This is a retrospective cohort study utilizing the TriNetX Research Network. We analyzed 123,405 patients diagnosed with LDH between 2000 and 2023, including 93,853 PELD and 29,552 OLD cases. After propensity score matching, a 1:1 cohort was created to ensure baseline comparability. Patients were followed for up to 20 years to assess the risk of subsequent spinal fusion. Primary outcome was the incidence of subsequent spinal fusion surgery following PELD or OLD. Subgroup analysis included age groups, sex, race, lifestyle factors, and comorbidities.

Results: 1,223,803 patients diagnosed with LDH were identified using TrinetX. After excluding spinal fracture, malignancy, infection and applying 1:1 propensity score matching, 29,552 matched patients were included in each cohort. (PELD group: mean[SD] age,48.0[13.7]years; 17039 male[57.7%];OLD group: mean[SD]age,48.0[13.7]years; 17045 male[57.7%]). PELD significantly reduced the risk of spinal fusion compared to OLD over a 20-year follow-up (HR 0.706; 95% CI: 0.656–0.760). Subgroup analysis revealed consistent benefits across younger patients (20–45 years), high-BMI individuals, and White and African American populations. However, PELD demonstrated limited effectiveness in Asian patients and those with alcohol-related diseases.

Conclusion: PELD offers substantial long-term benefits in reducing the need for spinal fusion, particularly for younger, obese, and racially diverse patients. These findings support PELD as a personalized surgical approach that minimizes invasive burden while optimizing outcomes. This study provides actionable insights to guide surgical decision-making and underscores the importance of tailoring treatment strategies based on patient characteristics to enhance outcomes in lumbar disc herniation. Further research should investigate mechanisms underlying subgroup-specific differences and evaluate additional long-term endpoints, including functional recovery and quality of life.

Free Paper 9

OP-034

The efficacy and safety of biportal endoscopic compared with microscopic discectomy in lumbar herniated intervertebral disc (ENDO-BH Trial): a multicenter, prospective, assessor-blind, randomized controlled trial

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Abstract: Study design: Prospective, randomized, multi-center, open-label, assessor-blind, controlled trial.

Objectives: This study aimed to compare the clinical efficacy and safety of biportal endoscopic with that of open microscopic discectomy in patients with single-level herniated lumbar discs.

Summary of Literature Review: Biportal endoscopic discectomy has been frequently performed in recent years and has shown acceptable clinical outcomes. However, evidence regarding its efficacy and safety remains limited.

Methods: One hundred participants were diagnosed with a single-level lumbar herniated disc and required a surgical discectomy. They were randomly assigned in a 1:1 ratio to undergo biportal endoscopy (biportal group) or microscopic discectomy (microscopy group). The primary outcome was the difference in Oswestry Disability Index (ODI) scores at the 12-month after surgery based on a modified intention-to-treat strategy. Secondary outcomes included patient-reported outcome measures, surgery-related outcomes, and adverse events.

Results: The ODI score at the 12-month follow-up was 10.32 in the microscopy group and 10.92 in the biportal group (mean difference, 0.61; 95% confidence interval [CI], -4.47 to 5.68), showing similar primary outcome in both group. The results for the secondary outcomes were similar to those for the primary outcome. Creatinine phosphokinase ratios were low in the biportal group. Early surgical site pain was slightly lower in the biportal group (mean difference of VAS pain score at 48-hr, -0.71; 95% CI, -1.27 to -0.15). Adverse events including reoperation showed no significant difference between the groups. However, wound dehiscence was significantly high in microscopic group.

Conclusion: This randomized controlled trial demonstrates that biportal endoscopic discectomy achieves clinical outcomes equivalent to conventional microscopic discectomy for lumbar disc herniation at 12 months post-surgery. These findings suggest that biportal endoscopic discectomy is a safe and effective alternative to microscopic discectomy, offering surgeons and patients an additional minimally invasive option for the treatment of lumbar disc herniation.

Keywords: Biportal endoscopic spinal surgery; Degenerative spine; Discectomy; Lumbar herniated disc; Microscopy; Oswestry disability index

Free Paper 9

OP-035

A novel repair strategy using knotless squeeze anchors for lumbar disc herniation with endplate junction lesions under biportal endoscopic spinal surgery

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Purpose: The structural integrity failure of annulus fibrosus (AF) and its cartilaginous endplate (EP) junction is the primary cause of lumbar disc herniation (LDH). Due to the particularity of disc structure and lifetime mechanical load, AF-EP junction lesions were found on radiological images of 65% LDH patients. However, there is currently no optimal solution for the junction lesions. It is still challenging to restore mechanical properties of AF-EP junction and reduce LDH recurrence. Getting inspired by arthroscopic shoulder labral repair using double-row suture anchors, we pioneered a Squeeze-Lock technology under biportal endoscopic spinal surgery (BESS) to repair AF-EP junction lesions for LDH patients.

Methods: The herniated lumbar segment and skin incision positions were determined according to radiological images and intraoperative fluoroscopic guidance. The vertical skin incisions (viewing portal 0.5 cm, working portal 0.8 cm in length) were placed at the projection of pedicle medial edges. Then, viewing and working portals were established and met at the junction of the targeted spinous process and lower edge of its lamina. After resection of partial ligamentum flavum and facet joint to expose lateral edge of the dural sac and passing through the operating tools, routine decompression was performed to excise herniated disc materials causing radiculopathy. During the suturing procedure, a suture strand from the working portal was passed through the intact AF tissue near the lesion and retrieved using the Suture Crossing Device. Then, the knotless suture limbs were joined and secured into the cortical bone socket of the vertebral body on the other side of the lesion with a PushLock anchor. Finally, the suture limbs were cut after AF tissue tension adjustment under direct visualization during anchor implantation.

Results: The AF-EP junction lesion was successfully repaired with direct visualization and flexibility in instrumentation under BESS. At the one-year postoperative follow-up, none of the patients who received suturing showed recurrence of LDH.

Conclusion: The Squeeze-Lock procedure is a simple, safe, and feasible knotless suturing technique for the treatment of LDH with AF-EP junction lesions, and it effectively reduces the recurrence rate.

Free Paper 9

OP-036

Endoscopic Interlaminar Standalone Decompression for Lumbar Lateral Recess Stenosis with Subligamentous Disc Herniation : A Disc-Preserving Alternative to Discectomy

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Purpose: Lumbar lateral recess stenosis (LRS) with subligamentous disc herniation often causes debilitating radicular pain. While discectomy is commonly performed, it risks disc degeneration and spinal instability. This study aimed to evaluate the clinical and radiographic outcomes of full-endoscopic interlaminar standalone decompression as a minimally invasive, disc-preserving alternative to discectomy for treating single-level LRS with subligamentous disc herniation.

Methods: We retrospectively reviewed 55 patients with single-level lumbar LRS and subligamentous disc herniation who underwent full-endoscopic interlaminar standalone decompression between 2013 and 2021. Inclusion criteria required radicular pain refractory to conservative treatment and magnetic resonance imaging (MRI) confirmation of subligamentous herniation. Clinical outcomes were assessed using the Visual Analog Scale (VAS) for leg and back pain, Oswestry Disability Index (ODI), and Short Form-12 Physical and Mental Component Scores (SF-12 PCS/MCS). Radiographic evaluations included disc height index (DHI) measurements and Bartynski grading for lateral recess stenosis. Pre- and postoperative data were compared using the Wilcoxon signed-rank test.

Results: At the 2-year follow-up, leg and back pain VAS scores improved significantly from 8.8 and 8.5 preoperatively to 1.0 and 0.9, respectively. ODI scores declined from 66.9 to 10.6, while SF-12 PCS and MCS improved from 30.1 to 42.5 and 26.3 to 42.6, respectively. According to the modified MacNab criteria, 96.3% of patients achieved "good" or "excellent" outcomes. Postoperative DHI remained stable, and no reoperations were required during follow-up.

Conclusions: Full-endoscopic interlaminar standalone decompression offers substantial symptom relief and functional improvement for single-level lumbar LRS with subligamentous disc herniation. By preserving disc integrity, this minimally invasive technique avoids the risks associated with discectomy, such as disc degeneration and instability. These findings suggest a paradigm shift in treating LRS, supporting the use of this disc-preserving approach as a viable alternative to conventional surgical methods in properly selected patients. Further research with larger cohorts and longer follow-up is warranted to validate these results.

Free Paper 10

OP-037

Effects of anti-osteoporosis medication in adult posterior spine fusion patients : a systematic review and meta-analysis

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Purpose: This study assessed the effects of anti-osteoporosis medications, especially teriparatide, bisphosphonates, denosumab, and romosozumab in adult posterior spine fusion patients with low bone mineral density(BMD) focusing on radiographic and functional outcomes.

Methods: A systematic search of PubMed, EMBASE and Cochrane Library was conducted. Adult patients with low BMD undergoing posterior spine fusion surgery were included. Studies using perioperative anti-osteoporosis medications-teriparatide, bisphosphonates, denosumab, romosozumab-to compare treatment versus no treatment or comparison between medications were also included. Outcomes analyzed were fusion rate, subsequent vertebral fracture(VF), screw loosening, cage subsidence, proximal junction kyphosis, patient reported outcomes(PROs); particularly VAS for pain and ODI for functional status. Two reviewers independently selected studies, extracted data and assessed quality of relevant studies. Meta-analysis was performed for four comparative groups-bisphosphonate vs control, teriparatide vs control, teriparatide vs bisphosphonate and denosumab vs control-for the effectiveness of anti-osteoporosis medications.

Results: Total 28 studies were included. Bisphosphonate reduced subsequent VFs [Odds ratio (OR)=0.27, 95% CI=0.09-0.81], cage subsidence [OR=0.29, 95% CI=0.11-0.75] and improved ODI at 12 months [Standardized mean difference (SMD) (95% CI)=-0.75(-1.42, -0.08)] compared to control. Teriparatide showed higher fusion rate [OR=3.52, 95% CI=1.84-6.75], lower screw loosening [OR=0.23, 95% CI=0.09-0.60] and improved ODI at 24 months [SMD(95% CI)=-0.57(-0.99, -0.15)] compared to control. Compared to bisphosphonates, teriparatide showed higher fusion rate [OR=2.28, 95% CI=1.67-3.11], lower subsequent VFs [OR=0.22, 95% CI=0.09-0.51], improved VASB [MD(95% CI)=-0.30(-0.54, -0.07)] and ODI [SMD(95% CI)=-0.39(-0.65, -0.13)] scores at 12 months. Denosumab showed no significant differences in fusion rate and complications compared to control.

Conclusion: Our results indicated that teriparatide should be used as the first-line perioperative treatment for patients with poor bone quality scheduled for posterior spine fusion. Teriparatide exhibited better fusion rates and reduced complications than controls and bisphosphonates, resulting in improved PROs. Moreover, bisphosphonates can be used as second-line treatment for patients with contraindications to teriparatide since it prevents osteoporosis-related complications compared to controls, resulting in improved PROs compared to controls. Further studies are warranted to evaluate the potential effects of denosumab and romosozumab which shows promising potential in model studies.

Keywords: Osteoporosis, Spine fusion, Teriparatide, Bisphosphonate, Denosumab, Romosozumab, Screw loosening, Cage subsidence, Proximal junction kyphosis

Free Paper 10

OP-038

The bony density of the pedicle plays a more significant role in the screw anchorage ability than other regions of screw trajectory

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Background: Osteoporosis is a crucial risk factor for screw loosening. Our studies indicate that the bone mineral density (BMD) in the screw trajectory is a better predictor of screw loosening compared to the BMD of the lumbar spine or screw insertion position. Research has shown that anchorage on the screw tip is the most significant factor for screw anchorage ability, while others argue that a decrease in bony quality of the pedicle poses a significant risk for screw loosening. However, it remains to be determined whether BMD of the screw tip, pedicle, or screw-anchored vertebral body plays the most substantial role in determining screw anchorage ability.

Methods: Clinical data were collected from patients who underwent bilateral pedicle screw fixed single segment posterior and transforaminal lumbar interbody fusion (PLIF and TLIF). The Hounsfield unit (HU) value of the fixed vertebral bodies, the entire screw trajectory, screw tip, screw anchoraged vertebral body, and pedicles were measured separately. Data from patients with and without screw loosening were compared, and regression analyses were conducted to identify independent risk factors. Additionally, the area under the curve (AUC) values were computed to assess the predictive performance of different parameters. Furthermore, fixation strength was calculated in numerical models with varying bony densities in different regions.

Results: HU values were found to be significantly lower in the loosening group across most measuring methods. Specifically, the AUC of screw loosening prediction was notably higher when using HU values of the pedicle compared to other methods. Additionally, computational results for fixation strength revealed a clear decline in screw anchorage ability in models with poor BMD in the pedicle region.

Conclusions: Pedicle bone quality plays a more significant role in screw anchorage ability than that in other regions. The innovation of bony augmentation strategies should pay more attention to this region to optimize the screw anchorage ability effectively.

Free Paper 10

OP-039

Pedicle screw migration and loosening after long segments of lumbosacral fusion stopping at L1 or L2

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Introduction: Determining the proximal fusion level in degenerative lumbar surgery including lumbosacral fixation is controversial. The purpose of this study was to analyze the risk factors that are associated with the pedicle screw migration and loosening after long segments of lumbosacral fusion stopping at L1 or L2.

Materials & Methods: The diagnostic criteria for screw loosening developed by plain radiograph include the radiolucent area (thicker than 1 mm) around the screw. Screw migration was defined as a significant movement of screws including angle change, pull-out, and endplate penetration. Patients were separated into "complicated" and "non-complicated" groups. Radiological variables and operative factors including interbody fusion of the uppermost segment (interbody fusion of L1-2 in the L1-stopped patients or L2-3 in the L2-stopped) were reviewed. We performed univariate and multiple logistic regression analyses to evaluate the odds ratios (ORs) of the related factors.

Results: We analyzed 102 patients with a mean age of 68.5 years. A total of 30 patients (29.4%) were included in the complicated group. Seventeen patients (16.7%) developed screw migration and thirteen patients (12.7%) developed screw loosening, of which five patients finally required additional fusion extension to the thoracic spine. The complicated group showed significantly smaller LL (30.2 degrees, p=0.008) and greater SVA (65.6 mm, p=0.012) at immediate postoperative radiograph than those of the non-complicated group (35.3 degrees and 45.4 mm). The complicated group showed a significantly higher rate of postoperative PI-LL mismatch (89.7%, p=0.011) and a lower rate of interbody fusion at the uppermost segment (43.3%, p=0.031) than the non-complicated group (64.1% and 77.8%). A multiple logistic regression analysis identified two independent risk factors; the absence of interbody fusion at the uppermost segment (OR 6.12, p=0.012) and the PI-LL mismatch (OR 3.94, p=0.019).

Conclusions: Screw loosening and migration were observed in 29% of patients following long segments of lumbosacral fusion stopping at L1 or L2. The upper lumbar region of L1 or L2 does not appear to be an ideal upper end of a long segments lumbosacral fusion. The interbody fusion for the uppermost segment and a sufficient correction of sagittal balance (PI-LL < 10 degrees) may help prevent these complications.

Free Paper 10

OP-040

Repair of L5 pars defect using headless compression screw with assistance of three-dimensional planning and patient-specific drill guides: The preliminary report and technical notes

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Purpose: The aim of this study was to evaluate the clinical outcomes in patients treated with modified Bucks pars repair technique, in which headless compression screws were used with assistance of three-dimensional planning and patient-specific drill guides.

Methods: Three patients with L5 spondylolysis who were managed nonsurgically for at least 6 months underwent a modified Buck technique repair with headless compression screws. Three-dimensional planning and patient-specific drill guides were designed for the optimal trajectory of screws. During the procedure, following the insertion of guide pins using a drill guide, cone-beam computed tomography was utilized to verify their positioning. The defect site was decorticated, followed by placement of autograft over the pars region, and subsequently, screw fixation was performed. During outpatient follow-up, computed tomography scans were utilized to evaluate the rate of bony union and fixation status.

Results: Three cases were all male with average age of 25.3 (range from 21 to 33). Mean average follow-up of all patients was 19.6 months (range from 10.7 to 24.6.8). All of them had lumbar motion pain, but only one patient suffered from neurological symptoms (numbness over bilateral lower legs). Disc of L5/S1 were examined with MRI and classified with Pfirrmann grade: one case was grade 2, and the others were grade 3. One patient experienced intraoperative screw breakage, while no other patients developed any neurologically related complications. At the final follow-up, one patient achieved bony union, while the remaining two exhibited asymptomatic nonunion. The average Visual Analogue Scale (VAS) improved from 7.6 preoperatively to 2.2 postoperatively. The Oswestry Disability Index (ODI) decreased from 27.3 before surgery to 8.3 after surgery.

Conclusion: The modified Buck technique utilizing headless compression screws with the aid of three-dimensional planning and patient-specific drill guides demonstrated favorable clinical outcomes in selected patients with L5 spondylolysis. Despite the small sample size and the presence of asymptomatic nonunion in two patients, all cases experienced significant pain reduction and functional improvement without postoperative neurological complications. This technique may represent a viable surgical option for young adults with symptomatic spondylolysis who have failed conservative treatment. Larger studies are needed to confirm its long-term efficacy.

Free Paper 11

OP-041

Unilateral Biportal Endoscopic Discectomy via the Contralateral Sublaminar Approach for Lumbar Disc Herniation with Very High-Grade Migration: A Technical Note and Case Series

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Purpose: Lumbar disc herniation (LDH) with very high-grade migration is surgically challenging due to its anatomical complexity and the risk of incomplete decompression. The unilateral biportal endoscopic (UBE) contralateral sublaminar approach is a minimally invasive alternative for managing these cases.

Methods: Fifteen patients with LDH and very high-grade upward or downward migrated disc fragments underwent decompression using the UBE contralateral sublaminar approach between June 2022 and June 2024 in a multicenter retrospective study. Clinical outcomes were evaluated using the visual analog scale (VAS) for back and leg pain, Oswestry Disability Index (ODI), and modified MacNab criteria. Radiological outcomes were assessed using postoperative MRI and serial plain radiographs.

Results: The mean operative time was 45.3 minutes, and the average hospital stay was 4.1 days. Significant improvements were observed in VAS and ODI scores at the final follow-up. Complete removal of migrated fragments was confirmed in all cases without postoperative instability. This approach enabled effective decompression with minimal bone removal while preserving surrounding structures.

Conclusion: The UBE contralateral sublaminar approach is an effective and minimally invasive surgical option for treating very high-grade migrated LDH. This technique allows for sufficient decompression and preservation of stability. Further comparative studies are needed to validate its clinical benefits.

Free Paper 11

OP-042

Treatment of lumbar disc herniation with multiple annulus fibrosus suture methods under Uni-portal Non-coaxial Spinal Endoscopic Surgery (UNS)

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Objective: This study explores the benefits of spinal endoscopic surgery with arthroscopic assistance. A retrospective case-control analysis will compare outcomes in young/middle-aged lumbar disc herniation patients treated with UNS technique (simple nucleus pulposus removal ± annulus fibrosus suture). Subgroup analysis will further evaluate different suture methods, aiming to strengthen evidence for UNS efficacy.

Method: This retrospective study analyzed 366 patients (20-50 years) with single-segment lumbar disc herniation and radiculopathy treated from 2021-2024. Patients were semi-randomized by ID: Group A (n=199) received AUSS-based annulus fibrosus suture, while Group B (n=167) did not. Of these, 359 completed 12-month follow-up (7 lost). Outcomes included back/leg pain VAS, ODI, and recurrence rates. Group A underwent subgroup analysis comparing single-needle, multi-needle, and special suture methods for these outcomes.

Results: All surgeries were successful. Both groups showed significant VAS improvement for lumbar/leg pain vs. preoperative scores ($P<0.05$). At 1/3/6/12 months post-op, lower limb VAS and ODI improvements remained significant ($P<0.05$). Group B had 8 recurrences (5% rate), while Group A had 2 (1%). Subgroup analysis revealed all recurrences occurred in single-needle suture cases; multi-needle sutures had no recurrences. Further mechanical analysis demonstrated multi-needle sutures distributed annular surface tension more evenly, substantially reducing re-rupture risk.

Conclusion: Compared with traditional surgeries, Arthroscopic-assisted Uni-portal Spinal Surgery, thanks to its wider field of view and free operating space, can adopt new annulus fibrosus suture methods, deal with more complex types of intervertebral disc herniation, improve the degree of retraction of the annulus fibrosus after surgery, help younger patients return to life and sports more quickly and safely, and has potential value in reducing the reoperation rate caused by recurrence of annulus fibrosus rupture and nucleus pulposus prolapse, making minimally invasive spinal surgeries more comprehensive.

Key words: Lumbar Disc Herniation in Young and Middle-Aged People; Uni-portal Non-coaxial Spinal Endoscopic Surgery (UNS); Annulus Fibrosus Suture

Free Paper 11

OP-043

Optimizing Surgical Approach Selection in Endoscopic Lumbar Discectomy Using 3D CT/MR Fusion Imaging

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Purpose: In endoscopic surgery for lumbar disc herniation, selecting the most appropriate surgical approach—unilateral biportal endoscopy (UBE), full-endoscopic spine surgery via the transforaminal (FESS-TF) or interlaminar (FESS-IL) route—is critical. However, objective criteria for this selection have not been clearly defined. Recent advancements in three-dimensional (3D) CT/MR fusion imaging allow for detailed preoperative visualization of the anatomical relationships between neural structures, intervertebral discs, and osseous elements. This study aimed to evaluate the impact and clinical utility of preoperative planning using 3D MRI/CT fusion images on surgical approach selection.

Methods: Patients who underwent endoscopic lumbar discectomy using UBE-IL, UBE-TF, FESS-TF, or FESS-IL were retrospectively analyzed. Preoperative 3D CT/MR fusion images were utilized to assess iliac crest interference, nerve root take-off level, direction of disc herniation, and facet joint morphology. Surgical approach was determined based on these anatomical features, and the consistency between planned and performed procedures, as well as postoperative outcomes, was examined.

Results: The incorporation of 3D CT/MR fusion imaging into preoperative planning enabled clear visualization of anatomical relationships that are difficult to appreciate with conventional two-dimensional imaging. This allowed intuitive assessment of key surgical considerations, including the degree of iliac crest interference, ease of herniation removal, required extent of bony decompression, and feasibility of facet joint preservation. UBE was primarily selected for cases with concomitant spinal canal stenosis, whereas FESS-TF was feasible in cases without iliac crest obstruction. In patients with hypoplastic facet joints, 3D imaging provided valuable insight into the viability of lateral approaches.

Conclusion: Preoperative planning using 3D CT/MR fusion imaging facilitates objective and rational selection of endoscopic surgical approaches for lumbar disc herniation. This strategy contributes to the advancement of minimally invasive spine surgery by enabling facet joint preservation and reducing the risk of postoperative segmental instability.

Free Paper 11

OP-044

Comparative Efficacy and Experience of Uni-portal versus Bi-portal Spinal Endoscopy in Treating Far Lateral Lumbar Disc Herniation (FLLDH)

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Purpose: To compare the clinical efficacy and technical characteristics of Uni-portal and Bi-portal spinal endoscopic techniques for treating far lateral lumbar disc herniation (FLLDH).

Methods: A retrospective analysis was conducted on 46 FLLDH patients treated between January 2024 and November 2024. Among them, 27 underwent Uni-portal spinal endoscopy under local anesthesia, and 19 underwent bi-portal transforaminal endoscopic surgery under general anesthesia. Visual Analog Scale scores for back and leg pain (VAS-Back, VAS-Leg), Oswestry Disability Index (ODI), operative time, intraoperative blood loss, and costs were compared preoperatively and at 1/3/6 months postoperatively.

Results: Both groups showed significant improvements in VAS-Back (Uni-portal: 6.2→2.1→1.8→1.5; Bi-portal: 6.1→2.0→1.7→1.4), VAS-Leg (Uni-portal: 7.5→1.9→1.5→1.3; Bi-portal: 7.6→1.8→1.4→1.2), and ODI (Uni-portal: 68.3%→19.2%→12.5%→9.8%; Bi-portal: 67.9%→18.7%→11.9%→8.6%) at all postoperative timepoints ($P<0.05$), with no significant intergroup differences ($P>0.05$). The Uni-portal group had shorter operative time (68.6±15.2 vs. 75.4±12.8 minutes), significantly less blood loss (15.2±4.6 mL vs. 22.7±5.3 mL, $P<0.05$), and lower costs (28,000±3,000 CNY vs. 36,000±4,000 CNY, $P<0.05$). However, 73.3% of Uni-portal patients reported significant intraoperative pain and expressed lower willingness to undergo similar procedures. The Bi-portal group demonstrated larger operative space, broader decompression, and higher patient satisfaction (89.5% willingness for reoperation).

Conclusion: Both techniques effectively achieve nucleus pulposus removal and nerve decompression in FLLDH. Bi-portal endoscopy offers procedural efficiency and superior patient tolerance but requires consideration of general anesthesia and higher costs. Uni-portal endoscopy is cost-effective for financially constrained patients, yet intraoperative analgesia and patient experience optimization under local anesthesia are critical.

Free Paper 12

OP-045

Enhancing Minimally Invasive Transforaminal Lumbar Interbody Fusion with a Novel V-Shape Bichannel Endoscopy System : Clinical Experience and Technical Considerations

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Background: Minimally invasive spine surgery is evolving with the integration of innovative visualization technologies. We introduced a novel V-shape bichannel endoscopy (VBE) system that supports two-media compatibility for transforaminal lumbar interbody fusion (TLIF). This study reports early clinical outcomes and proposes improvements based on observed limitations

Methods: Fifty-two patients with degenerative lumbar conditions underwent VBE-assisted TLIF (VBE-TLIF) at our institution. Perioperative indicators (operation time, off-bed time, hospital stay) and clinical outcomes were recorded. Pain was assessed by Visual Analog Scale (VAS), functional status via Oswestry Disability Index (ODI), and overall recovery by modified MacNab criteria. Follow-ups were conducted at 3, 6, 12, and 24 months with imaging evaluations (X-ray/CT) for fusion assessment.

Results: All patients received unilateral decompression with an average operative time of 178.49 ± 27.49 minutes. VAS scores for leg and back pain significantly improved (final: 0.80 ± 0.69 and 0.86 ± 0.75, respectively, $p < 0.05$). The mean final ODI was 15.20 ± 5.75. Based on the modified MacNab criteria, 39 patients rated outcomes as excellent and 10 as good (satisfaction rate: 94%). No major complications were reported. Radiographic fusion was observed in all patients.

Discussion: Although early outcomes were promising, this study lacked a control group for direct comparison with conventional TLIF. The relatively small sample size, limited long-term data, and lack of detailed complication reporting limit generalizability. Furthermore, functional outcomes were measured using limited tools, and the learning curve of the VBE system was not addressed.

Conclusion: The VBE system appears to be a safe and effective platform for minimally invasive TLIF. Future research should focus on larger, multicenter randomized controlled trials, longer follow-up periods, and comprehensive outcome measures to fully validate its clinical value. Surgical standardization and training pathways are also essential to promote broader adoption.

Keywords: V-shape bichannel endoscopy, minimally invasive TLIF, spinal fusion, dual-media endoscopy, endoscopic spine surgery, clinical outcomes

Free Paper 12

OP-046

Spontaneous facet fusion following lateral lumbar interbody fusion supplemented with percutaneous pedicle screw fixation in degenerative lumbar disease

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Purpose: We investigated contributing factors and clinical significance of spontaneous facet fusion (SFF) following minimally invasive lateral lumbar interbody fusion (LLIF) with percutaneous pedicle screw fixation, a phenomenon sometimes occurring earlier than interbody fusion.

Methods: From 52 patients who underwent LLIF with percutaneous pedicle screw fixation for degenerative lumbar disease, we included 43 patients (150 facet joints) with minimum 1-year follow-up. We analyzed demographic, spinal, and radiologic factors. Clinical outcomes were assessed using VAS for lower back pain (LBP), radiating pain, and Oswestry Disability Index (ODI). Patients were classified into groups with/without SFF for univariate analysis. Multivariate logistic regression identified SFF predictors. Clinical outcomes were compared across three groups: Group 1 (no fusion), Group 2 (facet fusion preceding interbody fusion), and Group 3 (solid interbody fusion with/without facet fusion).

Results: SFF occurred in 98/150 facet joints (65.3%). Univariate analysis identified preoperative facet osteoarthritis as a significant risk factor (p=0.001). Multivariate analysis confirmed preoperative facet osteoarthritis (p=0.009, OR=9.951) and modified Bridwell interbody fusion grade 1 (p=0.048, OR=9.837) as SFF predictors. VAS for LBP at 1-year post-surgery was significantly lower in fused segments (Groups 2 and 3) compared to non-fused segments (p=0.023), with no significant difference between Groups 2 and 3.

Conclusions: SFF was observed in over 65% of facet joints after minimally invasive LLIF with percutaneous pedicle screw fixation, often preceding interbody fusion. It was more common in patients with severe preoperative facet osteoarthritis and frequently accompanied solid interbody fusion. The clinical significance of SFF is demonstrated by reduced LBP in patients with fused segments, suggesting that facet fusion contributes to pain relief regardless of whether it precedes or accompanies interbody fusion.

Keywords: minimally invasive lateral lumbar interbody fusion, spontaneous facet fusion, facet osteoarthritis

Free Paper 12

OP-047

Hounsfield Units, Vertebral body quality score, and Posterior Disc Height Distraction as Predictors of Cage Subsidence After OLIF Surgery

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Purpose: The purpose of this study was to identify preoperative and intraoperative factors that can predict cage subsidence and fusion rate, in order to improve surgical outcomes following OLIF surgery.

Methods: A retrospective analysis was conducted on 70 patients (119 levels) who underwent OLIF using PEEK cage with posterior screw fixation between 2015 and 2023. Surgeries involved one to three lumbar levels. Preoperative bone quality was assessed using MRI-based vertebral body quality score (VBQS) on T1-weighted image and CT-based Hounsfield units (HU). Radiographic parameters including anterior disc height (ADH), posterior disc height (PDH), lumbar and segmental lordotic angle (LLA and SLA), foraminal height (FH), and cage position were evaluated preoperatively and one year postoperatively. Clinical data including visual analog scores for pain, were also analyzed. Cage subsidence and fusion status were evaluated at one year.

Results: Cage subsidence occurred in 25 of 119 levels (21.0%). Univariate analysis identified higher VBQS, lower HU, and greater PDH distraction as significant factors associated with subsidence (all $p<0.05$). Other variables, including changes in FH, LLA, SLA, and cage position, showed no significant association with cage subsidence. Multivariable analysis confirmed three independent predictors of cage subsidence: Higher VBQS (OR = 2.716; 95% CI: 1.208–6.104; $p = 0.016$), greater PDH distraction (OR = 1.418; 95% CI: 1.059–1.898; $p = 0.019$), and lower HU (OR = 1.017; 95% CI: 1.004–1.031; $p = 0.012$) were significantly associated with increased risk of subsidence. Receiver operating characteristic analysis identified the following cutoff values: VBQS > 3.30, HU < 145.86, and PDH distraction > 4.79 mm. None of these variables showed a significant association with radiographic fusion at one year.

Conclusion: Preoperative VBQS and HU, along with intraoperative posterior disc height distraction, were significant predictor of cage subsidence after OLIF. These findings suggest that careful preoperative evaluation of bone quality and avoidance of excessive disc distraction may reduce the risk of cage subsidence, although their impact on fusion rates appears limited.

Free Paper 12

OP-048

Oblique lumbar interbody fusion combined with anterolateral screw fixation and stress endplate augmentation for treating degenerative lumbar spondylolisthesis with osteoporosis

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Purpose: To evaluate the outcomes of Oblique lumbar interbody fusion (OLIF)combined with anterolateral screw fixation (AF) and Stress Endplate Augmentation (SEA) versus OLIF-AF in the treatment of degenerative lumbar spondylolisthesis (DLS) with osteoporosis (OP).

Methods: 30 patients underwent OLIF-AF-SEA (SEA group) were matched with 30 patients received OLIF-AF (control group), in terms of sex, age, body mass index (BMI) and bone mineral density (BMD). Clinical outcomes including visual analog scale (VAS) score of the lower back pain (VAS-LBP), leg pain (VAS-LP), and Oswestry Disability Index (ODI) were evaluated at different postoperative intervals and comparedwith their preoperative counterparts. Radiographic outcomes such as disk height (DH), slip distance (SD), lumbar lordosis (LL), segmental lordosis (SL), cage subsidence (CS) rate and fusion rate were evaluated at different postoperative intervals and compared with their preoperative counterparts.

Results: SEA group presented to be better at 3-month and 12-month follow-up, the VAS-LBP, VAS-LP and ODI scores of the SEA group were significantly lower than the control group (3-month SEA vs control: 2.30±0.70 vs 3.30±0.75, 2.03±0.72 vs 2.90±0.76,15.60±2.36 vs 23.23±3.07, respectively, all $p<0.05$. VAS-LBP and ODI 12-month SEA vs control: 1.27±0.74 vs 1.93±0.58, 12.20±1.88 vs 14.43±1.89,respectively, all $p<0.05$). At 24-month follow-up, both groups showed no difference in fusion rate (83.33% vs 90.00%, $p=0.45$), while SEA group showed a lower CS rate (13.33% vs 53.33%, $p<0.05$).

Conclusion: OLIF-AF-SEA was safe with no adverse effects and resulted in lower CS rate and better sagittal balance. OLIF-AF-SEA is a promising surgical method for treating patients with DLS-OP.

Free Paper 13

OP-049

Uniportal Full-endoscopic Unilateral Laminotomy for Bilateral Decompression in Lumbar Spinal Stenosis: Relationship between Decompression Range and Functional Outcomes

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Objective: Uniportal full-endoscopic unilateral laminotomy for bilateral decompression (UFE-ULBD) has been used to treat lumbar spinal stenosis (LSS) with satisfactory outcomes. However, a limited number of studies have investigated the relationship between decompression range and clinical outcomes. This study aimed to investigate the efficacy of UFE-ULBD for single-segment LSS and to explore the relationship between the decompression range and functional outcomes.

Methods: Single-segment LSS patients who had undergone UFE-ULBD using an interlaminar approach between November 2021 and February 2023 were retrospectively analyzed. Patient demographics, visual analogue scale (VAS) scores for leg and back pain, Oswestry disability index (ODI) scores, modified MacNab grades, and radiological outcomes, including the decompression ratio of the disc-flava ligament space and osseous lateral recess, the enlargement ratio of superior articular process interval, lamina interval dural sac cross-sectional area (DSCA), were collected. The independent sample t-tests, paired sample t-tests, chi-square tests, Fisher's exact tests, and Pearson's and Spearman's correlation analyses were used.

Results: Forty patients (23 males, and 17 females) were retrospectively enrolled in this study. The mean follow-up period was 12 months. At the last follow-up, VAS scores for leg pain and back pain decreased from 6.0 ± 0.8 to 1.0 ± 1.9 ($p < 0.001$), and from 6.0 ± 0.8 to 1.2 ± 1.8 ($p < 0.001$) respectively; ODI score decreased from 71.7 ± 6.2 to 24.3 ± 21.3 ($p < 0.001$). According to the modified MacNab criteria, the results were excellent in 28 (70%), good in 5 (12.5%), fair in 6 (15%), and poor in 1 (2.5%), with an excellent-good rate of 82.5%. The postoperative DSCA enlarged from 57.69 ± 21.86 to 150.75 ± 39.33 mm2 ($p < 0.001$), with an enlargement ratio of 189.43 ± 107.83%. No difference in clinical or radiological parameters was detected between patients with excellent, good, fair, or poor outcomes based on the modified MacNab criteria.

Conclusion: UFE-ULBD can provide satisfactory clinical and radiological outcomes in single-segment LSS patients. With sufficient exposure to the dural sac boundary, the functional outcome was not related to the radiological decompression range in LSS patients who had undergone UFE-ULBD.

Vertebral body quality score, Hounsfield Units, and Posterior Disc Height Distraction as Predictors of Cage Subsidence After OLIF Surgery

Free Paper 13

OP-050

No-Punch Decompression Can Effectively Reduce the Risks of Neurological Injury in Unilateral Biportal Endoscopic Surgery

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Introduction: Unilateral biportal endoscopic (UBE) spine surgery has gained worldwide popularity and extended indications in recent years. We have proposed the "no-punch technique" to effectively reduce the complication rate in decompression surgery for degenerative lumbar spinal stenosis by not using the Kerrison punch at all. This study is to evaluate the effectiveness of the "no-punch technique" in reducing the complication rate in the UBE surgeries for the extended surgical indications of degenerative spinal disorders.

Methods: A retrospective comparative study of two cohorts receiving UBE surgeries of different surgical techniques. This study included 914 consecutive patients with various degenerative spine disorders who received UBE surgery between October 2018 and July 2023. These patients were divided into two groups: Group A, comprising the first 660 patients (830 segments) who received UBE surgeries with Kerrison punches, and Group B, comprising the latter 254 patients (330 segments) who received UBE surgeries with the "no-punch technique." The "no-punch technique" uses electric high-speed drills and chisels of different curve angles as the principal surgical instruments to replace the Kerrison punches. The decompression was performed by resecting the peripheral bony margin and then removing the ligamentum flavum as a whole piece or pieces. The operation notes and medical charts were reviewed to evaluate the occurrence of surgical complications and their distribution in subcategories of surgical procedures.

Results: There were 63 surgical complications (58 in Group A and 5 in Group B), including accidental dural tears, nerve root injuries, incomplete decompression, epidural hematoma, and broken instruments were identified. The overall complication rate and the incidence of dural tears were significantly reduced in Group B (8.8% vs. 2.0% and 3.9% vs. 0). The incidence of neural injuries, including dural tears and nerve root injuries, was also significantly reduced in Group B (5.3% vs. 0.4%), especially in the subcategories of decompression surgeries (5.0% vs. 0.8%) and revision surgeries (9.9% vs. 0). The incidence of incomplete decompression and epidural hematoma and distribution of such complications in the subcategories of surgical procedures did not differ significantly between Group A and B.

Conclusions: The "no-punch technique" effectively reduces the overall complication rate and the incidence of neural injuries in UBE surgeries. This modification of the surgical technique makes UBE surgery a safer endoscopic procedure with guaranteed treatment outcomes.

Free Paper 13

OP-051

Biportal endoscopic laminectomy versus conventional open laminectomy in patients with lumbar spinal stenosis (ENDO-BS Trial): A multicenter, prospective, assessor-blind, randomized controlled trial

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Purpose: Lumbar spinal stenosis (LSS) significantly impairs quality of life and is commonly treated with conventional open laminectomy (CO-L). However, biportal endoscopic laminectomy (BE-L) has emerged as a less invasive alternative.

This study aimed to compare the clinical efficacy and safety of BE-L with those of CO-L for the treatment of LSS. We hypothesized that BE-L would demonstrate non-inferior functional outcomes when compared with CO-L while potentially offering advantages in perioperative morbidity and recovery time.

Methods: We conducted an assessor-blind, prospective, randomized controlled trial at multiple centers in Korea. A total of 120 patients with LSS were randomized to undergo BE-L or CO-L. The primary outcome was the Oswestry Disability Index (ODI) score at 12 months postoperatively. Secondary outcomes included pain scores, quality of life, perioperative parameters, and adverse events, assessed at baseline, 2 weeks, and at 3, 6, and 12 months.

Results: Clinical efficacy was similar between BE-L and CO-L for the primary outcome, while BE-L was superior to CO-L for several secondary outcomes. At 12 months, the mean ODI score was 13.15 in the BE-L group and 17.68 in the CO-L group (mean difference: -4.53, 95% confidence interval: -10.32 to 1.27, p=0.121), demonstrating equivalence between the techniques. BE-L offered advantages in terms of back pain relief, quality of life improvements, shorter operative time, and smaller incision size. The postoperative canal dimension was significantly larger in the BE-L group (p=0.037). No significant differences were observed in leg pain reduction, walking capacity, time to return to daily activities, or overall patient satisfaction. Safety outcomes were similar between BE-L and CO-L. Adverse events were similar between the two groups, although there was a trend toward fewer wound-related complications in the BE-L group.

Conclusion: This study found BE-L to be equivalent to CO-L in functional outcomes at 12 months, with benefits in secondary outcomes and no increased complication risk, supporting BE-L as a viable alternative for LSS treatment.

Level of Evidence: I

Keywords: Biportal endoscopic spinal surgery; Degenerative spine; Laminectomy; Lumbar spinal stenosis; Microscopy; Oswestry Disability Index

Free Paper 13

OP-052

Unilateral Biportal Endoscopic Precision Decompression for Lumbar Spinal Stenosis with Degenerative Scoliosis: Clinical and Radiographic Outcomes

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Purpose: To evaluate the efficacy of unilateral biportal endoscopic (UBE) precision decompression in treating degenerative lumbar spinal stenosis (DLSS) with scoliosis, focusing on neurological recovery and spinal deformity correction.

Methods: This retrospective cohort study (January 2021-March 2024) included 36 single-level DLSS patients with degenerative scoliosis (Cobb angle >10°, mean age 76.9±6.1 years). Targeted unilateral (n=10) or bilateral (n=26) neural decompression was performed using UBE's direct visualization advantage. Perioperative metrics (operative time, blood loss, fluoroscopy frequency) were analyzed. Clinical outcomes were assessed through VAS, ODI, and JOA scores from preoperative to final follow-up (≥12 months). Radiographic evaluation included spinal sagittal alignment (SVA, C7-CSVL), scoliosis parameters (Cobb angle), and spinal canal area.

Results: Pain Relief: Lumbar/leg VAS decreased from 7.2±1.3 preoperatively to 1.8±0.7 at final follow-up (P<0.001).Functional Restoration: ODI reduced from 68.5±8.2 to 22.1±6.3; JOA improved from 14.2±3.1 to 24.7±2.8 (both P<0.001) Deformity Control:Scoliosis: Cobb angle reduced from 18.3±4.1° to 14.7±3.8° (P=0.012).Sagittal alignment: SVA improved from 56.2±12.7mm to 42.3±10.5mm (P=0.003).Canal Expansion: Cross-sectional area increased from 92.5±15.3mm^2 to 162.8±20.1mm^2 (P<0.001).Macnab criteria showed 91.7% excellent/good outcomes with no neurological complications.

Conclusions: UBE's dual-portal design enables precise neural decompression under direct visualization, effectively addressing DLSS with degenerative scoliosis while achieving measurable deformity control. This technique demonstrates three-level clinical value:Symptom resolution (VAS reduction >70%)Functional restoration (ODI improvement >60%).Spinal stability preservation (Cobb angle correction >20%) These benefits, combined with minimal invasiveness (blood loss <50mL) and technical reproducibility (fluoroscopy <5 times), establish UBE as a first-line option for complex spinal stenosis with deformity.

Keywords: Unilateral biportal endoscopy, Degenerative scoliosis, Precision decompression, Spinal deformity correction, Minimally invasive spine surgery.

Free Paper 14

OP-053

Implant-Based Vertebral Augmentation versus Balloon Kyphoplasty in Thoracolumbar Vertebral Compression Fractures : A Comparative Analysis

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Purpose: Thoracolumbar vertebral compression fractures (VCFs) are a common cause of chronic back pain and functional limitation due to kyphosis. Balloon kyphoplasty (BKP) has been widely adopted for pain relief and partial vertebral height restoration. Implant-based vertebral augmentation (IBVA) techniques, which utilize expandable implants for mechanical reduction, have emerged as a promising alternative with improved anatomical restoration. This study aimed to compare clinical and radiological outcomes of IBVA and BKP in patients with thoracolumbar VCFs.

Methods: We retrospectively reviewed 30 patients who underwent surgical treatment for single-level thoracolumbar VCFs (T10–L2) between June and December 2024. Patients were treated with either IBVA using an expandable implant (n=10) or BKP (n=20). Visual Analog Scale (VAS) for back pain and Oswestry Disability Index (ODI) were assessed pre- and post-operatively. Radiological parameters included vertebral height restoration, segmental kyphosis correction, and sagittal vertical axis (SVA). Complications, including cement leakage, were also recorded. Statistical analyses were performed using t-tests and chi-square tests with a significance threshold of $p<0.05$.

Results: Both groups showed significant postoperative improvements in VAS and ODI ($p<0.01$). The IBVA group demonstrated greater vertebral height restoration (37.7% vs. 26.7%, $p=0.032$) and superior correction of segmental kyphosis (12.4° vs. 9.1°, $p=0.028$). SVA improvement was also more favorable in the IBVA group (ΔSVA: 5.8 mm vs. 4.6 mm, $p=0.041$). Complication rates were low in both groups, with one asymptomatic cement leakage in the IBVA group and three in the BKP group, including one symptomatic case.

Conclusion: Implant-based vertebral augmentation showed comparable clinical outcomes and superior radiological correction compared to balloon kyphoplasty in thoracolumbar VCFs. Its enhanced anatomical restoration capacity suggests potential long-term benefits for spinal alignment. Further large-scale studies with long-term follow-up are warranted.

Free Paper 14

OP-054

AI-Enhanced Spine Imaging: A Novel Framework for Osteoporosis Detection and Grading in the Indian Population

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Purpose: Osteoporosis affects 15.3% of Indian adults, more prevalent in women leading to significant morbidity and mortality. Osteoporotic fractures, caused by fragile bones, elevate the risk of disability and mortality, especially among older adults. DEXA, the current gold standard for diagnosing osteoporosis is very limited in India, with 0.26 scanners/million-people versus the recommended 10.6/million. This gap exacerbates socioeconomic burdens particularly in rural areas where treatment options are scarce. National Osteoporosis Foundation guidelines recommend bone density testing for women ≥65 and men ≥70, but limited DEXA access delays diagnosis, increasing fracture risk.To address these challenges, this study aims to develop an adaptive artificial intelligence (AI) system capable of classifying bone conditions into osteoporosis, osteopenia, and normal bone density using routine X-ray/MRI images of Indian subjects.

Materials: We used 304 spine X-ray images sourced from our Institute. Images were preprocessed using a median filter to reduce noise and Contrast Limited Adaptive Histogram Equalization to enhance local contrast. Mask R-CNN was employed to segment and extract the lumbar spine region of interest. For classification, the lightweight MobileNet architecture was used, leveraging depth wise separable convolutions to reduce computational cost while maintaining high performance. To further improve the performance, reinforcement learning techniques were integrated, allowing the model to iteratively adjust and enhance its predictions based on feedback. Grad-CAM (Gradient-weighted Class Activation Mapping) was applied to visualize the critical regions influencing the AI's predictions, enhancing model interpretability.

Results: With an overall accuracy of 70%, the proposed model performed well in all three categories. The reinforcement learning component further elevated the accuracy to nearly 80%. Corresponding Grad-CAM visualizations showed the model was focusing on clinically important areas of the spine, ensuring the predictions were reliable.

Conclusion: This study concludes that an automated osteoporosis screening is feasible with an AI powered deep learning approach augmented with reinforcement learning. The system has diagnostic accuracy, adaptability and interpretability and is well suited to real time clinical application and improved patient care.

Free Paper 14

OP-055

The Interplay among Bone Mineral Density, FRAX-Based Fracture Risk, Skeletal Muscle Mass, and Frailty in Patients with Osteoporotic Vertebral Fractures

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Purpose: This study aimed to investigate the complex interplay among bone mineral density (BMD), FRAX-based 10-year fracture risk, skeletal muscle mass, and frailty progression in patients with osteoporotic vertebral fractures (OVFs), with a focus on identifying early indicators of frailty progression.

Methods: A retrospective study of 164 patients diagnosed with OVFs was analyzed. Clinical data included demographic characteristics, BMD measured via dual-energy X-ray absorptiometry (DXA), relative skeletal muscle index (RSMI), FRAX 10-year major osteoporotic fracture probability, and frailty status using the Korean Frailty Index (KFI). Patients were classified into three groups based on frailty progression from pre-fracture to post-fracture: Group A was 32 cases who remained prefrail, Group B was 62 cases who progressed from prefrail to frail, and Group C was 70 cases who remained frail. Multivariate analyses and Pearson correlation coefficients were used to assess associations among variables.

Results: The mean results was 79.1 ± 7.2 years of the age, 22.8 ± 3.6 kg/m^2 of the body mass index(BMI), −3.5 ± 1.0 of T-score of the BMD, 36.3 ± 6.3 kg of the RSMI, and 2.9 ± 0.9 of the KFI, respectively. Group B revealed the lowest BMD (−3.75 ± 1.13) and skeletal muscle mass (35.74 ± 3.84 kg), accompanied by a significant increase frailty score following the fracture(from 1.65 ± 0.49 to 3.17 ± 0.49). FRAX scores were negatively correlated with BMD ($r = -0.275$, $p = 0.01$), skeletal muscle mass ($r = -0.262$, $p = 0.01$), BMI ($r = -0.202$, $p < 0.05$), and frailty score ($r = -0.170$, $p = 0.04$). Among frailty components, FRAX was significantly associated with resistance ($r = -0.20$, $p = 0.01$) and fatigue ($r = -0.17$, $p = 0.02$).

Conclusions: In patients with osteoporotic vertebral fractures, FRAX-based fracture risk was found to have a direct correlation with the frailty. Patients with elevated FRAX fracture risk, low BMD, and reduced skeletal muscle mass may represent a preclinical state of frailty and warrant early, proactive intervention to prevent further functional decline.

Keywords: Osteoporosis, Vertebral Fracture, Frailty, FRAX, Muscle Mass

Free Paper 15

OP-056

Prognostic Factors for Postoperative Outcomes in Biportal Endoscopic Spine Surgery

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Purpose: This study aims to identify preoperative and intraoperative prognostic factors associated with functional recovery and pain relief within three months following giportal endoscopic spine surgery (BESS). BESS has emerged as a minimally invasive alternative to conventional spinal procedures, offering reduced morbidity and expedited recovery. However, the prognostic factors influencing short-term postoperative outcomes remain inadequately characterized.

Methods: A retrospective cohort study was conducted on patients who underwent BESS for lumbar spinal stenosis between January 2018 and December 2022. Clinical outcomes were assessed using the Visual Analog Scale (VAS) for the back and legs, as well as the Oswestry Disability Index (ODI) for functional impairment. Preoperative factors, including age, symptom severity, and comorbidities, as well as intraoperative variables, were analyzed. Multivariate regression modeling was used to find independent predictors of suboptimal recovery, which was defined as a VAS or ODI score improvement of less than 50% or less than 40%.

Results: Among 80 patients, advanced age (≥65 years) was associated with delayed recovery and lower postoperative improvement in functional scores (OR = 0.72, p = 0.04). Higher preoperative pain severity (VAS ≥8) was a negative prognostic indicator for postoperative pain relief (OR = 0.65, p = 0.02). Diabetes was significantly associated with poorer functional recovery (OR = 0.58, p = 0.03), whereas hypertension did not exhibit a significant effect. Prolonged surgical duration (>90 minutes) was correlated with inferior short-term outcomes (OR = 0.66, p = 0.01). Despite these factors, 85% of patients demonstrated substantial pain reduction and functional improvement at three months postoperatively.

Conclusion: Short-term recovery following BESS is influenced by age, preoperative pain severity, diabetes, and intraoperative complications. These findings underscore the importance of comprehensive preoperative assessment and individualized perioperative management strategies to optimize patient outcomes. Future research should focus on long-term prognostic factors and refine patient selection criteria for BESS.

Keywords: Biportal endoscopic spine surgery, prognostic factors, postoperative outcomes, minimally invasive spine surgery

Free Paper 15

OP-057

Comparison of Safety and Efficacy of Anesthesia Methods in Percutaneous Endoscopic Lumbar Discectomy : A Network Meta-Analysis

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Purpose: The objective of this study was to systematically evaluate the safety and efficacy of local anesthesia, general anesthesia and epidural anesthesia in Percutaneous endoscopic lumbar discectomy(PELD).

Methods: We searched Pubmed, EMBASE and OVID databases for all relevant studies. All statistical analysis was performed using STATA 17.0.

Results: 14 studies were finally included, comprising 7 randomized controlled trials and 7 retrospective studies. The total number of subjects across these studies was 1655, with 316 undergoing general anesthesia, 789 undergoing local anesthesia, and 550 undergoing epidural anesthesia. The meta-analysis of pairwise comparisons suggests that there are no differences among epidural, general anesthesia, and local anesthesia in terms of postoperative VAS, ODI, and surgery time. Regarding complications, general anesthesia has a higher complication rate compared to local anesthesia, but there are no differences between epidural and general anesthesia or between epidural and local anesthesia. In terms of anesthesia satisfaction, both general and epidural anesthesia have higher satisfaction rates compared to local anesthesia, with no significant difference between general and epidural anesthesia. The ranking of the best probabilities shows that epidural anesthesia has the lowest postoperative VAS scores, general anesthesia has the lowest ODI scores, local anesthesia has the fewest complications, and epidural anesthesia has the highest anesthesia satisfaction.

Conclusion: Local anesthesia, general anesthesia, and epidural anesthesia are all safe and effective methods for PELD. Local anesthesia has advantages in complications and operation time. Epidural anesthesia is most advantageous in postoperative VAS scores, and general anesthesia is most advantageous in anesthesia satisfaction and postoperative ODI.

Free Paper 15

OP-058

Biportal endoscopic decompression for degenerative lumbar spondylolisthesis with stenosis

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Objective: This study aimed to evaluate the clinical and radiological outcomes of unilateral laminotomy for bilateral decompression (ULBD) using biportal endoscopic spinal surgery (BESS) in patients with central canal stenosis, with and without low-grade degenerative lumbar spondylolisthesis (DLS).

Methods: A retrospective observational study was conducted on 170 patients who underwent BESS-ULBD between 2015 and 2018, with at least two years of follow-up. Patients were categorized into two groups: Group A (68 patients) with central stenosis and low-grade DLS and Group B (102 patients) with central stenosis alone. Clinical outcomes were assessed using the Visual Analog Scale (VAS) for back and leg pain, Oswestry Disability Index (ODI), and Modified Macnab criteria. Radiological assessments included sagittal translation measurements on dynamic flexion-extension radiographs.

Results: Both groups significantly improved clinical outcomes at the final follow- up ($p < 0.05$). Group A's mean VAS scores improved from 3.8 ± 2.4 to 1.9 ± 2.0 for back pain and from 6.4 ± 1.8 to 2.3 ± 2.0 for leg pain. In Group B, back pain improved from 3.9 ± 2.5 to 1.7 ± 1.9, and leg pain from 6.6 ± 2.0 to 2.2 ± 2.2. ODI scores also improved significantly in both groups. Radiological evaluation showed no significant changes in sagittal translation postoperatively, indicating preserved spinal stability. Both groups had comparable clinical outcomes, with no major complications reported.

Conclusion: BESS-ULBD is a safe and effective minimally invasive option for managing central canal stenosis, with or without low-grade DLS. This technique provides substantial symptom relief, preserves spinal stability, and presents a promising alternative to more invasive fusion procedures in carefully selected patients.

Free Paper 15

OP-059

Ligamentum Flavum Preservation in PTED Enhances Long-Term Stability and Patient Satisfaction Over Partial Resection : A Randomized Controlled Trial

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Background: To evaluate the clinical efficacy of ligamentum flavum preservation versus partial resection during percutaneous transforaminal endoscopic discectomy (PTED) for lumbar disc herniation (LDH), and assess its impact on spinal sagittal parameters.

Methods: In this prospective randomized controlled trial, 134 LDH patients treated at Tianjin Union Medical Center (January 2023-January 2024) were randomly allocated to a ligament preservation group (LR group, n=67) or partial resection group (PR group, n=67). Outcomes included operative duration, complication rates, visual analog scale (VAS) and Oswestry Disability Index (ODI) scores at 3 days, 2 months, and 1 year postoperatively, reherniation rate, and 1-year modified MacNab outcomes. Radiographic parameters comprised facet joint resection extent, disc height, lumbar mobility, and segmental stability.

Results: The PR group exhibited significantly longer operative times and higher incidences of dural tears/nerve injuries versus the LR group ($P<0.05$). Both groups demonstrated significant reductions in VAS and ODI scores over time. At 3 days and 2 months, the PR group showed superior VAS and ODI improvements ($P<0.05$). By 1 year, VAS/ODI differences were non-significant; however, the LR group achieved significantly higher modified MacNab excellent/good rates ($P<0.05$), indicating superior long-term efficacy. Reherniation rates were comparable. The LR group required greater facet joint resection, exhibited accelerated disc height loss, and significantly reduced segmental stability at 1 year despite higher lumbar mobility ($P<0.05$).

Conclusion: Ligamentum flavum preservation in PTED reduces operative time and complication risk while yielding superior long-term patient-reported outcomes and radiographic stability compared to partial resection. Although resection provides earlier symptomatic relief, it compromises segmental stability and accelerates disc height collapse. Preservation optimizes the balance between short-term recovery and long-term structural integrity, establishing it as the preferred technique. Future studies should validate these findings through extended follow-up and comprehensive biomechanical assessments.

Free Paper 16

OP-060

Prophylactic Antibiotics in Vertebroplasty and Kyphoplasty : A Nationwide Analysis of Infection Rates and Antibiotic Use

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Objective: Vertebroplasty (VP) and kyphoplasty (KP) are minimally invasive procedures widely used for osteoporotic vertebral compression fractures and vertebral metastases. Although generally safe, postoperative surgical site infections (SSIs) may cause severe complications. The incidence of SSIs in VP and KP remains unclear, and optimal prophylactic antibiotics strategies have not been established. This study evaluated SSI incidence and the impact of prophylactic antibiotics using a nationwide quality assessment (QA) database.

Methods: Data from 7th to 9th QA waves of the Health Insurance Review and Assessment (HIRA) Service in Korea were analyzed. A total of 23,868 patients who underwent VP or KP were included. SSI incidence was assessed, and patients were categorized based on antibiotic timing (preoperative-only, postoperative-only, and both pre- and postoperative) and antibiotic type. Infection rates were compared among these groups.

Results: Among 23,868 patients, 47 SSIs (0.2%) occurred. Notably, no SSIs were observed in the preoperative-only group, whereas incidences were 0.36% (9 cases) in the postoperative-only group and 0.19% (38 cases) in the both pre- and postoperative group. Regarding antibiotic types, the lowest SSI incidence (0.16%) occurred with first- or second-generation cephalosporins, whereas higher rates were found in groups receiving other antibiotics alone (0.3%) or combined antibiotics (0.53%).

Conclusion: The overall SSI incidence for VP and KP was low (0.2%). Preoperative-only prophylactic antibiotic administration appears effective. Additionally, first- and second-generation cephalosporins showed the lowest SSI rates, suggesting their preferential use. Further prospective studies are needed to confirm these findings and refine prophylactic antibiotic protocols.

Keywords: antibiotic prophylaxis, spine surgery, vertebroplasty, kyphoplasty, surgical wound infection

Free Paper 16

OP-061

Impact of Endoscopic and Open Approaches on Spinal Alignment and Reoperation after Treatment for Pyogenic Spondylodiscitis

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Purpose: While both open and minimally invasive surgical techniques are effective in managing pyogenic spondylodiscitis, their long-term effects on spinal alignment and reoperation rates remain debated. This study evaluates how surgical modality influences infection control, sagittal balance, and fusion outcomes.

Methods: We retrospectively analyzed 60 patients with thoracolumbar pyogenic spondylodiscitis treated surgically between 2020 and 2022, with at least 12 months of follow-up. Patients were classified into three groups: (A) open debridement with pedicle screw fixation and autologous bone graft, (B) open debridement with screw fixation and interbody cage, and (C) endoscopic transforaminal debridement under local anesthesia, without instrumentation.

We assessed inflammatory markers, pain, and segmental kyphosis pre- and post-operatively. Outcomes included time to reoperation and time to fusion (defined as Patil grade ≤2). Statistical analysis involved repeated-measures ANOVA, mixed-effects models, and Kaplan-Meier survival analysis with the log-rank test.

Results: All surgical approaches achieved comparable infection control (CRP: $p = 0.327$; ESR: $p = 0.396$). However, changes in spinal curvature varied significantly ($p = 0.001$). Immediate postoperative correction of segmental lordosis was greater in open approaches (A: 7.97°, B: 9.33°) than in endoscopic surgery (C: 0.60°). Significant kyphotic relapse was observed in patients treated without a cage (A: -3.78°, $p = 0.025$), while changes were not statistically significant in groups B (1.44°, $p = 0.082$) and C (1.44°, $p = 0.302$).

Reoperation rates were similar across groups (A: 40%, B: 20%, C: 30%, $p = 0.3065$). However, fusion occurred fastest in group B ($p = 0.002$).

Conclusion: Endoscopic debridement under local anesthesia effectively controls infection with acceptable alignment preservation, offering a less invasive alternative. However, open surgery with interbody cage placement optimizes spinal stability and accelerates fusion. Pedicle screws alone do not prevent postoperative kyphosis, highlighting the structural advantage of cage support in surgical management of spinal infection.

Free Paper 16

OP-062

Unveiling Nonlinear Synergy: BMI, Osteoporosis & Disc Degeneration in Post-UBE Lumbar Stability

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Background: Unilateral biportal endoscopy (UBE) has emerged as the mainstream minimally invasive technique for treating lumbar spinal stenosis; however, postoperative segmental stability may be jointly influenced by multiple pathological factors, including body mass index (BMI), osteoporosis (BMD), and intervertebral disc degeneration.

Objective: To assess the independent and synergistic biomechanical effects of elevated BMI, osteoporosis, and intervertebral disc degeneration on lumbar segmental stability following UBE decompression, thereby providing a theoretical basis for pre-operative risk stratification and optimization of postoperative rehabilitation strategies.

Methods: A high-fidelity three-dimensional finite-element model of the L3–S1 lumbar spine was constructed from computed-tomography data of a healthy 31-year-old male volunteer using ANSYS APDL 13.0, in order to simulate segmental mechanical responses after UBE decompression. Four BMI levels (22.86, 26.12, 29.39, and 32.65 kg · m^{-2}), normal versus osteoporotic bone quality, and mild versus severe disc degeneration were configured, yielding 24 pathological combinations in total. A 150 N axial compressive load and pure moments of ±10 N · m were applied; outcome measures—including segmental range of motion (ROM), intradiscal pressure (IDP), and facet-joint von Mises stress—were extracted and validated against published data to ensure model fidelity.

Results: (1) Single-factor effects: For every one-grade increase in BMI, L4–L5 intradiscal pressure (IDP) rose by 9 %–12 %. Severe osteoporosis increased vertebral axial-compression displacement by ≈ 55 % and elevated peak facet-joint stress by ≈ 48 %. Severe disc degeneration markedly amplified axial-rotation ROM (≈ 70 % increase); flexion and lateral-bending ROM rose by ≈ 65 % and 63 %, respectively, whereas extension showed the smallest gain (≈ 12 %).

(2) Synergistic effects: When a high BMI (32.65 kg/m^2) was combined with severe osteoporosis and severe degeneration, axial-rotation ROM increased by 118 % and peak facet-joint stress rose from 1.02 to 2.47 MPa, far exceeding linear additive expectations.

The combination of high BMI and osteoporosis elevated unit stress on posterior facet surfaces by ~42 %.

(3) "Pseudo-stability" window: In the presence of severe degeneration plus osteoporosis, macroscopic ROM increased by only 12 % beyond the high-BMI condition, yet the internal IDP peak surged by 54 %, indicating that apparent stability masks internal overload—a "pseudo-stability" state characterized by slightly reduced mobility but substantial stress accumulation.

Conclusion: Elevated BMI, osteoporosis, and intervertebral disc degeneration exert a pronounced nonlinear synergistic enhancement on lumbar segmental stability after unilateral biportal endoscopy (UBE), and macroscopic mobility alone is insufficient to capture the attendant internal stress risk. Clinically, a comprehensive pre-operative appraisal of these three risk factors, coupled with post-operative weight control, anti-osteoporotic therapy, and staged rehabilitation, is advised to reduce the likelihood of instability and recurrent degeneration.

Free Paper 16

OP-063

Posterior Fixation with Vertebroplasty for Osteoporotic Vertebral Fractures at the Thoracolumbar Junction: A Comparative Study of the Percutaneous and Conventional Open Pedicle Screw Fixation

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Purpose: Posterior fixation with vertebroplasty has shown favorable outcomes in managing osteoporotic vertebral fractures (OVF). However, the comparative efficacy of percutaneous pedicle screw (PPS) fixation and conventional open pedicle screw (OPS) fixation remains controversial. This study aimed to compare the clinical outcomes of PPS and OPS fixation for OVF.

Methods: A retrospective cohort study included 41 patients (mean age 77.4 years; 27 women, 14 men) treated for OVF at the thoracolumbar junction from two medical centers, with a minimum follow-up of one year. 20 patients underwent PPS fixation, and 21 underwent OPS fixation. For OPS fixation, sublaminar taping and transverse rod connectors were employed, with posterior bone grafting performed. Comparative outcomes included kyphosis angle, screw loosening, adjacent vertebral fractures, operative time, intraoperative blood loss, blood transfusion requirements, infection, and reoperation rates.

Results: The mean kyphosis angles for PPS/OPS fixation were 30°/35° preoperatively, 14°/5° immediately postoperatively, 24°/17° at 3 months, and 24°/20° at 1 year, with OPS achieving significantly greater correction angles ($p<0.01$). However, correction loss did not differ significantly ($p=0.17$), as analyzed using a mixed-effects model. Screw loosening occurred in 14 and 15 patients, and adjacent vertebral fractures were observed in 4 and 5 patients in the PPS and OPS groups, respectively ($p=1.00$). The mean operative time was significantly shorter in the PPS group (94 vs. 244 minutes, $p<0.01$), and intraoperative blood loss was significantly lower (37 vs. 175 cc, $p<0.01$). Blood transfusions were required in 1 PPS case and 3 OPS cases. Postoperative infections occurred in 2 OPS cases, while reoperations were needed in 2 PPS cases.

Conclusion: PPS fixation showed inferior correction angles compared to OPS fixation. However, surgical outcomes were comparable, and PPS fixation offered superior minimal invasiveness, making it particularly advantageous for elderly patients.

Free Paper 17

OP-064

Effect of fusion vs. pseudarthrosis on development of adjacent segment degeneration and disease after anterior cervical discectomy and fusion (ACDF), at least 5 years follow-up

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Dongguk University Ilsan Hospotal

Backgrounds & Objectives: Cervical disc replacement has been compared with anterior cervical discectomy and fusion (ACDF) to elucidate the effect of preserved segmental motion on adjacent segment degeneration (ASD). However, the comparative evaluation has inherent limitation in terms of different criteria for patient selection and the cause of ASD is still controversial. The objective of this study is to analyze the effect of fusion on development of ASD by comparing to pseudarthrosis after ACDF.

Methods: This retrospective cohort study included patients who underwent single or multi-level ACDF to treat cervical radiculopathy or myelopathy. Status of fusion and ASD was determined at least 5 years after surgery. Adjacent segment disease (ASDi) was defined as ASD with related symptoms treated with cervical injection or surgery at the ASD level. Radiological parameters and clinical outcomes were compared between fusion group and pseudarthrosis group. Logistic regression analysis was performed to identify the risk factors of ASD.

Results: One-hundred four patients were enrolled in this study. Fusion rate was 62.5% (65/104 patients). There was no difference in demographics between the fusion group and the pseudarthrosis group except the number of multi-level surgery (42% vs 72%, p=0.003). There was no significant difference in radiological and clinical outcomes between two groups. ASD rates were 36.9% and 7.7% in the fusion group and the pseudarthrosis group, respectively (p<0.001). ASDi rates were 20% and 5.1% in the fusion group and the pseudarthrosis group, respectively (p=0.037). Multivariate logistic regression analysis demonstrated that fusion, low bone mineral density (BMD), high C2-C7 sagittal vertical axis (SVA) were significantly correlated with ASD.

Conclusions: Fusion causes significantly more ASD and ASDi after ACDF compared to pseudarthrosis. Fusion is an independent risk factor of ASD after ACDF and other risk factors include low BMD and high C2-C7 SVA.

Keywords: ACDF, adjacent segment degeneration, adjacent segment disease, fusion, pseudarthrosis

Free Paper 17

OP-065

Research on the Mechanism of Discogenic Neck Pain Based on the Anatomy of the Cervical Sinuvertebral Nerve

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Objective: To conduct an anatomical study of the sinuvertebral nerve in the intervertebral foramina regions from C2/3 to C7/T1 and explore the anatomical mechanisms underlying discogenic neck pain.

Methods: Under a surgical microscope, 96 intervertebral foramina from 8 embalmed adult cervical spine specimens were dissected and observed. The origin, number, diameter, and course of the sinuvertebral nerve were recorded, along with its spatial relationships with the spinal nerve, vertebral artery, intervertebral disc, and uncovertebral joint.

Results: A total of 528 sinuvertebral nerves were identified in the 96 intervertebral foramina regions, with diameters ranging from 0.1 mm to 1.50 mm. Sinuvertebral nerves were present in all foramina (100%) and categorized into primary and secondary branches. Among them, 172 primary branches (average 1.79 per foramen) and 356 secondary branches (average 3.71 per foramen) were observed. The origins of the sinuvertebral nerves included the spinal nerve, vertebral nerve, and dual roots. Primary branches were thicker, traveled longer distances, and distributed extensively. They arose from the spinal nerve and/or vertebral nerve, coursed dorsolaterally around the uncovertebral joint, entered the spinal canal through the intervertebral foramen, and extended medially beyond the medial edge of the pedicle, innervating the posteromedial intervertebral disc, posterior longitudinal ligament, vertebral body, uncovertebral joint, and vertebral artery surface. Secondary branches were thinner and shorter, primarily distributed outside the medial edge of the pedicle. Notably, sinuvertebral nerves were observed around the vertebral artery in the C2–C7 segments but absent in the C7–T1 segment.

Conclusion: This study provides a systematic anatomical investigation of the cervical sinuvertebral nerve. A comprehensive understanding of its distribution patterns contributes to elucidating the mechanisms of discogenic neck pain and refining treatment strategies.

Keywords: Discogenic neck pain; Sinuvertebral nerve; Vertebral nerve; Intervertebral disc;

Free Paper 17

OP-066

Age-related Postoperative Outcomes in Cervical Myelopathy Surgery: A Propensity-Matched Comparison Between Patients Aged ≥75 Years and Younger Patients

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Introduction: The role of age in surgical outcomes for degenerative cervical myelopathy (DCM) remains controversial. This study aimed to compare neurological and quality-of-life outcomes following cervical spine surgery between elderly (≥75 years) and younger (<75 years) patients.

Methods: A retrospective cohort of 756 patients who underwent DCM surgery from 2011 to 2021 was analyzed. Propensity score matching (1:1, nearest neighbor) was used to control for baseline differences, resulting in two balanced groups (n=87 each). Matching factors included preoperative Japanese Orthopedic Association (JOA) scores, Charlson Comorbidity Index (CCI), sex, smoking status, and surgical procedure. One-year postoperative outcomes included JOA score and recovery rate, NRS neck/arm pain, Neck Disability Index (NDI), SF-12 PCS/MCS, EQ-5D, and minimum clinically important difference (MCID) achievement.

Results: Matched cohorts showed similar preoperative characteristics, including JOA (elderly 9.60 vs. younger 9.67, p=0.990) and NDI scores (34.38 vs. 33.60, p=0.792), with elderly patients reporting lower preoperative neck pain (p=0.003). At 1-year, both groups achieved comparable JOA recovery (22.08% vs. 15.33%, p=0.791), NDI improvement (-10.03 vs. -8.79, p=0.779), SF-12 PCS (40.01 vs. 39.07, p=0.899), and EQ-5D scores (0.66 vs. 0.67, p=0.862). Notably, elderly patients demonstrated superior arm pain improvement (p=0.044) and higher MCID achievement for neck pain (83.9% vs. 29.9%, p<0.05).

Conclusion: Elderly patients (≥75 years) undergoing DCM surgery experience neurological and quality-of-life improvements comparable to younger patients, with superior outcomes in some domains. Age alone should not preclude surgical consideration; patient selection should prioritize clinical status and comorbidity profile.

Free Paper 17

OP-067

The efficacy and safety of mini-open (air/water medium) endoscopy-assisted anterior cervical discectomy and fusion for the treatment of cervical spondylotic myelopathy

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Purpose: To compare the clinical efficacy of mini-open (air/water medium) endoscopy-assisted anterior cervical discectomy and fusion (MOEA-ACDF) and anterior cervical decompression and fusion (ACDF) for cervical spondylotic myelopathy (CSM).

Methods: This study retrospectively analysed the clinical data of CSM patients who received surgical treatment from January 1, 2020, to December 31, 2022. Patients were divided into two groups according to the surgical method: the MOEA-ACDF group and the ACDF group. The preoperative and postoperative imaging results at 1 week and the last follow-up examination were compared between the two groups. The Japanese Orthopaedic Association (JOA) score, visual analogue scale (VAS) score and neck disability index (NDI) score were used to evaluate the clinical outcomes preoperatively, 1 week postoperatively and at the last follow-up examination. The minimum follow-up duration was 12 months.

Results: A total of 131 CSM patients who underwent surgery at our institution were included, including 61 patients in the MOEA-ACDF group and 70 patients in the ACDF group. In the MOEA-ACDF group, the postoperative C2-C7 Cobb angle and HAVB were significantly greater than the preoperative values ($P < 0.05$). In the ACDF group, the postoperative C2-C7 Cobb angle was also significantly greater than the preoperative value, and the C2-C7 ROM and HAVB significantly decreased ($P < 0.05$). The postoperative neurological function of the patients in both groups improved, and the postoperative VAS score and NDI score significantly decreased. Compared with ACDF, MOEA-ACDF is associated with a significantly larger postoperative C2-C7 Cobb angle and significantly better C2-C7 ROM and HAVB, as well as better clinical efficacy ($P < 0.05$).

Conclusions: MOEA-ACDF combines endoscopic systems with ACDF technology to treat CSM, but its clinical efficacy is not inferior to that of ACDF in the short- to intermediate-term. It can effectively and safely restore the cervical intervertebral height, physiological curvature, and range of motion.

Keywords: anterior cervical discectomy and fusion; cervical spondylotic myelopathy; endoscopy; clinical efficacy

Free Paper 18

OP-068

Clinical and Radiographical Efficacy of Single Prone Position Oblique Lateral Interbody Fusion in Lumbar Degenerative Disease

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Purpose: Single prone position oblique lateral interbody fusion (prone-OLIF) is a newer variant that eliminates patient repositioning and aims to improve outcomes compared to minimally invasive transforaminal lumbar interbody fusion (MIS-TLIF). This study compares the clinical and radiographic results of prone-OLIF and MIS-TLIF. The study aimed to explore the feasibility of the prone OLIF.

Methods: This retrospective study involved 28 prone-OLIF patients and 56 MIS-TLIF patients, matched 1:2 based on age, comorbidity index, and fused spinal levels. Anthropometric, clinical, and radiographic outcomes were compared using statistical analyses.

Results: Prone-OLIF showed superior postoperative clinical outcomes with lower Oswestry disability index (ODI) scores at 5.61 and visual analogue scores (VAS) at 1.43, compared to 11.00 and 3.64 in the MIS-TLIF group, respectively. It also resulted in greater sagittal alignment correction, with a 5.46° improvement in the regional lumbar lordotic angle versus 0.19° in MIS-TLIF. Additionally, prone-OLIF had less intraoperative blood loss but longer operation times.

Conclusion: Prone-OLIF offers superior clinical and radiographic outcomes over MIS-TLIF in pain relief, functional improvement, and spinal alignment correction, despite longer surgical times. Further studies with larger cohorts are needed to validate these findings.

Free Paper 18

OP-069

Overcoming Age Barriers: Oblique Lateral Interbody Fusion as a Safe Surgical Option for Super-Elderly Patients

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Purpose: With an aging population, degenerative lumbar spinal stenosis (DLSS) requiring surgery are increasing. Oblique lateral interbody fusion (OLIF) is a minimally invasive technique, but its safety and efficacy in super-elderly (SE) patients remain unclear. The purpose of this study was to compare the outcomes and complication of OLIF outcomes in SE patients with elderly patients.

Methods: This study analyzed patients who underwent OLIF for DLSS between January 2018 and December 2022. A total of 41 patients aged ≥80 years were included in the super-elderly group (group SE). Using 1:2 propensity score matching based on sex, body mass index, American Society of Anesthesiologists score, Charlson comorbidity index, and the number of fusion levels, 82 matched patients aged 65 to 75 years were selected as the elderly group (group E). All patients had a minimum follow-up of one year. Preoperative ASA scores were used to evaluate baseline performance status. Visual analog scales for back pain (VAS-BP) and leg pain (VAS-LP), and Korean Oswestry disability index (K-ODI) were used to assess clinical and functional outcomes preoperatively and last follow-up. Percent changes of VAS-BP, VAS-LP and K-ODI were also analyzed. Fusion rates were evaluated by computed tomography six months and one year after surgery. In addition, bone mineral density (BMD), operative time, estimated blood loss (EBL), blood transfusion, hospital days, hospitalization in intensive care unit (ICU) and postoperative complications were compared between the two groups.

Results: The average age of group SE was 81.8 years and that of group E was 70.1 years. There were no differences in preoperative or postoperative VAS BP and VAS-LP, BMD, operative time, EBL, blood transfusion, hospital days, hospitalization in ICU and fusion rates. Preoperative and postoperative K-ODI were significantly higher in group SE than group E (all $P<0.05$). However, percent changes of VAS-BP, VAS-LP and K-ODI showed no significant differences between the groups. Overall early and late complications after surgery were not significantly different in the two groups.

Conclusion: OLIF is considerable treatment to improve the quality of life of SE patients with DLSS.

Key words: Oblique lateral interbody fusion, super-elderly

Free Paper 18

OP-070

Perioperative outcomes of octogenarian patients in OLIF surgery

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CHA university

Purpose: As life expectancy increases, the demand for spinal fusion surgery in elderly patients has grown significantly. Oblique Lumbar Interbody Fusion (OLIF) has been increasingly adopted due to its minimally invasive nature and favorable postoperative recovery profile. However, perioperative outcomes in octogenarian patients undergoing OLIF remain underreported. This study aims to compare the perioperative clinical parameters, complication profiles, and short-term outcomes of OLIF surgery between patients in their 70s and those in their 80s.

Methods: We retrospectively reviewed patients who underwent OLIF surgery at a single institution. Patients were grouped by age: those in their 70s (n=64) and those in their 80s (n=42). Demographics, perioperative lab parameters (CRP, hemoglobin), hospital stay, complication incidence, and past medical histories were collected and compared.

Results: Octogenarians had a statistically longer hospital stay compared to patients in their 70s (12.54 ± 6.52 vs. 10.18 ± 4.62 days, $p<0.05$). The mean CRP level on postoperative day 3 was also significantly higher in the 80s group (11.66 ± 5.94 mg/dL) than in the 70s group (9.16 ± 5.12 mg/dL, $p<0.05$), suggesting a heightened inflammatory response. The incidence of ileus was 4.8% in the 70s group and 17.1% in the 80s group. Delirium occurred in 0.0% of the 70s group and 7.3% of the 80s group. Logistic regression showed that patients in their 80s had a 4.1-fold increased odds of developing ileus ($p=0.05$), though the trend for delirium did not reach statistical significance due to low event numbers.

Conclusion: While OLIF surgery is feasible in octogenarian patients, they are at increased risk for specific perioperative complications, notably ileus and elevated inflammatory responses as evidenced by higher POD C3 CRP levels. Additionally, older patients experienced longer hospital stays, highlighting the need for anticipatory perioperative care and vigilant postoperative monitoring. Further prospective studies are warranted to optimize outcomes in this vulnerable population.

Free Paper 18

OP-071

Self-solidified calcium phosphate artificial bone with rhBMP-2 versus allograft bone for OLIF: a self-controlled, randomized and double-blind study

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Purpose: This study aims to evaluate the difference in fusion rates between patients undergoing OLIF with the application of rhBMP-2 self-solidified calcium phosphate artificial bone (granule form) and allograft bone, using a prospective self-controlled randomized double-blind design.

Methods: A prospective self-controlled randomized double-blind design will be employed, enrolling patients who require OLIF of L3-5. Inclusion criteria: (1) Lumbar spinal stenosis with incomplete nerve damage, lumbar instability with incomplete nerve damage, or grade <II Meyerding spondylolisthesis at L3 or L4; (2) Patients who have undergone at least 6 months of conservative treatment without significant symptoms relief; (3) Age >18 years; (4) Patients who provide informed consent to participate in the clinical study. Exclusion criteria: (1) History of lumbar spine surgery; (2) Incomplete posterior spinal structures; (3) Vertebral body damage due to trauma; (4) Progressive neuromuscular diseases; (5) Patients with systemic diseases who are not suitable for surgery; (6) History of abdominal surgery that affects the retroperitoneal anatomy on the left side; (7) Patients with a narrow gap between the psoas muscle and surrounding blood vessels. Patients will be randomly assigned to groups using the drawing of method: 40 patients of "Group A: Artificial bone for L3-4, allograft bone for L4-5" and 40 of "Group B: Allograft bone for L4-5, artificial bone for L3-4." On the first day after surgery and each follow-up, lumbar spine X-rays and CT scans will be taken. Preoperative and postoperative (at 1 day, 1, 3, 6, and 12 months) visual analogue scale (VAS) scores will be recorded for back pain and leg pain. Preoperative and 12-month postoperative Oswestry Disability Index (ODI) scores will be recorded. Evaluation of imaging data will be performed by two experienced orthopedic surgeons who are blinded to the group assignment of the patients.

Results: A total of 80 patients were included. The average age was 72.4±8.4 years, including 30 males and 50 females. All patients were followed up for more than 2 years. The preoperative VAS scores for back pain were 3.7±1.9, and for leg pain, they were 4.1±2.0. One day after surgery, the VAS scores for back pain were 3.1±1.4, and for leg pain, they were 1.9±1.4. At the last follow-up, the VAS scores for back pain and leg pain were 1.5±1.2 ($p<0.05$) and 0.5±0.6 ($p<0.05$), respectively. ODI score before surgery was 57.5±3.4, and at 12 months postoperatively, it was 27.3±2.8 ($p<0.05$). The 24-month follow-up results were as follows: the fusion rate with rhBMP-2 artificial bone was 91.3%, while the fusion rate of allograft bone was 77.5% ($p<0.05$).

Conclusions: Patients who underwent OLIF with rhBMP-2 artificial bone as the bone graft material had a significantly higher fusion rate at 12 months compared to those who received allograft bone.

Free Paper 19

OP-072

Comparison of Open Microscopic and Bi-portal Endoscopic Approaches in Multi-Level Posterior Cervical Foraminotomy: Radiological and Clinical Outcomes

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Purpose: This study compares clinical and radiological outcomes of open microscopic posterior cervical foraminotomy (PCF) and biportal endoscopic spine surgery (BESS) PCF in multi-level cases. While BESS PCF is effective in single-level surgeries, its role in multi-level procedures remains unclear.

Methods: This retrospective cohort study included 60 patients treated for cervical radiculopathy from 2016 to 2023, divided into two groups: open microscopic PCF (Group M, n = 30) and BESS PCF (Group B, n = 30). Clinical outcomes were assessed using visual analogue scale (VAS) scores for neck and arm pain and the neck disability index (NDI). Radiological parameters included cervical angle, segmental angle, range of motion (ROM), and the extent of facetectomy.

Results: Both groups showed improvement in the arm pain VAS and the NDI. However, Group B exhibited significantly better neck pain on the VAS at the final follow-up ($p = 0.03$). Radiologically, Group B maintained lordotic cervical and segmental angles postoperatively, while Group M showed kyphotic changes ($p < 0.01$). Segmental ROM was larger in Group M, indicating greater instability ($p < 0.01$). Group B had less extensive facetectomy while achieving comparable foraminal enlargement. Operative time was longer for Group B ($p < 0.001$).

Conclusion: BESS PCF preserves cervical stability and reduces postoperative neck pain compared to open microscopic PCF in multi-level procedures. Despite longer operative times, its benefits in minimizing instability make it a promising option for treating multi-level cervical radiculopathy. Further research with long-term follow-up is recommended.

Figure Legend: The available surgical routes were drawn to the facet joint on the postoperative CT images. (A, B) A representative patient from Group B and M, respectively. (A) The lateromedial surgical route was available in BESS PCF. (B) The lateromedial surgical route was restricted in open microscopic PCF.

Free Paper 19

OP-073

Clinical Efficacy of Percutaneous Endoscopic Treatment via the Lateral Mass Approach for Cervical Spondylotic Radiculopathy

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Purpose: To evaluate the feasibility, efficacy, and safety of the single-port spinal endoscopic lateral mass approach for treating cervical radiculopathy.

Methods: A retrospective analysis was conducted on 31 patients (19 males, 12 females; mean age 45.2 years, range 28-79) with single-level unilateral cervical radiculopathy treated with single-port spinal endoscopic lateral mass approach at Chongqing Traditional Chinese Medicine Hospital between April 2021 and April 2024. Affected levels included C4/5 (5 cases), C5/6 (17 cases), and C6/7 (9 cases). Surgical technique: Under direct endoscopic visualization, the medial 1/3-1/2 of the lateral mass was identified. The superomedial portion of the pedicle was drilled to open the neural foramen, followed by removal of herniated free nucleus pulposus and osteophytes to decompress the nerve root. Outcome measures: Operative time and complications were recorded. Visual Analog Scale (VAS) and Oswestry Disability Index (ODI) scores were assessed preoperatively and at 3 days, 1, 3, 6, and 12 months postoperatively. The modified Macnab criteria evaluated clinical outcomes at 12 months.

Results:

• Mean operative time: 100 ± 21.20 min with no complications

• Significant improvement in VAS and ODI scores at all postoperative timepoints vs. preoperative ($P < 0.01$)

• Modified Macnab outcomes at 12 months:

- Excellent: 28 cases
- Good: 2 cases
- Fair: 1 case
- Poor: 0 cases

• Overall satisfaction (excellent/good rate): 96.77% (30/31)

Conclusion: The single-port spinal endoscopic lateral mass approach is a safe, feasible, and effective surgical technique for treating cervical radiculopathy.

Free Paper 19

OP-074

Delta Large-Channel Endoscopy Versus Anterior Cervical Discectomy and Fusion for Cervical Spondylotic Radiculopathy : A Retrospective Cohort Study

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Purpose: To compare the clinical efficacy of posterior cervical delta large-channel endoscopy versus anterior cervical discectomy and fusion (ACDF) in the treatment of single-segment cervical spondylotic radiculopathy (CSR).

Methods: A retrospective analysis was conducted on 75 patients with single-segment CSR treated between February 2022 and March 2024. Patients underwent either posterior cervical delta large-channel endoscopy (n = 32) or ACDF (n = 43). Clinical and radiological follow-ups were performed preoperatively, and at 3 days, 3 months, and 12 months postoperatively. Collected data included demographics, operative time, incision length, intraoperative blood loss, hospital stay, and complications. Outcomes were evaluated using the Japanese Orthopaedic Association (JOA) score, Neck Disability Index (NDI), Visual Analogue Scale (VAS), and cervical range of motion (ROM). Radiological parameters included C2–7 Cobb angle and cervical spondylotic angle (CSA). Overall efficacy was assessed by the modified Macnab criteria.

Results: Both groups showed significant postoperative improvements in JOA and ROM, and reductions in VAS and NDI scores ($P < 0.05$). There were no significant differences in JOA or NDI scores between the groups at any time point. However, the endoscopy group demonstrated significantly better ROM and lower VAS scores at 3 days and 3 months postoperatively ($P < 0.05$); differences were not significant at 12 months ($P > 0.05$). Cervical curvature improved significantly over time in both groups ($P < 0.05$), with no significant intergroup differences ($P > 0.05$). Operative time was comparable between groups ($P > 0.05$), but the endoscopy group had greater blood loss and higher hospitalization costs ($P < 0.05$). According to the modified Macnab criteria, both groups achieved similar rates of excellent and good outcomes. Postoperative imaging confirmed complete decompression of the affected nerve roots in all patients.

Conclusions: Both posterior cervical delta large-channel endoscopy and ACDF are safe and effective for managing single-segment CSR. The endoscopic approach offers advantages in early postoperative recovery, particularly in preserving cervical mobility and alleviating early postoperative pain.

Keywords: Cervical spondylotic radiculopathy, Delta large-channel endoscopy, ACDF, Clinical efficacy

Free Paper 20

OP-075

Is Intraoperative Force Measurement Effective for Cage Size Selection in Oblique Lateral Interbody Fusion (OLIF)? A Retrospective Study

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Purpose: Selecting an appropriately sized interbody cage is critical in OLIF surgery to restore disc height while avoiding complications such as loosening of the interbody cage due to undersized cage or endplate collapse due to oversized cages. Traditional cage selection relies heavily on surgeon experience, which prolongs the learning curve. This study evaluates the efficacy of intraoperative force measurement (pull-out force and torsional resistance) for optimizing cage size selection.

Methods: A retrospective analysis was conducted on 41 patients with degenerative lumbar diseases undergoing OLIF between 2023 and 2024. Preoperative CT scans were used to estimate target disc height. Patients were divided into two groups: Group 1 (n=20): Cage size selected based on surgeon experience after trial spacer insertion. Group 2 (n=21): Cage size determined using a force measurement to measure pull-out force (>100 N) and torsional resistance (>20 N). Outcomes included deviation between postoperative fusion device height and preoperative plan, operative time (from discectomy to cage placement), postoperative disc height, lumbar lordosis angle, fusion rate, and cage subsidence.

Results: Cage size selection showed no statistically significant deviation from preoperative planning in both groups. Operative time and postoperative disc height improvement were comparable between groups. At 1-year follow-up, fusion rates were excellent in both groups (no significant difference). Cage subsidence occurred in 2 cases (10%) in Group 1 vs. 1 case (4.8%) in Group 2.

Conclusion: Intraoperative force measurement is a safe and effective method for cage size selection in OLIF, potentially reducing the learning curve for surgeons and minimizing complications such as subsidence. This technique offers an objective, biomechanically guided approach to enhance surgical precision without prolonging operative time.

Free Paper 20

OP-076

A Novel Surgical Approach Using the "Lateral Corridor" for Minimally Invasive Oblique Lumbar Interbody Fusion at L5-S1 : A Clinical Series and Technical Note

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Purpose: The minimally invasive oblique lumbar interbody fusion (MI-OLIF) L5-S1 was introduced to overcome the limitations of conventional fusion techniques, however, MI-OLIF is not possible using the standard method due to vascular structures in some cases. We aimed to introduce the "lateral corridor" and report the details of the surgical technique with a clinical case series.

Methods: We utilized the lateral access route of the left common iliac vein and named it the "lateral corridor", to distinguish the technique from the standard technique (central corridor). The type and frequency of branch vessels that required additional manipulations were reviewed, and the frequency of intraoperative vascular injury was investigated.

Results: Among the 107 patients who underwent MI-OLIF L5-S1, 26 patients (24.3%) who received the "lateral corridor" technique were included. Branch vessel ligation was required in 42.3% of the patients. The types of branch vessels that required ligation were seven cases (26.9%) of the iliolumbar vein (ILV) and six cases (23.1%) of ascending lumbar vein (ALV). The ILV and ALV were ligated in two cases. None of the patients developed intraoperative vascular injuries.

Conclusion: We introduced the "lateral corridor" as an alternative approach for MI-OLIF L5-S1, implemented it in 24.3% of the patient cohort, and reported favorable outcomes devoid of vascular complications. The "lateral corridor" necessitated ligation of the ILV or ALV in 42.3% of cases. The "lateral corridor" approach appears to be a promising surgical technique, offering feasibility even in instances where the vascular anatomy precludes the employment of the conventional approach.

Keywords: Oblique lumbar interbody fusion; Lateral corridor; Surgical approach; Vascular injury; Complicatio

Free Paper 20

OP-077

Single incision MIS-TLIF decompression for lumbar spondylolisthmia

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The First Affiliated Hospital of University of Sci

Background: Minimally invasive fusion of lumbar isthmus in pursuit of early rehabilitation.

Objective: Treat lumbar spondylolisthmia with unilateral bilateral decompression using modified single incision microscope assisted transforaminal nucleus pulposus fusion nail-rod internal fixation (MIS-TLIF).

Methods: From January 2020 to December 2022, 46 cases of lumbar isthmic spondylolisthesis were retrospectively analyzed and selected in our department, including 36 cases of lumbar isthmic spondylolisthesis 5, 7 cases of lumbar spondylolisthesis 4, and 3 cases of double-level spondylolisthesis. There were 20 males and 26 females, aged 42 ~ 69 years, with an average age of 52.4 years. Operation time and blood loss were recorded during the operation. Follow-up was performed 1 month, 3, 6 and 12 months after operation, and VAS and ODI scores were used at the last time. $P<0.05$ was considered statistically significant.

Results: All patients were followed up for (16.4±4.1) months, the operation time was 66.35±24.52min, the intraoperative blood loss was 55±40ml, the VAS scores of lumbago and leg pain were significantly lower than before surgery, and the ODI scores were significantly better than before surgery. On the second day after surgery, 5 patients had transient numbness of lower limbs. All patients disappeared or improved within 3 months after treatment, and no infected nerve root injury or serious complications occurred. During the follow-up period, there was no fracture of nail rod internal fixation, aggravation of symptoms and long-term complications of revision.

Conclusion: MIS-TLIF treatment of isthmic spondylolisthesis can reduce the damage of muscle, nerve root and dural sac, and has the advantages of less damage, less bleeding, lower infection rate and faster postoperative recovery.

Free Paper 20

OP-078

Validating and Predicting the Impact of Socioeconomic Status on Early Outcomes Following Oblique Lumbar Interbody Fusion

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Introduction: Early postoperative pain following lumbar fusion can delay the progress of patients' rehabilitation and increase medical costs. Socioeconomic status (SES) has the potential to act as a predictor of early postoperative pain. Nevertheless, current research employs definitions of SES that may not be universally applicable across diverse countries or regions.

Object: This study aims to validate the impact of SES on early outcomes following oblique lumbar interbody fusion (OLIF), and precluded the limitations of regional or national differences. Additionally, we create a prediction model to quickly assess early postoperative prognosis, allowing for treatment decision making.

Methods: Patients who received OLIF combined with anterolateral screw fixation (OLIF-AF) and stress endplate augmentation (OLIF-AF-SEA) at our center between March 2021 and July 2022 were retrospectively reviewed. The one-month postoperative Visual Analog Scale (VAS) was used as the outcome measure. Demographic and clinical data were collected and subjected to preliminary statistical analysis. According to the different OLIF modalities, data were divided into training and validation datasets. Three different machine learning models were trained, and were evaluated according to the area under the curve (AUC) of the receiver operating characteristics (ROC) curve. Feature importance for each SES indicator was calculated in all models.

Results: A total of 165 patients were included, with 83 reporting moderates to severe pain during the early postoperative period. Binary logistic regression revealed that reimbursement rate, residential area, and employment status were significantly associated with early outcomes following OLIF ($P<0.001$). Pearson's chi-square analysis also indicated that patients without family support had worse early clinical outcomes ($P<0.001$). The random forest (RF) model demonstrated the best performance in the validation set with an AUC of 0.84. All three models consistently identified the insurance reimbursement percentage (IRP) as the as the most important features.

Conclusions: This study validates the impact of SES on early outcomes following lumbar fusion in OLIF patients. The machine learning models developed in this study can aid medical workers in quickly identifying patients with poor early clinical outcomes based on SES factors, enabling timely interventions for postoperative rehabilitation.

Abstracts

Quick fire

PASMISS 2025
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Quick fire 1

OP-079

A new 3D full-body scanner analyzing the sagittal and coronal balance of the adult spine: a preliminary prospective observational study

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Background: The degenerative spondylosis can cause the difficulty in maintaining sagittal and coronal alignment of spine, and X-ray parameters are the gold standard to analyze the malalignment. This study aimed to develop a new 3D full body scanner to analyze the spinal balance and compare it to X-ray parameters.

Methods: Ninety-seven adult participants who suffer degenerative spondylosis underwent 3D full body scanning, whole spine X-rays, clinical questionnaires and body composition analyses. The 5 inflection points (ear, shoulder, hip, knee, ankle) of the 3D scanner in the sagittal plane were automatically labeled by an AI algorithm. Three concepts are created including "the angle between two points with respect to the plumb line", "the horizontal distances between two points in the sagittal plane" and "the angle between three points". For the coronal plane, the shoulder gradient was analyzed. X-ray parameters of cervical, thoracolumbar and whole spine sagittal balance and coronal balances were compared. The body composition data and clinical questionnaire scores were compared to x-ray and 3D scanner parameters.

Results: The correlation coefficient (C.C.) of dAB_hor (horizontal distance between ear and shoulder in the sagittal plane) and C2-C7 SVA was 0.478 (p-value < 0.001). The C.C. of aAC_sag (sagittal angle of ear-hip from the plumb line) and ODHA was 0.336 ($p < 0.001$). About coronal balance, the C.C. of shoulder gradient and clavicle angle from x-ray was 0.373 ($p < 0.001$). The C.C.s were merely affected by body composition data. But in multiple regression analysis, BMI affected 3D scanner data. Clinical symptoms showed correlations with aBCD(shoulder-hip-knee) and aCDE(hip-knee-ankle angle), which may reflect a compensatory pelvic retroversion and knee flexion for positive sagittal imbalance.

Conclusions: This new 3D scanner has some strengths like radiation-free methods, correlation with x-ray parameters and clinical symptoms, independence to body composition data, and possibility of analyzing dynamic spine balance.

Keywords: Sagittal and coronal balance of the adult spine · 3D full body scanner · Anthropometry · Adult spine deformity · Compensatory mechanism of positive sagittal balance · Dynamic spine balance

Quick fire 1

OP-080

Real-Time Anatomical Structure Identification in Lumbar Endoscopic Spine Surgery Using Artificial Intelligence

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Purpose: Artificial intelligence (AI) has been increasingly applied in spine surgery, particularly in diagnostic imaging and preoperative planning. However, real-time AI assistance during endoscopic procedures remains underdeveloped in the field of orthopaedic surgery. This study aimed to develop and validate a real-time AI-based object detection model that can automatically identify key anatomical structures during spine endoscopic surgery, with the goal of supporting intraoperative decision-making and improving surgical safety.

Methods: We collected intraoperative endoscopic video data from 112 patients who underwent lumbar endoscopic spine surgery at five tertiary centers. To construct a high-quality dataset, still images were extracted at one frame per 300 frames, yielding 58,087 images. Spine surgeons manually annotated the images to label anatomical landmarks (e.g., traversing and exiting nerve roots, ligamentum flavum, intervertebral disc) and surgical instruments. A total of 2,728 labeled images were used to train and validate the AI model in a 4:1 ratio. We employed the YOLOv11 deep learning architecture for object detection. Model performance was evaluated using mean Average Precision (mAP), Intersection over Union (IoU), precision, recall, F1-score, and inference speed in frames per second (FPS).

Results: The AI model achieved a mAP@0.5 of 0.857 and an average IoU of 0.753 in the validation dataset. The inference speed reached 114.65 FPS, confirming real-time applicability. The model demonstrated robust detection of multiple anatomical structures, including nerve roots and the ligamentum flavum, with accurate localization across different surgical approaches such as interlaminar and extraforaminal routes. Instrument tip tracking was also feasible with high temporal resolution.

Conclusion: We developed a high-performance real-time AI model capable of accurately recognizing anatomical structures during lumbar endoscopic spine surgery. This technology holds potential for integration into the operative workflow to assist surgeons in navigating complex anatomy, reducing iatrogenic risk, and facilitating surgical education. Future efforts will focus on enhancing anatomical landmark detection and real-time clinical deployment.

Quick fire 1

OP-081

Percutaneous Transpedicular Intravertebral Cage Augmentation with Short-Segment Fixation Using Specially Designed Cannulated Cage Trials for Advanced Kummell Disease: A Preliminary Study Comparing with Vertebroplasty with Short-Segment Fixation

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Purpose: The management of Kümmell's disease (KD) remains controversial. Traditionally, corpectomy and reconstruction or osteotomy with long level fusion was performed for the advanced KD. These procedures, however, can be disadvantageous for elderly patients. Several alternative surgical procedures including transpedicular intravertebral cage augmentation (TPICA) or vertebroplasty (VP) in conjunction with short segment fixation (SSF) have been suggested to reduce operative morbidity. This study aimed to compare the outcomes of percutaneous TPICA plus SSF with VP plus SSF for advanced thoracolumbar (T11-L2) KD, and to describe our novel percutaneous TPICA technique using custom-designed cannulated cage trials.

Methods: We devised specially designed cannulated cage trials to make the TPICA procedure safer and more reproducible, minimizing the risk of the pedicle medial wall violation. All consecutive patients who underwent percutaneous TPICA or VP combined with SSF for advanced thoracolumbar KD, from January 2021 to June 2022, with ≥1-year follow-up at a single institution, were included. Perioperative details, clinical outcomes (visual analogue scale, Oswestry disability index), and radiological measurements (anterior vertebral body compression percentage and vertebral kyphotic angle [VKA] of the fractured vertebra, local cobb angle [LCA]) were collected and compared between the groups.

Results: A total of 42 patients were enrolled, with 21 allocated to each group. Notably, there were no patients with pedicle medial wall fracture in the TPICA group. Both procedures provided significant improvements in radiological parameters compared to preoperative values. No significant differences were observed in the changes over time in all radiological parameters between the groups. Loss of correction during the follow-up period was significantly smaller in patients with TPICA than in those with VP in VKA (2.15 [0.30 – 2.80] vs. 2.90 [0.90 – 6.53], $p = 0.030$) and LCA (2.70 ± 2.90 vs. 5.17 ± 4.40, $p = 0.037$).

Conclusion: Both procedures are minimally invasive and useful options for advanced KD, especially for elderly patients with high comorbidities. Our novel percutaneous TPICA technique using cannulated cage trials may offer enhanced safety and reproducibility, potentially facilitating wider adoption of this procedure among spine surgeons.

Quick fire 1

OP-082

Changes in facet orientation can simultaneous affect the potential risk of annulus tears and zygapophyseal joint osteoarthritis : a clinical review and biomechanical simulation

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Purpose: The lumbar motion segment, comprising the intervertebral disc (IVD) and articular processes, is crucial for spinal load transmission. Morphological variations in these components are implicated in degenerative changes. While prior research suggests sagittally oriented articular processes are associated with a lower incidence of severe zygapophyseal joint osteoarthritis (ZJOA) potentially by reducing load transmission to the facet joints, it is hypothesized that this orientation might conversely elevate the risk of annulus tears due to increased stress concentration on the disc. This study aims to investigate the relationship between articular process orientation and the occurrence of both ZJOA and annulus tears, exploring the underlying biomechanical mechanisms.

Methods: Clinical data from 111 patients were retrospectively analyzed. Facet orientations and ZJOA grades were assessed using MRI and CT imaging. Annulus integrity was evaluated via diffusion tensor fibre tractography (DTT). Regression analyses were conducted to determine independent predictors for ZJOA severity and annulus tears. Complementarily, finite element models of the L4-L5 motion segment with varying facet orientations were developed to simulate stress distribution on the annulus and facet cartilages, providing insights into the biomechanical basis of the clinical observations.

Results: Consistent with existing literature, a sagittal orientation of the articular processes emerged as an independent predictor of lower severe ZJOA grades. Conversely, a more coronal orientation was associated with a higher incidence of mild ZJOA and a concurrent increase in annulus tears. Numerical simulations revealed that coronally oriented facets shift load transmission anteriorly, resulting in elevated stress on the annulus and reduced stress on the facet cartilages. The opposite stress distribution pattern was observed in models with sagittally oriented articular processes.

Conclusion: Facet orientation significantly influences local load transmission within the lumbar spine. Coronally oriented articular processes may offer protection against severe ZJOA by shifting load anteriorly, but this comes at the cost of increased susceptibility to annulus tears due to heightened stress on the intervertebral disc. Conversely, sagittally oriented facets may predispose individuals to ZJOA progression while potentially mitigating the risk of annulus tears through a similar biomechanical mechanism of load redistribution. These findings highlight the intricate interplay between spinal morphology and degenerative processes, suggesting that facet orientation is a critical factor to consider in understanding and potentially managing lumbar spine degeneration.

Quick fire 1

OP-083

Deep learning Algorithm to predict hip disease on lumbar spine X-rays.

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Purpose: The purpose of this study was to develop deep learning algorithms (DLAs) to identify patients with hip osteoarthritis (OA) on lumbar spine X-rays.

Methods: A total of 1,100 patients who underwent lumbar spine operation (LSO) without hip OA and total hip arthroplasty (THA) from 2021 to 2023 at our hospital were enrolled. Patients with no radiographic signs of hip OA after LSO were classified as the "normal group" (N group: n=550), while those who underwent THA were defined as the OA group (OA group: n=550). A convolutional neural network (CNN) was constructed to classify cases into N or OA group using preoperative lumbar anterior-posterior (AP) and lateral X-rays. Additional CNN models were developed by incorporating both AP and lateral views, as well as clinical symptoms (low back pain, groin pain, thigh pain, knee pain, lower leg pain, and lower limb numbness) into the input. Of the 1,100 cases, 1,000 were used for internal validation via five-fold cross-validation, and the remaining 100 were used for external validation. Model performance was evaluated using receiver operating characteristic (ROC) curve and the area under the curve (AUC), accuracy, and heatmaps generated by Gradient-weighted Class Activation Mapping (Grad-CAM) to visualize high-importance regions.

Results: On AP views alone, the models achieved an AUC of 0.93–0.97 and an accuracy of 89–93% in internal validation and the AUC ranged from 0.88 to 0.94 with an accuracy of 83–91% in external validation. The average predictive performance (APP) was an AUC of 0.93 and an accuracy of 89%. On lateral views alone, the average AUC and accuracy dropped significantly to 0.60 and 62%, respectively. Combining AP and lateral views also resulted in lower performance: AUC was 0.64 and accuracy was 62%. Adding clinical symptoms to the AP view generally decreased model performance. However, incorporating lower limb numbness as an additional feature maintained performance levels comparable to AP-only input, with an AUC of 0.92 and accuracy of 89%. Grad-CAM visualization commonly highlighted the hip joint region as a key area of focus.

Conclusion: The CNN developed in this study demonstrated high diagnostic performance when using lumbar AP radiographs alone or in combination with lower limb numbness. Lateral views and most additional clinical features did not enhance model accuracy.

Quick fire 2

OP-084

Uni-portal non-coaxial spinal endoscopic surgery assisted by intraoperative O-arm total navigation for unilateral laminotomy for bilateral decompression in patients with lumbar spinal stenosis: A retrospective study

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Background: In recent years, unilateral laminectomy for bilateral decompression under spinal endoscopy (ULBD) has been successfully applied to lumbar spinal stenosis, with reports of good clinical efficacy. However, its shortcomings mainly lie in the fact that the decompression range can only be determined based on the surgeon's experience, leading to inadequate or excessive decompression, as there is a lack of real-time dynamic monitoring.

Objective: This retrospective study aims to compare the outcomes of the navigation group and the non-navigation group and explore the beneficial effects of O-arm total navigation-assisted ULBD technique during surgery.

Methods: A retrospective analysis was conducted on 54 patients from August 2022 to August 2023. Perioperative data were collected, including surgical time, estimated intraoperative blood loss, postoperative hospital stay, radiation dose, fluoroscopy time and frequency, and radiation exposure time. Additionally, postoperative data were used to evaluate clinical outcomes, such as the Oswestry Disability Index (ODI), Visual Analog Scale (VAS) for pain, modified MacNab criteria, CT imaging parameters of spinal stenosis, and postoperative complications.

Results: The non-navigation and navigation groups included 28 and 26 patients, respectively.All the patients were followed up for at least 12 months. The surgical time in the navigation group was shorter than that in the non-navigation group, and the estimated intraoperative blood loss was lower in the navigation group, with statistically significant differences ($P < 0.05$). There were no statistically significant differences in preoperative VAS scores for back pain and leg pain between the two groups ($P > 0.05$). Postoperatively, both groups showed significant reductions in back and leg pain, with VAS scores significantly lower than preoperative scores ($P < 0.05$). Three months after surgery, CT re-examination results showed that the condition of spinal stenosis improved significantly, with measurements of lumbar interspace APDC, CAC, ICA, CAD, and LAC all significantly higher than preoperative values ($P < 0.05$). Furthermore, both groups showed significant improvements in lumbar function, with ODI measurements significantly lower than preoperative values ($P < 0.05$). There were no significant differences in postoperative drainage, postoperative hospital stay, or perioperative complications between the two groups, while the radiation dose in the navigation group was significantly lower than in the non-navigation group. All clinical outcomes improved at different postoperative time points, with no significant differences between the two groups ($P > 0.05$).

Conclusion: Compared to the non-navigation approach,the O-arm total navigation-assisted UNSES-ULBD technique not only demonstrates comparable clinical outcomes but also provides real-time intraoperative guidance, helping spinal surgeons achieve precise spinal decompression. Additionally, it reduces radiation exposure and surgical time for the surgeon, decreases blood loss, thereby improving the efficiency and safety of the surgery.

Keywords: intraoperative o-arm;total navigation;Uni-portal non-coaxial spinal endoscopic surgery;minimally invasive spine;lumbar spinal stenosis

Quick fire 2

OP-085

The Role of Paraspinal Muscle Health in Predicting Adjacent Segment Disease After Lumbar Spinal Fusion : A Systematic Review and Meta-Analysis

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Background: Adjacent segment disease (ASD), a complication that arises following spinal fusion, remains a significant concern. This study examines the role of preoperative fat infiltration (FI) and relative cross-sectional area (rCSA) of the paraspinal muscles (PSM) health, specifically the multifidus (MF) and erector spinae (ES), in predicting the development of ASD after lumbar fusion.

Purpose: To evaluate whether preoperative FI and rCSA of PSM health, measured through preoperative MRI, are reliable risk factors for the development of ASD in adult patients.

Methods: A systematic review and meta-analysis assessed the association between preoperative FI or rCSA of PSM and ASD. Cohort and case-control studies with ≥18 months of follow-up were identified via PubMed, Embase, and Scopus (up to February 2025). SMDs were pooled using a random-effects model, with heterogeneity evaluated by the I^2 statistic.

Results:

Out of 630 studies identified, 15 met the inclusion criteria (10 on FI, 8 on rCSA), totaling 1,748 patients. ASD patients were on average 1.51 years older than controls (95% CI: 0.61–2.40).

A significant association between higher preoperative FI and the development of ASD was found (SMD = 0.59, 95% CI: 0.43–0.75), with moderate heterogeneity (I^2 = 42.4%). The analysis of rCSA indicated no statistically significant difference in ASD risk, suggesting that FI is a stronger predictor of ASD development compared to rCSA. Subgroup and regression analyses showed no significant effect of fusion length or muscle type on the FI-ASD relationship, though age differences partially explained study variability.

Conclusion: This meta-analysis confirms that higher preoperative FI of paraspinal muscles, particularly the multifidus and erector spinae, is associated with an increased risk of developing ASD. FI is a more reliable predictor than rCSA, with consistent effects across fusion lengths and muscle types. PSM conditions should be considered in preoperative risk assessment.

Quick fire 2

OP-086

Clinical characteristics and surgical treatment strategies of multi-regional (≥3) spinal canal stenosis

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Purpose: Although some studies have reported the multi-regional (≥3) spinal canal stenosis, the clinical manifestations of multi-regional spinal stenosis may not be very obvious, and the focus and challenges of its surgical treatment are also different from those of single-regional spinal stenosis. The purpose of this article is to summarize the clinical characteristics of multi-regional (≥3) spinal canal stenosis and explore its treatment strategies.

Methods: The cases of multi-regional spinal stenosis treated by spinal surgery in the First Affiliated Hospital of University of Science and Technology of China were followed up. The effects of different treatment regimens on the surgical efficacy and their potential complications were retrospectively analyzed.

Results: A total of 17 cases of multi-regional spinal stenosis were collected, with an average follow-up time of 2.5 years. Among them, 8 cases underwent one-stage posterior cervical C3-7 laminoplasty + upper thoracic laminectomy for ossification of the ligamentum flavum of cervical, upper thoracic vertebras and lumbar vertebras, and the excellent and good rate was 75%.; A total of 9 cases underwent two-stage surgeries. Among them, 3 cases underwent anterior cervical surgery in the first stage and thoracolumbar laminectomy and decompression in the second stage, with an excellent and good rate of 67%. 6 cases underwent C3-7 cervical laminectomy in the first stage and thoracolumbar laminectomy and decompression in the second stage, with an excellent and good rate of 83.3%.

Conclusion: The treatment of multi-regional spinal stenosis must take a holistic view and pay attention to the comprehensive analysis of the pathogenic factors and clinical manifestations of each segment of the neck, chest and waist. If the dysfunction of the upper limbs is severe, cervical decompression should be performed first. Depending on the relief of the patient's symptoms, thoracolumbar laminectomy and decompression should be carried out in the second stage. If thoracic spinal stenosis is located in the upper thoracic vertebrae, posterior cervical laminoplasty should be performed concurrently with laminectomy and decompression of the upper thoracic vertebrae. If the symptoms in the lower limbs are severe while those in the upper limbs are mild, thoracolumbar surgery should be performed first, and cervical spine surgery should be carried out if necessary.

Quick fire 2

OP-087

Endoscopic vs. Conventional Lumbar Interbody Fusion: Less Invasive, but Equally Effective?

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Purpose: To compare fusion success, clinical outcomes, and radiographic findings between endoscopic and conventional lumbar fusion using retrospective data.

Methods: This retrospective study was conducted at Park Weon Wook Hospital (Busan, Korea) and included patients who underwent single-level lumbar interbody fusion between January 2018 and December 2019. Patients were divided into two groups based on surgical technique: endoscopic (ELIF) and conventional (CLIF) fusion. Each type of surgery was performed by different surgeons, each highly experienced and dedicated to their specific surgical method, ensuring technical consistency within each group. Radiographic fusion was assessed using the Bridwell classification, with Grades I and II defined as successful fusion and Grades III and IV as nonunion. Demographic variables were compared between groups. Statistical analysis included Fisher's exact test, Mann-Whitney U test, and multivariate logistic regression to identify fusion success.

Results: A total of 103 patients were included (Endoscopic: n=51; Conventional: n=52). The CLIF group demonstrated a significantly higher fusion success rate (86.5%) compared to the ELIF group (64.7%) ($p = 0.012$). Bridwell fusion grades were significantly better in the CLIF group ($p = 0.003$). Multivariate logistic regression identified the endoscopic approach as an independent negative predictor of successful fusion (OR = 0.27, $p = 0.012$). There were no significant differences in baseline age, sex, or osteoporosis prevalence between the two groups. Bone resorption was observed in 6 patients (5 in the endoscopic group and 1 in the conventional group), but the difference was not statistically significant ($p = 0.198$). At 1-year follow-up, the mean decrease in VAS was significantly greater in the CLIF group (3.96 points) compared to the ELIF group (2.35 points) ($p < 0.001$), indicating superior pain relief in patients who underwent conventional fusion.

Conclusion: Conventional lumbar interbody fusion resulted in significantly better radiographic fusion outcomes and greater long-term pain relief compared to the endoscopic approach. These findings suggest that surgical technique plays a critical role not only in achieving structural fusion but also in improving clinical outcomes. Further technical refinement and surgical consideration may be necessary to improve outcomes in endoscopic lumbar fusion.

Quick fire 2

OP-088

Extending the Indications of Minimally Invasive Scoliosis Surgery in Idiopathic Scoliosis: Feasibility in Very Severe Curves Exceeding 75°

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Purpose: To evaluate the feasibility and efficacy of minimally invasive scoliosis surgery (MISS) in patients with idiopathic scoliosis (IS) presenting with very severe curves exceeding 75°.

Methods: A total of 588 patients with IS who underwent MISS between 2015 and 2023 were included, each with a minimum follow-up period of two years. Included cases were divided into the three groups based on the main Cobb's angle: M group (n = 335, 45° ≤ Main Cobb's angle < 60°), S group (n = 216, 60° ≤ Main Cobb's angle < 75°), and VS group (n = 35, Main Cobb's angle ≥ 75°). For the VS group, we sub-divided into two subgroup: VS-1 group (n = 23, 75° ≤ Main Cobb's angle < 80°), and VS-2 group (n = 12, Main Cobb's angle ≥ 80°). Radiological parameters, operative data, and complications were compared across groups at the preoperative, postoperative, and final follow-up.

Results: The mean operative time was significantly shorter in the M group (279.0 minutes) compared to the S (311.2 minutes) and VS (319.9 minutes) groups ($P < 0.001$). Estimated blood loss was also significantly lower in the M group (813.1 mL) compared to the S (986.6 mL) and VS (1000.0 mL) groups ($P = 0.006$), though there were no significant differences in postoperative transfusion rates. Radiologically, the mean preoperative Cobb angles were 52.9° (M), 66.2° (S), and 79.3° (VS) ($P < 0.001$). No significant differences were found among groups regarding correction rate, correction loss, coronal balance, sagittal vertical axis, thoracic kyphosis, or lumbar lordosis. Subgroup analysis revealed no difference in correction rate between VS-1 and VS-2 ($P = 0.836$). Pleural effusion was the most common complication, associated with thoracoplasty, but incidence did not differ significantly across groups.

Conclusions: MISS via a posterior approach demonstrated acceptable radiological and operative outcomes, even in patients with idiopathic scoliosis presenting with Cobb angles exceeding 75°. These findings support the feasibility of MISS as a viable surgical option in more severe cases, thereby suggesting an expanded indication for its application in the treatment of IS.

Quick fire 3

OP-089

Observation on the Application Effect of Retroperitoneal Laparoscopy in Debridement and Bone Graft Fusion for Lumbar Spinal Infections

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Objective: To investigate the application effect of retroperitoneal laparoscopic debridement and interbody bone graft fusion via an extraperitoneal approach in patients with lumbar spinal infections.

Methods: Forty patients with lumbar spinal infections were selected and divided into an observation group (n=20) and a control group (n=20). The observation group underwent retroperitoneal laparoscopic debridement and interbody fusion via an extraperitoneal approach, while the control group underwent mini-open OLIF (oblique lumbar interbody fusion) via an extraperitoneal approach. The surgical procedures included debridement of paravertebral and intervertebral lesions, followed by interbody fusion. Surgical duration, blood loss, hospitalization time, costs, complications, VAS scores, ODI index, and imaging results were recorded to evaluate efficacy.

Results: The surgeries were successfully completed. The observation group showed superior outcomes in surgical duration, intraoperative blood loss, hospitalization time, and complication rates compared to the control group, with statistical significance ($P<0.05$). However, the observation group had higher hospitalization costs, which were statistically significant ($P<0.05$). After a 2-year follow-up, no recurrence of infection was observed in any patient, and all achieved bony fusion. The final follow-up VAS pain scores and ODI scores showed significant improvement compared to preoperative levels, with no notable difference between the two groups ($P>0.05$).

Conclusion: Retroperitoneal laparoscopic debridement and interbody bone graft fusion via an extraperitoneal approach demonstrates significant efficacy in treating lumbar spinal infections. Although the cost is relatively higher, the procedure is safe, reliable, and offers minimally invasive advantages.

Keywords: Retroperitoneal laparoscopy; OLIF; Extraperitoneal approach; Spinal infection

Quick fire 3

OP-090

A novel steerable PKP for treatment of thoracolumbar osteoporotic vertebral compression fractures :a study of the clinical efficacy and safety

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Purpose: To explore the clinical efficacy and safety of a novel steerable percutaneous balloon kyphoplasty (S-PKP) for treatment of thoracolumbar osteoporotic vertebral compression fractures (OVCFs).

Methods: From April 2023 to April 2024, a total of 29 patients(32 vertebrae) with thoracolumbar OVCFs were treated with a novel steerable percutaneous balloon kyphoplasty (S-PKP). The injured vertebrae were distributed as follows: T11 in 6 case, T12 in 10 cases, L1 in 8 cases, L2 in 4 cases, L3 in 4 cases. All patients underwent S-PKP procedure using a unipedicular approach. Introduced the novel steerable curved bone expander from the puncture side, expansion and bending to the contralateral side then inserted and inflated the curved balloon tamp. After vertebral body reduction, the bone cement was injected into the vertebral body. Clinical efficacy of S-PKP treatment was evaluated by kyphot¬ic Cobb's angle, ODI and VAS score. Bone cement leakage and postoperative complications were also observed.

Results: The anterior vertebral body height of the fractured vertebrae, Cobb's angle was a significant improvement between pre-operative and post-operative values without spinal cord or nerve root injury. The VAS was 8.2±0.3 at pre-operative, 2.1±0.5 at post-operative, 1.8±0.3 at final follow-up; and the ODI was 86.3±2.2 at pre-operative, 32.1±2.9 at post-operative, 27.1±2.3 at final follow-up. There was statistically significant improvement in the VAS and ODI at the post-operative assessment compared with the pre-operative assessment. Asymptomatic leakage was seen in 3 vertebrae.

Conclusion: The novel S-PKP technology is a safe and efficient way for the treatment of thoracolumbar OVCFs.

Keywords: Osteoporosis; vertebral compression fractures;steerable PKP

Quick fire 3

OP-091

Trans-pedicular Intravertebral Cage Augmentation (TPICA) with Short-level Fixation in the Treatment of Kummell Disease : Mid-term Results from a Case Series

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Introduction: Kummell disease is a post-osteoporotic vertebral fracture condition characterized by non-union or avascular necrosis (AVN), leading to intravertebral instability, progressive kyphosis, intractable pain, or neurologic deterioration. Surgical treatment often involves anterior column reconstruction, but trans-pedicular intravertebral cage augmentation (TPICA) offers a less invasive alternative, providing anterior support and stabilization with short-level fixation.

Objectives: The aim of this study was to evaluate the clinical and radiographic outcomes of TPICA with short-level fixation in patients with Kummell disease. Specifically, we sought to determine its effectiveness in restoring structural stability, correcting kyphosis, and assessing complications during mid-term follow-up. As a secondary objective, we aimed to identify potential risk factors associated with postoperative junctional complications following TPICA with short-level fixation.

Methods: This study retrospectively analyzed 39 patients who underwent TPICA with short-level fixation at a single institution. Patients were included if they exhibited significant vertebral body collapse, progressive kyphosis, intravertebral instability causing neurologic deterioration, or intractable back pain unresponsive to conservative treatment. Radiographic parameters, including Local Kyphotic Angle (LKA), Thoracolumbar Kyphosis (TLK), and Relative Anterior Vertebral Height (RAVH), were measured preoperatively, immediately postoperatively, and at the final follow-up to assess structural stability and kyphosis correction. Fusion was defined as the disappearance of air clefts on dynamic radiographs or the presence of bone trabeculation in the index vertebral body on CT. Complications such as screw pullout, junctional kyphosis, infection, hematoma, and revision surgery were documented. We performed multivariate logistic regression analysis to identify independent risk factors for mechanical complications. Key variables included cement augmentation and fusion length.

Results: The study included 39 patients with a mean age of 77.8 years and a mean follow-up period of 52.3 months. The minimum follow-up period was 13 months (mean 52.3 months). Most patients underwent surgery due to intravertebral instability (78.4%) or progressive kyphosis (21.6%). Surgical fixation level involved two-segment (61.5%), or three-segments or more (38.5%).

Radiographic parameters showed improvement after surgery. The mean LKA decreased from 21.2° ± 14.5° preoperatively to 9.8° ± 13.9° immediately postoperatively and increased to 14.4° ± 15.9° at the final follow-up. Similarly, TLK decreased from 26.5° ± 14.9° preoperatively to 19.5° ± 12.8° postoperatively but increased to 24.4° ± 14.1° at the final follow-up. RAVH improved from 0.446 ± 0.296 preoperatively to 0.705 ± 0.270 immediately after surgery and stabilized at 0.634 ± 0.300 at the final follow-up. However, repeated measures ANOVA revealed no statistically significant differences for any radiographic parameter (LKA, $p = 0.167$; TLK, $p = 0.496$; RAVH, $p = 0.192$). Surgical complications were observed in 18 patients (48.6%), including junctional kyphosis in 11 patients (29.7%), revision surgery in 4 patients (10.8%), non-union in 3 patients (8.1%), hematoma in 2 patients (5.4%), and periprosthetic infection in 1 patient (2.7%). Logistic regression analysis showed that cement augmentation significantly lowered the risk of mechanical failure. On the other hand, fusion length was not a contributing factor, supporting the safety and practicality of using short-level fixation.

Conclusion: TPICA with short-level fixation provides a minimally invasive alternative for Kummell disease, demonstrating favorable radiographic and clinical outcomes in mid-term follow-up. Although the improvements in radiographic parameters were not statistically significant, the procedure effectively restored structural stability and corrected kyphosis with favorable fusion rate. This novel technique offers a promising option for addressing the challenges of traditional surgical methods, warranting further validation in larger studies.

Quick fire 3

OP-092

Minimal Invasive Spine Surgery for Very Elderly Patients with Destructive Spondylodiscitis: Case Series

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Purpose: To evaluate the clinical outcomes of a minimal invasive spine surgery (MISS) technique in very elderly patients, defined as those aged seventy-five years and older, with destructive lumbar spondylodiscitis. The procedure involves disc space debridement followed by vancomycin irrigation, local insertion of vancomycin powder, autologous bone grafting harvested from lamina and facet joints, and percutaneous pedicle screw fixation. The goal is to reduce complications associated with conventional open surgery, such as prolonged operative time, delayed recovery, and wound-related morbidity.

Methods: Very elderly patients with lumbar pyogenic spondylodiscitis underwent MISS with targeted decompression and disc space preparation. After thorough irrigation with vancomycin mixed in saline, vancomycin powder was locally inserted into the disc space. Autologous bone harvested from the lamina and facet joints was packed into the space to promote fusion. Percutaneous pedicle screw fixation was performed for stabilization. Postoperative outcomes were evaluated based on clinical improvement, infection markers, and radiographic evidence of fusion.

Results: This minimally invasive approach resulted in prompt pain relief and early normalization of infection markers. Radiographic follow-up demonstrated successful bone fusion without progression of vertebral destruction or instability. No reinfection, hardware failure, or revision surgery occurred. The technique proved safe and effective in very elderly patients with multiple medical comorbidities.

Conclusion: MISS using vancomycin irrigation, local vancomycin powder insertion, autologous bone grafting, and percutaneous pedicle screw fixation is a safe and effective treatment for destructive lumbar spondylodiscitis in very elderly patients, providing reliable infection control and stable fusion with reduced surgical burden.

Quick fire 3

OP-093

Clinical outcome and image study of percutaneous vertebroplasty and augemtation with SpineJack system for compression fracture with vacuum cleft

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Purpose: This research is intended to evaluate the efficacy of percutaneous vertebroplasty in vertebral compression fracture with vacuum cleft, which is the unstable fracture type. This is the challenge for treatment. We evaluate the clinical results of only vertebroplasty and vetebroplasty with augmentation of SpineJack system.

Methods: the clinical outcome and image study was evaluated by total 38 patients (18 patient in group of vetebroplasty with augmentation of SpineJack system; 20 patients in group of percutaneous vertebroplasty only. The outcomes included injected cement volume, postoperative visual analog scale (VAS) scores, operative time, cement leakage rate and global and focal angel change of further image study.

Result: There are similar results of operative time and postoperative VAS score in these two groups. Lesser cement leakage rate and lesser global and focal angel change in group of vetebroplasty with augmentation of SpineJack system

Conclusion: better result of image studies in vetebroplasty with augmentation of SpineJack system. Further long-term outcome is needed for the treatment of compression fracture with vacuum cleft

Quick fire 4

OP-094

Novel Technique Of Assisted Uniportal Interlaminar Percutaneous Endoscopic Lumbar Discectomy To Increase Versatility For Discectomy : Technical Notes

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Introduction: Discectomy was initially performed using a microsurgical interlaminar approach, which later evolved into microendoscopic discectomy, enabling a more minimally invasive technique. The current standard of percutaneous endoscopic lumbar discectomy (PELD) technique is widely accepted. However, it requires a single operator to perform both visualization and discectomy. The limitations persist in treating contained disc herniations, where more aggressive disc removal and annulotomy are often necessary and requires a stable visualization. To address these challenges, we proposed a novel approach to increase technique's versatility by introducing assisted uniportal interlaminar PELD (IPELD).

Materials and Methods: The technique begins with the insertion of a spinal needle using interlaminar approach under fluoroscopic guidance to target the affected disc space. A working cannula is then positioned to create a stable endoscopic access to the intervertebral disc. Primary operator focused on discectomy, while the working channel was stabilized by a secondary operator. The secondary operator performed annular docking by medialization of the dural sac for better visualization of the herniated disc. Discectomy was then performed by the primary operator. This particular technique is indicated in contained disc herniations, where annulus still remained intact. Patients were then evaluated for postoperative VAS, ODI, and complication rates.

Results: We observed similar improvements in VAS and ODI scores in our patients compared to those undergoing traditional PELD. Minor complications were reported, predominantly paresthesia. Semi-quantitative measurements showed a more effective learning process of this technique with the help of the assistants. The technique offered several advantages, such as enhancing visualization for contained herniated discs, improving safety while increasing operator focus, and addressing the learning curve of uniportal IPELD, making it a more user-friendly approach for surgeons in any level of expertise.

Conclusion: Assisted uniportal IPELD is a safe and valuable option to enhance versatility for discectomy and reduce the learning curve of PELD.

Keywords: assisted uniportal IPELD, patient outcome

Quick fire 4

OP-095

Alteration of Spinopelvic Alignment Following Percutaneous Endoscopic Lumbar Discectomy

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INTRODUCTION: Spinopelvic parameters play a crucial role in evaluating the spinal alignment of the spine. They provide quantitative measurements that help assess the relationship between the spine and pelvis, allowing healthcare professionals to understand the overall sagittal balance. In our daily practice, these parameters were routinely measured for treatment planning and surgical decision-making. While one of spine surgery goals is to restore sagittal alignment, changes in spinopelvic parameters after non-instrumented spine procedures such as PELD (percutaneous endoscopic lumbar discectomy) have not been well evaluated.

MATERIALS & METHODS: We evaluated 60 lumbar disc herniation patients undergoing PELD at our health center. Spinal alignment was measured through spinopelvic parameters including pelvic tilt (PT), sacral slope (SS), lumbar lordosis (LL), and PI-LL mismatch. Measurements were made before surgery and 3 months after surgery, and comparison between interlaminar and transforaminal approaches were analyzed using independent t-tests. The spinopelvic parameters are measured pre- and postoperatively.

RESULTS: Significant changes in PT (p=0.002), SS (p=0.006), LL (p=0.001), and PI-LL (p=0.001) were observed following both Interlaminar PELD. There were also significant changes in PT (p=0.01), SS (p=0.011), LL (p=0.000), and PI-LL (p=0.000) post Transforaminal PELD. There was no significant difference of parameter changes between both approaches.

DISCUSSIONS: In patients with disc herniation, spinal sagittal imbalance caused by LDH is influenced by decreased trunk muscle strength. PELD surgery can contribute to the improvement of spinopelvic parameters in patients with lumbar disc herniations. We found significant increase LL, SS, PT, and PI-LL postoperatively after PELD surgery, leading to a more balanced and aligned spine.

CONCLUSION: Endoscopy for LDH can improve spinopelvic parameters in patients with lumbar disc herniation, specifically LL, SS, PT and LL-PI mismatch, leading to a more balanced and aligned spine. Spinopelvic parameters as apart of sagittal balance is recommended to be evaluated before and after PELD surgery as an indication of therapeutic success.

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Quick fire 4

OP-096

Comparative Analysis of Percutaneous Transforaminal Endoscopic Technique and VBE Technique in Treating Single-Level Lumbar Disc Herniation

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Purpose: To compare and analyze the clinical efficacy of the V-shaped Bichannel Spinal Endoscopy (VBE) system and the traditional percutaneous transforaminal endoscopic technique in treating single-level lumbar disc herniation.

Methods: A retrospective analysis was conducted on 204 patients who underwent treatment for single-level lumbar disc herniation at our hospital from January 2020 to December 2024. The cohort included 112 males and 92 females, aged 22-77 years, with an average age of 49.32 ± 17.57 years. Parameters such as operation time, fluoroscopy frequency, incision length, and complication rates were recorded. The Visual Analog Scale (VAS) for pain, Oswestry Disability Index (ODI), modified MacNab score, facet joint resection rate, and imaging data were used to evaluate treatment outcomes.

Results: All 204 patients showed significant improvement in symptoms. There were no statistically significant differences in hospital stay or fluoroscopy frequency between the two groups. The percutaneous transforaminal endoscopic group had a shorter operation time compared to the VBE group, but the incision length was longer. The facet joint resection rate did not differ significantly between the groups. At all follow-up time points, both groups showed significant improvements in lower back and leg VAS and ODI scores compared to preoperative values, with no significant differences between the groups. One case of dural tear occurred in the percutaneous transforaminal endoscopic group. Each group had one case of transient hypoesthesia. The excellent and good rates were 96.8% for the percutaneous transforaminal endoscopic group and 98.6% for the VBE group.

Conclusion: The application of the VBE system in single-level discectomy demonstrates its effectiveness and safety as a minimally invasive surgical technique. The advantage of full visualization provided by the VBE system may offer higher safety compared to the traditional percutaneous transforaminal endoscopic technique.

Quick fire 4

OP-097

Clinical Study of Annulus Fibrosus Suture Repair Treatment Under Dual Medium Spinal Endoscopy (DMSE)

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Objective: To analyze the clinical efficacy and safety of Dual Medium Spinal Endoscopy (DMSE) for nucleus pulposus removal of lumbar disc herniation with simultaneous application of disposable fibrous annular suture for repair of broken annulus fibrosus.

Methods: A total of 243 patients who underwent nucleus pulposus removal for lumbar disc herniation in our hospital between March 2021 and March 2023 were enrolled in this study, and all of them had their herniated disc nucleus pulposus removed microscopically, and at the same time received disposable fibrous annular suture to repair the rupture. Among them, 105 patients who underwent Dual Medium Spinal Endoscopy (DMSE) were classified as the observation group, and 138 patients who underwent ordinary Microendoscopic Discectomy(MED) were classified as the control group.

Results: The patients in both groups were followed up for 12-24 months, with a mean follow-up of 15.5 months. There was no difference in intraoperative bleeding between the two groups (P>0.05), but the overall bleeding was less in the DMSE group, and there was no difference in the operation time (P>0.05); there was insignificant difference in the postoperative bed rest time, postoperative lumbar spine function ODI scores, and VAS scores of the patients in the observation group compared with those in the control group (P>0.05); there were insignificant postoperative complications in the observation group; the total effective rate of patients in the observation group was 100%, the excellent rate was 97.1% (102/105), and the recurrence rate was 1.9% (2/105); the total effective rate of patients in the control group was 100%, the excellent rate was 96.3% (133/138), and the recurrence rate was 2.1% (3/138); the comparison of the total effective rate and the excellent rate between the two groups (P>0.05); the comparison of the recurrence rate after operation (P>0.05).

Conclusion: Dual Medium Spinal Endoscopy (DMSE) nucleus pulposus removal surgery for lumbar disc herniation with intraoperative repair of the fibrous annulus breach using disposable fibrous annular suture, relative to ordinary Microendoscopic Discectomy surgery, is equally effective in relieving the disease and promoting the recovery of lumbar spine function of the patients, with a high degree of safety, and is equally effective in reducing the postoperative recurrence rate.

Quick fire 4

OP-098

Cauda equina syndrome due to intra-dural hematoma after endocopic fusion

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Purpose: This report presents a case of intradural hematoma with cauda equina syndrome after endoscopic fusion for degenerative spinal disease.

Methods: A 60-year-old woman who underwent endoscopic fusion at another hospital was referred to our hospital with sudden-onset paraparesis and saddle anesthesia that occurred 2 days after endoscopic fusion. The patient was diagnosed with cauda equina due to an intradural hematoma from an untreated dural tear during endoscopic fusion. The patient underwent laminectomy, durotomy, intradural hematoma evacuation, and repair of the untreated injured dura during previous surgery.

Results: The patient's motor weakness and pain were relieved after surgery without any complications. She could stand independently and walk using a walker 2 weeks after surgery. She still had a voiding problem and saddle anesthesia.

Conclusion: Recently, endoscopic spine surgery has been performed more widely. The surgeon must be aware of unexpected complications related to endoscopic surgery. If the complication is not solved with endoscopic surgery, the surgeon should solve the problem with conventional surgery.

Quick fire 4

OP-099

Indications for and outcomes of full endoscopic lumbar discectomy between spinal levels.

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Purpose: Although full endoscopic lumbar discectomy (FED) is a common procedure, specific indications for FED across different lumbar disc levels remain unclear. Further studies are needed for the selection of optimal operational methods for herniation at each lumbar disc level. Therefore, the aim of the present study was to consider the indications for and outcomes of FED between disc levels.

Methods: Seventy-eight patients diagnosed with paramedian lumbar disc herniation that underwent surgery over a 6-year period were enrolled. The average age of patients was 45.4 (16-86) years and there were 37 men and 41 women. Indications for FED were made by spine surgery specialists. Patients with merged spinal stenosis or severe paralysis were excluded and underwent surgery using open methods. We divided patients who underwent FED into two groups: L4-5 level: Group H, and L5-S1 level: Group L. We retrospectively investigated the indications for and outcomes of FED in the two groups. Statistical analyses were conducted using the chi-squared test and Mann-Whitney U test, with significance being defined as $P < 0.05$.

Results: FED performance rates were 56.8% (21 patients) in Group H and 83.0% (34 patients) in Group L ($P < 0.05$). The interlaminar approach (IL) was more common than the transforaminal approach (TF) (Group H: 18 patients underwent IL and three underwent TF; Group L: 33 patients underwent IL and one underwent TF). The average operation time was longer in Group H (110.6 minutes) than in Group L (98.3 minutes). The recovery rates of the Japanese Orthopedic Association score for lumbar disease (Group H: 74.1%, Group L: 72.8%) and complication rates (Group H: 9.5%, Group L: 0%) were similar between the groups. Leg paralysis occurred as a complication in Group H.

Conclusion: Paramedian lumbar disc herniation commonly occurs at the L4-5 and L5-S1 levels. Open surgery and TF-FED were selected for L4-5 herniation because the spinal canal is narrower at the L4-5 level than at the L5-S1 level. IL-FED was selected for L5-S1 herniation because the spinal canal is wide and the iliac bone is hindered by TF-FED.

Quick fire 5

OP-100

A New Docking Point for Bi-Portal Spinal Endoscopy Technique Through the Intervertebro-Foramen: Technical Note on the Safety and Reproducibility of "Doom's Point"

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Purpose: This technical note introduces Doom's point—a novel anatomical landmark for portal placement in unilateral bi-portal endoscopic (UBE) transforaminal surgery—to optimize safety and reproducibility in treating lumbar foraminal stenosis and extreme lateral disc herniation (ELD).

Methods: Defined as the intersection of the superior articular process (SAP) and transverse process (TP), Doom's point enables fluoroscopy-free, landmark-guided docking, minimizing risks of neural injury and facet violation. In 15 consecutive cases, the technique achieved consistent foraminal decompression with no major complications. Postoperative outcomes demonstrated significant pain relief (VAS leg: 5.1→1.9, $p<0.001$) and functional improvement (ODI: 38.4%→15.6%, $p<0.001$). Radiographic analysis confirmed preserved segmental stability and a 68.9% mean foraminal area expansion.

Conclusion: This report details the anatomical rationale, technical workflow, and validation of Doom's point as a reliable docking target for UBE transforaminal approach.

Keywords: bi-portal endoscopy, lumbar foraminal stenosis, anatomical landmark, docking point, minimally invasive spine surgery

Quick fire 5

OP-101

Does the number of drain tubes influence the formation of postoperative spinal epidural hematoma following biportal endoscopic unilateral laminotomy for bilateral decompression in patients with two-level adjacent lumbar spinal stenosis?

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Purpose: The formation of postoperative spinal epidural hematoma (POSEH) following lumbar spinal surgery is a potentially serious complication. The efficacy and necessity of prophylactic postoperative drain tubes in preventing symptomatic postoperative spinal epidural hematoma (SPOSEH) after lumbar spinal decompression remain subjects of ongoing debate. The objective of this study is to investigate the potential impact of the number of drain tubes on POSEH following biportal endoscopic unilateral laminotomy for bilateral decompression (BE-ULBD) in patients of two-level adjacent lumbar spinal stenosis.

Methods: A prospective randomized study was conducted involving 89 patients with two-level adjacent lumbar spinal stenosis who underwent BE-ULBD. Patients were divided into two groups: Group A (one drain tube) and Group B (two drain tubes). Demographic data were collected, including preoperative visual analog scale (VAS) scores for leg pain and preoperative blood pressure (BP). The primary outcome was the cross-sectional area (CSA) of POSEH assessed at 72 hours postoperatively. Secondary outcomes included operative duration, postoperative BP, postoperative VAS scores for leg pain, volume of drainage output, and length of hospital stay.

Results: A total of forty-three patients were assigned to Group A, while forty-six patients were assigned to Group B. The demographic characteristics of the patients in both groups were comparable. No significant differences were observed between the two groups regarding the cross-sectional area (CSA) of POSEH. However, a significantly greater volume was noted in Group B (P=0.015). There were no significant differences between the groups for other secondary outcomes, including operative duration (P=0.905), postoperative BP, postoperative visual analog scale (VAS) scores for leg pain (P=0.584), and length of hospital stay (P=0.428).

Conclusions: More drain tubes may result in statistically significant output but not clinically significant differences in influencing the formation of POSEH following BE-ULBD for two-level adjacent lumbar spinal stenosis.

Quick fire 5

OP-102

Technical Strategies for Revision Foraminal Decompression/ Discectomy by Biportal Endoscopy: A Clinical Series

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Purpose: Revision surgery for recurrent foraminal disc herniation or incomplete foraminal decompression is technically challenging due to altered anatomical landmarks and postoperative fibrosis. This study aims to describe effective technical strategies for biportal endoscopic revision decompression and evaluate the clinical outcomes and safety profile of the procedure.

Methods: We retrospectively analyzed 6 patients (mean age: 64.2 years) who underwent biportal endoscopic revision foraminal decompression or discectomy between 2023 and 2024. All patients had a history of previous foraminal decompression or discectomy. Preoperative imaging (MRI and CT) was used to identify residual foraminal stenosis and perineural fibrosis. Key intraoperative techniques included identification of the cranial pedicle, clear visualization of the exiting nerve root, precise resection of the superior articular process, and removal of extruded disc fragments. Clinical outcomes were assessed using the Visual Analog Scale (VAS) for leg pain and the Oswestry Disability Index (ODI), both preoperatively and at 6 months postoperatively. Operative time, estimated blood loss, and perioperative complications were also recorded.

Results: Preoperative leg pain VAS scores improved significantly from 7.2 ± 1.1 to 2.1 ± 0.9 at 6 months postoperatively ($p < 0.01$). ODI scores improved from 48.6% to 24.3%. The mean operative time was 44.5 ± 15.6 minutes, and the average estimated blood loss was 52.1 ± 22.4 mL. There were no major complications such as nerve root injury or conversion to fusion surgery. Technical success was attributed to early identification of anatomical landmarks and careful dissection of fibrotic tissue under continuous saline irrigation.

Conclusion: revision foraminal decompression by biportal endoscopy is a relatively safe and effective treatment option for recurrent lumbar foraminal pathology. With appropriate visualization, hydro-dissection, and strategic use of angled endoscopy, the procedure minimizes the risk of neural injury and provides a less invasive alternative to conventional open revision surgery.

Quick fire 5

OP-103

Comparative Analysis of Full Endoscopic Unilateral Laminotomy with Bilateral Decompression Using 3D Versus 2D Spine Endoscopy for the Treatment of Spinal Stenosis: A Retrospective Study

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Purpose: Lumbar spinal stenosis (LSS) is a common degenerative disease characterized by the narrowing of the spinal canal, leading to nerve compression and neurogenic claudication. This study aimed to compare the efficiency, safety, and surgical outcomes of unilateral laminotomy with bilateral decompression (ULBD) using a novel three-dimensional (3D) endoscopic technology versus the conventional two-dimensional (2D) endoscopic system.

Methods: This study included 62 consecutive patients who underwent full endoscopic ULBD for lumbar spinal stenosis at a tertiary medical center between January 2023 and December 2024. Patients were retrospectively assigned to either the 3D Endoscopy Group or the 2D Endoscopy Group. Data collected included demographic information, comorbidities, Charlson comorbidity index (CCI), operative details (surgery time, time to drill, time to yellow ligament, blood loss), and functional outcomes (Visual Analog Scale for pain, Oswestry Disability Index, patient satisfaction scores) evaluated at 1, 3, 6, and 12 months postoperatively. Statistical analysis was performed using SPSS 26.0, with $p<0.05$ considered statistically significant.

Results: In terms of surgical efficiency, the 3D group had significantly shorter times from skin incision to drill positioning ($p=0.047$) and from skin incision to yellow ligament exposure ($p<0.001$), demonstrating superior procedural navigation and speed. While intraoperative blood loss was lower in the 3D group, this difference was not statistically significant ($p=0.079$). The 3D endoscopic system also demonstrated significant advantages over the traditional 2D system in clinical outcome measures. The 3D group showed significantly lower back pain VAS scores at 6 months postoperatively compared to the 2D group (1.935 vs. 2.355, $p=0.050$). Additionally, at 12 months postoperatively, the 3D group exhibited significantly lower ODI percentages (0.194 vs. 0.232, $p=0.050$), reflecting better long-term pain relief and functional recovery. Although leg VAS scores in the 3D group were slightly higher than in the 2D group at 1, 3, and 12 months postoperatively, these differences did not reach statistical significance ($p>0.05$).

Conclusions: The novel 3D endoscopic system significantly improves surgical efficiency by reducing the time from skin incision to drill positioning and yellow ligament exposure, demonstrating enhanced navigational accuracy during ULBD procedures. This optimization of surgical exposure and procedural workflow leads to better long-term pain relief and functional outcomes compared to conventional 2D endoscopy. By expediting the critical early stages of surgery and improving decompression processes, the 3D endoscopic system not only enhances surgical efficiency and safety but also effectively promotes postoperative pain relief and functional recovery, demonstrating its potential for widespread application in endoscopic spine surgery.

Keywords: Lumbar spinal stenosis; endoscopic spine surgery; unilateral laminotomy with bilateral decompression; three-dimensional endoscopy; minimally invasive surgery

Quick fire 5

OP-104

Does grade one stenotic spondylolisthesis increase the revision rate of single level Percutaneous Stenoscopic Lumbar Decompression (PSLD), A retrospective study of at least three years follow-up

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Background: Percutaneous stenotic lumbar decompression (PSLD) or LE-ULBD (lumbar endoscopic unilateral laminotomy with bilateral decompression) has gained popularity as a minimally invasive surgery for treating lumbar stenosis. However, there is limited research focusing on the radiologic outcome and reoperation rate on the patients with stable degenerative spondylolisthesis.

Methods: We performed a retrospective cohort analysis of lumbar spine stenosis cases treated with PSLD at our institution during 2017 to 2021. There are 99 patients with single-level lumbar stenosis who were recruited in the study. These patients presented predominantly leg-related symptoms and experienced either tolerable or no mechanical back pain. Minimum follow up was 36 months (mean, 52.2 months; range,36–84 months). The primary outcomes were reoperation rate, radiological outcomes of percent slippage of spondylolisthesis, disc height change and segmental angle difference. The secondary outcomes were 1-month, 3-month, 1-year and 2-year post-operative Oswestry disability index (ODI) and visual analogue scale (VAS) scores for low back and lower limb.

Results: The patients presented significant improvement in VAS and ODI. The reoperation rate is 4 percent (4/99). There were no statistically significant differences observed in disc height change and segmental angle difference. Patients with spondylolisthesis have a higher reoperation rate compared to those without spondylolisthesis (10% (2/20) versus 2.5% (2/79), p-value =0.146) but did not meet statistically significant. There is one reoperation case in non-spondylolisthesis group treated with repeat PSLD. The remaining three reoperation cases were treated with transforaminal interbody fusion.

Conclusion: PSLD is the least invasive and safe surgery for treating lumbar stenosis which can achieve satisfactory outcomes under at least three years follow up. Patients with stable spondylolisthesis have similar functional outcomes, radiologic outcomes and reoperation rate. Based on the above conclusions, stable spondylolisthesis can be effectively treated by PSLD.

Key words: Percutaneous stenotic lumbar decompression, Lumbar stenosis, Percutaneous endoscopic lumbar discectomy

Quick fire 6

OP-105

The fine line of bone resection: subtle differences impact nerve safety in LE-ULBD

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Purpose: LE-ULBD (Lumbar Endoscopic Unilateral Laminotomy for Bilateral Decompression) is a commonly performed surgical procedure. The adequacy of cranial decompression is determined by insertion of the ligamentum flavum, while caudal decompression is assessed based on the upper margin of the lower lamina. Laterally, the procedure should reach the lateral border of the nerve root, with care taken to avoid postoperative instability. However, the success of this procedure heavily depends on the surgeon's experience and judgment. Variations in patient anatomy, the severity of stenosis, and the surgeon's expertise significantly influence the surgical outcomes. Severe lateral recess stenosis presents unique challenges. Inadequate decompression in such cases risks nerve injury.

Methods: Retrospectively review the cases underwent LE-ULBD at VGHKS. Cases will be presented using surgical video footage to illustrate a near-miss incident where the nerve root was almost injured if insufficient bone resection.

Results: One case had a nerve root injury during learning curve. To avoid root injury, it is recommended to resect approximately 2 mm of the superior articular process (SAP) laterally. This allows clear identification of the nerve root, ensures sufficient space for nerve mobilization, and minimizes the risk of inadvertent nerve injury.

Conclusion: By standardizing these decompression techniques, surgeons can achieve more consistent and efficient outcomes, ultimately improving patient safety and surgical precision.

Quick fire 6

OP-106

Biportal Endoscopic Lumbar Interbody Fusion for Pedicle Insufficiency Fracture with Spondylolytic Spondylolisthe-sis

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Purpose: Currently, endoscopic spine surgery is expanding its indications and replacing and is actively being used in fusion surgery. Pedicle insufficiency fracture with spondylolytic spondylolisthesis is extremely rare and most are caused by major trauma, previous spine surgery, or stress-related activity.

The author reports a case of successful treated by biportal endoscopic fusion in a patient with spondylolytic spondylolisthesis accompanied by an L5 pedicle fracture of no specific cause.

Methods: he patient was a 64-year-old female patient with left buttock pain and lower extremity radiating pain. She was diagnosed with spondylolytic spondylolisthesis L5 on S1 and underwent conservative treatment for 5 months, but her limping gait and intermittent claudication worsened, so she decided to undergo biportal endo-scopic fusion. Since L5 left pedicle insufficiency fracture was additionally diagnosed in the preoperative CT scan, there was a possibility of displacement at the spondylolitic site and fracture site during the cage insertion process, so a 5.5 mm sized screw was inserted first, and decompression and cage insertion were performed. After that, a 6.5 mm sized screw was replaced and posterior fixation was performed, and the bony fragment of the pedicle fracture site was removed using an endoscope, and the surgery was completed.

Results: ostoperatively, the patient experienced significant improvement in her severe preoperative radiating pain in the lower extremity, with only mild residual back pain. She was able to ambulate independently without limping or the need for assistive devices. At the 6-month follow-up, the patient remained neurologically intact, per-forming daily activities without difficulty, and radiographic evaluation confirmed progressive fusion at the operated segment.

Conclusion: his case demonstrates the successful treatment of a rare L5 pedicle insufficiency fracture associat-ed with spondylolytic spondylolisthesis using biportal endoscopic spinal fusion. The result suggests that endo-scopic techniques can serve as a safe and effective minimally invasive option, even in complex cases involving both spondylolysis and pedicle fractures. Careful stabilization and the combination of endoscopic decompression and fusion can achieve favorable clinical and radiological outcomes, minimizing surgical morbidity.

Key words: biportal endoscopic surgery, spondylolytic spondylolisthesis, pedicle insufficiency fracture

Quick fire 6

OP-107

Contralateral Sublaminar Approach for L5–S1 Foraminal Stenosis: A Viable Surgical Option?

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Introduction: L5–S1 foraminal stenosis poses challenges for endoscopic surgery due to the high iliac crest and sacral alar via paraspinal or transforaminal approach. To overcome these, we used a contralateral sublaminar approach via a posterior route, allowing better access and anatomical preservation.

Materials and Methods: This retrospective, single center study included 13 patients who underwent surgery for L5–S1 foraminal stenosis by single spine surgeon and were followed for at least one year. The cohort consisted of 3 men and 10 women, with a mean age of 68.56 ± 6.74 years. Prior to surgery, all patients underwent diagnostic selective nerve root block. Patients were included if they experienced either reproduction of concordant radicular symptoms during injection, or more than 50% symptom relief following the procedure. Among the 13 patients, 9 had right-sided and 4 had left-sided L5–S1 foraminal stenosis. All patients underwent foraminal decompression using the contralateral sublaminar approach via biportal endoscopic spine surgery (BESS). Clinical outcomes and complications were assessed after surgery.

Results: The mean operative time was 129.23 ± 27.83 minutes. The average numerical rating scale improved from 8.46 ± 0.78 preoperatively to 1.92 ± 0.64 postoperatively. According to the modified Macnab criteria, satisfactory outcomes were achieved in 85.71% of patients, excluding two cases who reported root irritation symptoms postoperatively. One patient experienced an iatrogenic dura tear without rootlet escape, with a defect less than 5 mm in size. No other intraoperative or postoperative complications were observed.

Conclusions: The contralateral sublaminar approach for L5–S1 foraminal decompression using BESS offers several advantages. This technique utilizes a posterior interlaminar route, which is more familiar to most surgeons, and allows for simultaneous central canal decompression when necessary. Unlike conventional approaches, this method is not restricted by anatomical structures such as the iliac crest or sacral alar, and enables better preservation of the superior articular process through a more medial trajectory. Our findings demonstrate that L5–S1 foraminal decompression via the contralateral sublaminar approach is comparable to paraspinal or transforaminal approach in clinical results.

Quick fire 6

OP-108

How to Prevent and Manage Epidural Hematoma in Endoscopic Spinal Surgery

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Purpose: Epidural hematoma (EH) is a rare but potentially devastating complication of spinal surgery, with the potential to cause irreversible neurological damage if not promptly recognized and managed. According to the previous study, the incidence of epidural hematoma (8.4%) in endoscopic spine surgery was 6 times as the traditional open surgery. This study aims to review current preventive strategies and management protocols to minimize neurological deterioration and optimize outcomes following EH in endoscopic spinal procedures.

Methods: A comprehensive review of the published literature and clinical guidelines was conducted, focusing on the incidence, risk factors, surgical techniques, and postoperative monitoring protocols related to EH in endoscopic spine surgery. In addition, we evaluated institutional practices at Far-Eastern Memorial Hospital, analyzing perioperative management and outcomes of EH in patients who underwent endoscopic spinal surgery between December 2018 and April 2025.

Results: Among 1,500 endoscopic spinal surgeries performed in our department, epidural hematoma occurred in only 0.13% (n=2) of cases. Successful prevention strategies included appropriate control of the peri-operative blood pressure and coagulation function, delicate hemostasis during the operation, and insertion of the subfascial drainage tube. Postoperatively, patients were monitored with hourly neurological checks for the first 6 hours. Early detection of suspicious clinical symptoms and timely evaluation play a critical role in the management of EH. Full recovery of the EH-related symptoms could be achieved once the surgical evacuation was timely performed.

Conclusion: The incidence of epidural hematoma in endoscopic spinal surgery can be significantly minimized through a combination of thoughtful patient selection, vigilant perioperative management, and standardized postoperative monitoring. Early recognition of clinical signs and timely surgical intervention are essential for favorable outcomes. Based on our institutional experience, endoscopic spine surgery—when guided by well-established protocols—can achieve a lower EH incidence rate than conventional open approaches.

Quick fire 6

OP-109

Original Uni-portal Bi-channel & Dual-media Spinal Endoscopy system assists for transpedicular antero-dura decompression (UBD-TADD): clinical practice and technical notes

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Purpose: This study aimed to evaluate the clinical practice and technical efficacy of the novel Uni-portal Bi-channel and Dual-media Spinal Endoscopy system assists for transpedicular antero-dura decompression.

Methods: A retrospective, single-center review was conducted on patients who underwent UBD-TADD from August 2023 to April 2024. Comprehensive preoperative evaluations and postoperative follow-ups were performed to assess surgical outcomes.

Results: A total of 7 female patients with a mean age of 64.28+9.74 years were included. The average operation time was 245.50+21.68 minutes, with no intraoperative or postoperative complications. Patients were ambulatory the day after surgery. Blood loss was minimal, and postoperative recovery was swift. Clinical outcomes, including creatine phosphokinase 139.71 +22.21 vs.115.71+10.86,P=0.351),C-reactive protein (5.14+0.67 vs.6.00±0.82,P=0.421)and white blood cell count (6.71 + 1.11 vs.7.29+0.95,P=0.513) levels, returned to preoperative baselines, indicating minimal surgical invasiveness. Significant improvements were observed in thoracic kyphosis, Visual Analog Scale for back(14+0.62 to 2.14+0.79,P<0.001)and leg (6.86+0.86 to 1.86+0.43,P<0.001)pain, and Oswestry Disability Index scores (42.86+4.95 to 12.57+4.21,P<0.001)postoperatively.

Conclusion: The UBD-TADD technique offers a minimally invasive, secure, and effective endoscopic approach for spinal decompression in patients with spinal cord compression from bony elements. It results in reduced surgical trauma, faster recovery, and improved functional outcomes, particularly beneficial for the elderly with osteoporosis and multiple comorbidities.

Key words: Spinal Endoscopy; decompression; UBD system; technical notes

Quick fire 7

OP-110

Postoperative Contralateral Facet Cyst After Endoscopic Unilateral Laminectomy for Bilateral Decompression: A Case Report

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Introduction: Endoscopic unilateral laminectomy for bilateral decompression (Endo-ULBD) is a minimally invasive, motion-preserving surgical technique designed to decompress neural elements while preserving the posterior spinal structures. Because it maintains spinal integrity, the risk of postoperative instability is generally lower than that of conventional decompression techniques. However, microinstability-related complications, such as facet cyst formation, can still occur and may lead to recurrent symptoms

Case Presentation: A 63-year-old male underwent ULBD for L4-5 lumbar stenosis and showed notable symptom improvement, which enabled his discharge without complications. However, on postoperative day 5, he developed low back pain and right-sided radiating leg pain. At the 3-month follow-up, these symptoms persisted, prompting an MRI, which revealed a right-sided facet cyst formation. Conservative management, including analgesics, was initiated. By the 4-month follow-up, the patient reported significant symptom improvement.

Conclusion: This case highlights that, despite the minimally invasive nature of Endo-ULBD and its intent to reduce instability, complications related to microinstability, such as facet cyst formation, can still occur. Awareness of such potential complications is crucial for early diagnosis and management.

Keywords: Endoscopic ULBD complications, Microinstability, Postoperative facet cyst, postoperative complication

Quick fire 7

OP-111

Quality of Life and Functional Outcomes after Caudal Epidural Steroid Injection Versus Selective Nerve Root Block in Chronic Low Back Pain : A Single-Center Retrospective Cohort Study

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Purpose: To compare the quality of life and functional outcomes of Caudal Epidural Steroid Injection (CESI) versus Selective Nerve Root Block (SNRB) in chronic low back pain patients, including those who refuse or not eligible for spine surgery.

Methods: A retrospective cohort study was conducted in Ulin General Hospital for patients who suffered from chronic low back pain and underwent CESI and/or SNRB between January 2020 to December 2024. 90 patients were included in this study. The patient's pain intensity using VAS, and health-related quality of life after intervention using the SF-36 questionnaire were analyzed.

Results: 33 male and 57 female patients with mean age 51.38 years + 11.27 SD were included in this study. The patients were classified into 3 groups: 42 patients (46.67%) received CESI, 6 patients (6,67%) received SNRB only, and 42 patients (46.67%) received both CESI and SNRB. The mean VAS before & after intervention was 8.26+1.4 SD and 3.50+1.64 SD. There was a statistically significant difference in VAS scores before and after intervention (p-value < 0.001). However, there was no significant difference among each group of intervention (p=0.169). For quality of life and functional outcome, there was significant difference in physical functioning (p=0.01), energy/fatigue (p<0.001), emotional well-being (p=0.001) and pain (p=0.002) between each group.

Conclusion: There was significant reduction in pain intensity across all groups, but the specific intervention types (CESI, SNRB, or both) did not significantly differ. Differences in quality-of-life measurement, particularly in physical functioning, energy/fatigue, emotional well-being and pain were noted between each group. Therefore, CESI and SNRB remain valuable treatment modalities for LBP patients who refuse or not eligible for spine surgery.

Keywords: Caudal Epidural Steroid Injection, Selective Nerve Root Block, Chronic Low Back Pain

Quick fire 7

OP-112

Observation on the Clinical Efficacy of VBE Combined with Percutaneous Internal Fixation in the Treatment of Lumbar Discitis

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Objective: To investigate the clinical efficacy of V-shaped bilateral endoscopic spinal system (VBE) combined with percutaneous pedicle screw internal fixation in the treatment of lumbar discitis.

Methods: A total of 21 patients with primary lumbar spinal infections admitted to the Department of Spinal Infection Surgery in our hospital from January 2022 to January 2023 were selected. The inclusion criteria were lumbar infections involving the intervertebral space with indications for internal fixation surgery, including 9 cases of pyogenic lumbar discitis, 6 cases of Brucella lumbar discitis, and 6 cases of lumbar tuberculosis. All patients received targeted anti-infective therapy preoperatively based on etiological results. After inflammatory markers decreased, they underwent VBE-assisted lumbar intervertebral lesion debridement, bone graft fusion, and percutaneous pedicle screw internal fixation. Patients requiring decompression underwent VBE endoscopic decompression. Postoperative anti-infective therapy was continued. Erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) were monitored until normalization before discharge, and follow-up was conducted to observe clinical outcomes.

Results: All surgeries were successfully completed, with an operative time ranging from 74 to 148 minutes (mean: 88.4 minutes) and minimal intraoperative blood loss. Two patients underwent VBE endoscopic decompression, with postoperative relief of neurological symptoms. No surgical complications occurred in any of the 21 cases. The time required for ESR and CRP to normalize was 8–19 days (mean: 11.8 ± 3.5 days). Postoperative follow-up ranged from 6 to 18 months, with no cases of recurrent infection. Bone fusion was successful in 18 segments (85.7%), while the remaining 3 segments (not fully fused) belonged to patients with follow-up periods of less than 12 months and are still under observation.

Conclusion: VBE-assisted lumbar intervertebral lesion debridement, bone graft fusion, and percutaneous internal fixation for lumbar discitis demonstrate advantages such as shorter operative time, minimal blood loss, low complication and recurrence rates, and high fusion rates, proving to be safe and reliable. This approach holds promising clinical prospects and may provide valuable insights for the minimally invasive treatment of spinal infections.

Keywords: Spinal infection; Lumbar discitis; Surgical treatment; Minimally invasive treatment; VBE

Quick fire 7

OP-113

Biportal Endoscopic-assisted Treatment for Symptomatic Tarlov Cyst – Technical Report and Preliminary Results at CMUH

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Objective: Tarlov cysts, or perineural cysts, are fluid-filled sacs located between the perineurium and endoneurium, typically found in the sacral region of the spine.[5] While often asymptomatic, these cysts can sometimes cause symptoms such as radiculopathy or back pain[7]. This study reports on a 43-year-old male with a symptomatic Tarlov cyst in the sacral region, presenting with severe back pain and radiculopathy. The patient was treated with a biportal endoscopic-assisted cyst fenestration, autologous fat grafting, and size-reduction clipping technique.

Methods: The cystic lesion was identified through lumbar spine MRI. Pre-operative planning included anteroposterior and lateral imaging under C-arm guidance. Viewing and working portals were then docked. The treatment involved biportal endoscopic-assisted fenestration of the cyst, with an autologous fat graft inserted into the communication gap between the nerve root and the cyst. Finally, the cyst size was reduced by clipping, resulting in complete obliteration of the lesion. Clinical outcomes measures included visual analogue scale (VAS) score for lower back pain and leg pain, Japanese Orthopedic Association (JOA) and Oswestry Disability Index (ODI), postoperative radiology follow up including X ray and MRI on 1, 3, 6 months.

Results: this patient underwent biportal endoscopic treatment for symptomatic Tarlov cyst, and was symptom-free and discharged just one day after surgery. There were significant improvement in VAS for lower back pain from 6±2 to 1±1, VAS for leg pain from 5±1 to 1±1; JOA score from 4 to 10, ODI score from 41 to 15.

Conclusion: Biportal endoscopic-assisted surgery proves to be a safe and effective approach for treating single oval Tarlov cysts. This technique significantly reduces blood loss, minimizes muscle damage, and preserves more bony structure, which collectively contribute to a decreased risk of cerebrospinal fluid (CSF) leakage.[8]

Keywords: Tarlov cyst; Biportal Endoscopic spine surgery (BESS); Sacral perineural cyst; Cyst fenestration

Quick fire 7

OP-114

The treatment of facetogenic low back pain by full endoscopic lumbar rhizotomy: the systematic review of current literatures

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Background: Chronic low back pain (CLBP) is a debilitating condition affecting millions worldwide, imposing a substantial healthcare burden. Traditional treatments have limitations, prompting the exploration of innovative interventions. Endoscopic rhizotomy (ER) has emerged as a promising option, particularly for facetogenic pain. We conduct a systematic review to offer a comprehensive examination of ER's historical evolution, contemporary practices, and outcomes in CLBP management.

Methods: This systematic review followed PRISMA guidelines. Comprehensive searches were conducted in Embase, PubMed, and the Cochrane Central Register of Controlled Trials up to February 1, 2024, using specific keywords related to low back pain(LBP) and full endoscopic lumbar rhizotomy. Data extraction focused on patient characteristics and clinical outcomes, including any documented complications.

Results: A meta-analysis of 10 selected studies, involving 529 patients, was conducted. Notably, about 96.7% to 97.8% of patients who underwent ER reported excellent or good results based on the Macnab score. Comparative analysis revealed that ER patients had significantly better VAS scores (−2.39, 95% CI −3.15 to −1.63, $p < 0.00001$) and improved performance on the ODI (−19.97, 95% CI −37.48 to −2.46, $p = 0.03$) compared to those in the traditional percutaneous radiofrequency ablation(TPRA) group. Furthermore, no major postoperative complications were observed in the studies included.

Conclusion: Full endoscopic lumbar rhizotomy stands as a notable advancement in addressing CLBP, especially when associated with facetogenic pain. It demonstrates a more favorable outcome in treating facetogenic LBP compared to traditional percutaneous radiofrequency ablation(RFA), as evidenced by higher patient satisfaction rates and better clinical outcomes. The absence of major postoperative complications further underscores its potential as a preferred treatment modality.

Quick fire 8

OP-115

The risk factors associated with delirium after lumbar spine surgery in elderly patients

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Background: To prospectively explore the incidence and risk factors for postoperative delirium in elderly patients following lumbar spine surgery.

Methods: This prospective study enrolled 148 consecutive patients over the age of 65 who were scheduled to undergo spine surgery. Patients were screened for delirium using the short Confusion Assessment Method (CAM) postoperatively. Patient demographics and relevant medical information were collected. Logistic regression analysis was used to identify the risk factors associated with postoperative delirium.

Results: Eighty-three patients (56.1%) who underwent lumbar spine surgery (not coexisting with cervical or thoracic spine surgery) were enrolled in our study. Post-operative delirium was noted in 14.5% of patients over 65 years old. The presence of preoperative Parkinsonism was significantly higher in the delirium group (41.7% vs. 8.5%, P=0.002), as was a higher preoperative C-reactive protein (CRP) (7.0±15.2 vs. 1.3±2.3 mg/L,P=0.017) when compared with the non-delirium group. Of the risk factors, male sex [odds ratio (OR) =0.10, 95% confidence interval (CI): 0.01–0.66, P=0.017], Parkinsonism (OR =5.83, 95% CI: 1.03–32.89, P=0.046), and lower baseline MMSE score (OR =0.71, 95% CI: 0.52–0.97, P=0.032) were independently associated with postoperative delirium in elderly patients undergoing lumbar spine surgery.

Conclusions: Post-operative delirium occurred in 14.5% of elderly patients who underwent lumbar spine

surgery. Male sex, Parkinsonism, and lower baseline MMSE score were identified as independent risk factors for postoperative delirium in elderly patients following lumbar surgery.

Keywords: Delirium; elderly patients; lumbar surgery; risk factors

Quick fire 8

OP-116

Minimally Invasive versus Open Micro Lumbar Discectomy Early outcome observations

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Purpose: Minimally invasive procedures result in better functional outcome due to lesser tissue destruction and preservation of posterior spinal midline structures.

Our study was to compare early clinical and surgical outcome of patients treated with minimal invasive lumbar discectomy (MIS-MLD) and open microscopic lumbar discectomy (O-MLD).

Method: Eighty total patients, 40 in each group, were retrospectively analysed for demographic data, Pre and Post-op visual analogue scale (VAS) and Japanese orthopaedic association scores (JOA). Follow-up data was collected by out- patient consultation, imaging studies and telephonic questionnaire to assess JOA and VAS scores. JOA recovery rates were calculated (Hirabayashi formula).

Results: Demographic profile, pre-op VAS and JOA scores were similar in both groups. Hospital stay was shorter for MIS-MLD (4days) than O-MLD (7 days). Average blood loss for MIS-MLD (30ml) was lower than for O-MLD (100ml). Requirement of analgesics was higher in O-MLD group. Average post-op JOA score and JOA recovery rate were better in MIS –MLD (67.7% vs. 39.8%). Average duration of follow-up was 12 months. Return to work for MIS-MLD was an average of 4 weeks & for O-MLD was 8 weeks. JOA recovery rates at follow-up for MIS-TLIF was also better (68.3% vs. 40.2%)

Conclusion: Both procedures showed similar improvement in leg pain. MIS- MLD results showed significantly less blood loss, post op analgesic use, hospital stay and earlier return to work. Post-operative and follow-up mean JOA recovery rates were better in MIS-MLD cases.

Quick fire 8

OP-117

Persistent Pain After Decompression: Unmasking the Role of Facet Joint Pathology in Lumbar Facet Cyst Surgery

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Purpose: Lumbar facet joint cysts are an uncommon but important cause of radiculopathy, often linked to degenerative changes and segmental instability of the facet joint complex. Endoscopic resection effectively relieves nerve root compression; however, persistent axial low back pain remains a frequent postoperative issue, likely due to unaddressed facet joint pathology. This study evaluates long-term outcomes, focusing on persistent axial pain after endoscopic cyst resection.

Methods: A retrospective cohort study was performed at a tertiary care centre, including patients who underwent endoscopic laminotomy and cyst resection of MRI-confirmed lumbar facet joint cysts from January 2022 to December 2025. Patients with at least 24 months of follow-up were included. Data collected encompassed demographics, clinical presentation, surgical details, imaging, and outcomes. The primary endpoint was persistent axial low back pain at 24 months, measured by Visual Analog Scale (VAS) and Oswestry Disability Index (ODI). Secondary outcomes included radiological evidence of facet degeneration and cyst recurrence.

Results: Twenty-seven patients met inclusion criteria. Radicular symptoms improved significantly in 90.5% of cases. VAS and ODI scores showed statistically significant improvement at 24 months ($p< 0.01$). Despite this, 59.2% (16 patients) reported persistent axial low back pain. Follow-up MRI frequently revealed ongoing facet degeneration and residual or recurrent cysts in symptomatic patients. Conservative treatments provided limited relief, leading to subsequent percutaneous pedicle screw fixation in these cases.

While endoscopic cyst resection effectively resolves radicular symptoms, failure to address underlying facet joint pathology predisposes patients to persistent axial pain. The high rate of residual symptoms suggests the need for adjunctive procedures such as facet joint denervation or segmental stabilization, especially in patients with imaging or intraoperative signs of instability.

Conclusion: Persistent axial low back pain is a common long-term outcome after endoscopic lumbar facet cyst resection. Comprehensive surgical strategies addressing both neural decompression and facet pathology may optimize outcomes. Prospective studies are needed to clarify the role of stabilization and adjunctive techniques in managing this condition.

Keywords: Lumbar facet cyst, endoscopic resection, persistent axial back pain, facet joint instability, spinal surgery, segmental stabilization

Quick fire 8

OP-118

Posterior thoracic interbody fusion - when is it useful

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Background: Posterior thoracic interbody fusion (PTIF) is technically demanding because of narrow disc spaces, proximity to the spinal cord, and historically limited indications. However, when pathology is located ventral to the dura, a posterior corridor can avoid thoracotomy-related morbidity while providing direct decompression and rigid stabilization. This study evaluates the indications and outcomes of PTIF performed at a single institution.

Methods: A retrospective review identified 16 adults (mean age 66.4 years; 9 females) who underwent PTIF between T1–L2 from 2018–2023. Indications included thoracic disc herniation, proximal junctional kyphosis, infectious spondylitis, and ossification of the posterior longitudinal ligament, all with ventral dural involvement. Surgical technique consisted of bilateral total facetectomies, meticulous discectomy-endplate preparation, pedicle-screw instrumentation, and insertion of either cage + allobone or allobone alone (8 patients each). Radiographic fusion was assessed by CT ≥6 months post-operatively; neurological status used the ASIA scale. Mean clinical/radiological follow-up was 19.4 months.

Results: No intra-operative spinal cord injuries, dural tears, or cerebrospinal-fluid leaks occurred. Fusion was achieved in all cases; no cage migration or pedicle-screw loosening was noted on serial CT. Patients with pre-operative neurological deficits demonstrated improvement or stabilization, and most reported meaningful back-pain relief. Post-operative ASIA grades were unchanged or improved in every patient.

Conclusions: When ventral thoracic pathology mandates direct decompression, PTIF provides a safe and effective alternative to anterior approaches, yielding high fusion rates and consistent neurological recovery without thoracotomy-related complications. Careful patient selection and generous bilateral facetectomy are key technical factors that enable adequate exposure while minimizing neural manipulation. Further comparative studies are warranted to clarify long-term functional and cost-effectiveness profiles.

Keywords: posterior thoracic interbody fusion; ventral thoracic pathology; thoracic disc herniation; ossification of posterior longitudinal ligament; thoracic spine fusion

Quick fire 8

OP-119

Newly developed probe showing depth in anteroposterior view for safe PPS insertion

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Purpose: During insertion of PPS under C-arm, probe is proceeded by anteroposterior view as first step, then converted to lateral view. In the first step, there is risk of vascular penetration by too-deep needle insertion, since it is difficult to know the depth. To avoid such accident, innovative probe is developed.

Materials and methods: The feature of new probe is, the diameter of probe become thicker at the point of 30mm from the tip of probe, from the diameter of 3mm to 6mm. By the difference of diameter, the depth can be clearly known. If the probe is inserted 30mm before probe tip reaches medial wall of pedicle, the depth is enough and C-arm is converted to lateral view. And oppositely if the probe tip reached medial wall too shortly, the angle of should be raised. The design and manufacturing were done by TAKAYAMA INSTRUMENT (Tokyo, Japan). Intraoperative C-arm image and postoperative CT scan of the patients received thoraco-lumbar PPS insertion is investigated.

Results: 80 PPSs were inserted with this probe for 11 cases. They were 5 cases of thoracolumbar fractures including 4 cases of osteoporotic fractures and 6 cases of lumbar degenerative disease. During surgery, the point of 30mm from probe tip was easily recognized. When probe was proceeded 30mm before reaching inner wall of pedicle, resistance due to sudden change of diameter could be felt. Then C-arm was changed to lateral view. Since the probe couldn't proceed more, guide wire was inserted more deeply. After removal of probe, rest of procedure was same as using traditional probe. There was no probe insertion beyond anterior wall of vertebral body. Postoperative CT revealed adequate PPS position. Handling was equivalent to traditional probes. And the probe was named as "T-Probe".

Conclusion: This probe contributes for safe PPS insertion, without any expensive tools like navigation system. And the cost is less expensive. It is recommended for use in C-arm assisted surgery for lower thoracic and lumbar spine, where the distance to the anterior wall exceeds 30 mm.

Key words: PPS, probe, safety

Quick fire 8

OP-120

Comparison of Acupuncture and Lumbar Traction in Reducing Subsequent Lumbar Fusion or Discectomy for Lumbar Disc Herniations: Real World Evidence from the Multinational Database

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Background: Lumbar disc herniation (LDH) is a leading cause of low back pain, often managed with conservative treatments or, in severe cases, surgical interventions like discectomy or fusion. While acupuncture and lumbar traction are widely used non-invasive treatments, their comparative effectiveness in preventing surgery has not been well established.

Objective: To evaluate whether acupuncture is more effective than lumbar traction in reducing the incidence of lumbar discectomy or spinal fusion in patients with LDH.

Methods: A retrospective cohort study was conducted using the TriNetX database, analyzing electronic health records from over 800,000 individuals across 64 U.S. healthcare organizations (2000–2023). Adults diagnosed with LDH were included and categorized into acupuncture (n=2,085) or traction therapy (n=2,085) groups after 1:1 propensity score matching. Kaplan-Meier survival analysis and Cox proportional hazards models were used to compare surgery rates between groups.

Results: Acupuncture significantly reduced the risk of discectomy (HR=0.325; 95% CI: 0.232–0.457; p<0.001) and spinal fusion (HR=0.585; 95% CI: 0.427–0.801; p<0.001) compared to traction. Subgroup analyses confirmed the overall trend, though some confidence intervals were wide and crossed unity, especially in patients with comorbidities or advanced age.

Conclusion: Acupuncture was associated with a significantly lower incidence of lumbar discectomy and fusion than lumbar traction in patients with LDH. Given its favorable safety profile and potential to delay or reduce the need for surgery, acupuncture should be considered as a frontline conservative therapy in LDH management.

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OP-121

Early application of L-Unitary Soft Endoscopic anterior cervical discectomy decompression fusion for single-level cervical spondylotic myelopathy

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Purpose: Anterior cervical discectomy decompression fusion(ACDF) is standard treatment for cervical spondylotic myelopathy. Endoscopy in cervical surgery is advantageous in that it allows clear visibility and ensures adequate decompression; however, there is currently no endoscopic system specially designed for application in ACDF. This research investigated the efficacy and safety of early LUSE-ACDF for single-level CSM.

Methods: A retrospective comparative study of clinical data collected preoperatively and at the 1-week, 1-month, 3-month, and 6-month postoperative follow-ups from 24 patients who underwent LUSE-ACDF between August 2022 to November 2023 was conducted. Of the 24 patients (9 males, 15 females, average age: 57.83 years), 4 underwent surgery at C3/4, 4 at C4/5, 14 at C5/6, and 2 at C6/7. All surgeries were performed by spine surgeons at the Third Affiliated Hospital of Southern Medical University. The exclusion criteria included: ossification of the posterior longitudinal ligament; ligamentum flavum hypertrophy; cervical deformity; tumor; infection; and prior cervical spine trauma or surgery.

Clinical outcomes, including Japanese Orthopedic Association (JOA) scores and neck/shoulder visual analog scale (VAS) scores, were compared preoperatively and at each follow-up. Other metrics included operation time, blood loss volume, drainage volume, and postoperative complication rates.

Results: Twenty-four patients underwent surgery successfully without any postoperative complications. The operative time was 57.42 ± 13.12 min (40~85 min), the incision length was 3.46 ± 1.12 cm (2~5 cm), the intraoperative blood loss volume was 20.42 ± 14.52 ml (5~50 ml), and the postoperative length of hospital stay was 5.38 ± 1.28 days (3~8 days). Significant improvements in JOA and VAS scores were observed at each follow-up ($p<.001$). No significant prevertebral soft tissue edema was observed on postoperative MRI. At the final follow-up, 19 patients had excellent outcomes, 4 had good outcomes, and 1 had a fair outcome, for an excellent and good rate of 96% based on JOA scores.

Conclusion: LUSE-ACDF combines the benefits of both open and endoscopic techniques, minimizing complications and achieving favorable clinical outcomes. However, prospective studies with long-term follow-up are needed to fully evaluate its clinical utility.

Quick fire 9

OP-122

Biportal Endoscopic Thoracic Discectomy

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Object: The use of conventional spinal decompression surgery for thoracic disc herniation (TDH) can be limited by technical difficulties and a restricted field of vision. The purpose of this study is to describe the technique for discectomy and/or fusion procedure using unilateral biportal endoscophy (UBE) for TDH and analysis of clinical postoperative results.

To reduce the invasiveness and risk of thoracic disc surgery, a transpedicular endoscopic approach has been created. The surgical technique and outcome of endoscopic transpedicular thoracic discectomy are reported.

Methods: The authors performed laminotomy, foraminoplasty, partial pediculotomy and corpectomy via using UBE posterolateral approach in patients with TDH. Indications of fusion consist of revision case and wide pediclulotomy (> 50%).

From March 2018 to July 2020, twelve patients with thoracic disc herniation (TDH) underwent unilateral biportal endoscopic thoracic discectomy with or without fusion. The authors performed laminotomy, foraminoplasty, partial pediculotomy and corpectomy via using UBE posterolateral approach in patients with TDH. Indications of fusion consist of revision case and wide pediclulotomy (> 50%). 4 patients were men and 8 were women, aged 48 to 73 years (mean: 65 years). Myelopathy, with or without radiculopathy was present in all patients. The follow-up periods ranged from 8 to 60 months (median 27 months). The clinical outcome was evaluated using the visual analogue scale (VAS) and Oswestry disability index (ODI).

The authors enrolled only patients who underwent follow-up for longer than 12 months after UBE.

Fifty-eight patients were enrolled in this study. This approach was based on 2 portals: one portal was used for continuous input and endoscopic viewing and the other portal was used for continuous output and manipulating the instruments used in the decompression procedures.

The surgical technique of posterior transpedicular thoracic discectomy was modified to endoscopic transpedicular surgery. A 1.5-cm trocar was placed in the interlaminar space via a 2-cm transverse paramedian skin incision. At the ventral aspect of the spinal cord discectomy was performed under direct visualization by using a 70°-lens endoscope.

This surgical technique was used in 12 patients. 4 patients were men and 8 were women, aged 48 to 73 years (median 65 years). Myelopathy, with or without radiculopathy was present in all patients. The follow-up periods ranged from 8 to 60 months (median 27 months).

Results: In 11 of the 12 patients with myelopathy excellent improvement was shown postoperatively; One patient who was unable to walk preoperatively was able to ambulate with the use of a cane, but residual spasticity is still present. The average length of hospital stay was one night. Four patients were male and eight were female, aged 48 – 73 years (mean: 65 years). Mean follow-up period was 60 months (8 – 60 months), mean operative time was 81 min. The mean VAS improved from 6.5 to 3.0 for back pain and 5.8 to 2.5 for leg pain at the final follow-up. The mean ODI scores also improved from 58.1 before surgery to 24.5 at the final follow-up. Conversion to an open procedure was not required for any of the patients.

Conclusions: Unilateral biportal endoscopic discectomy was found to be a minimally invasive and effective surgical treatment.

From a surgical point of view, unilateral biportal endoscopy (UBE) is very similar to microscopic spinal surgery, permitting good visualization. The authors suggest that the UBE, which is a minimally invasive procedure, is an alternative treatment option for thoracic TDH.

KEY WORDS: thoracic spine • thoracic disc herniation • unilateral biportal endoscopy • discectomy

Quick fire 9

OP-123

Introduction of Pao's Flash sign

TA LI HSU / Yu-Hao-Huang / Yu-Hung Chen/ Jwo Luen Pao

Far East Memorial Hospital

Purpose : About the diagnosis and UBE treatment experience of foraminal stenosis

Methods : Retrospective reviewing 30 cases with Ackward acute tuning points along the traveling course of the nerve root via coronal plan MRI, which was defined as Pao's Flash signs for lumbar foraminal stenosis.

The foraminal stenosis can be treated via paraspinal approach of UBE technique. However, during operation, not only unroofing the L5 root, we have to dealing with the osteophyte arising from the L5 endplate.

Results :

1. Potential offending pathology: posterior marginal spur of vertebral body, Bulgin annulus fibrosis in spondylolisthesis, foraminal disc herniation

2. The Flash signs teach us that we should not only unroof the nerve root but also need to fight with the pathology beneath the nerve root so that the root will be return to the normal position.

3. End point of foraman decompression: good mobility, good pulsation, good reperfusion, reposition

4. The Pao's Chop-Chop technique is giving birth to fight the flash sign! (Normal position improve the perfusion and is highly correlated with patient's recovery)

Conclusion : Pao's Flash signs is an effective sign for preoperative diagnosis and evaluate the pathology beneath the nerve root (ventral site of body). Futhermore, the Pao's Chop-Chop technique is giving birth to fight the flash sign! (Normal position improve the perfusion and is highly correlated with patient's recovery)

Quick fire 9

OP-124

A Comparative Analysis of Postoperative Imaging and Functional Recovery between Endoscopic and Microscopic Assisted Cervical Discectomy: Evidence from a Retrospective Cohort Study

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Purpose: Cervical spondylopathy significantly impacts patient quality of life and imposes an economic burden due to its prevalence and healthcare costs. This study aimed to compare three surgical techniques—microscopic assisted anterior cervical discectomy and fusion (M-ACDF), coaxial endoscopic ACDF (C-ACDF), and non-coaxial endoscopic ACDF (NC-ACDF)—in terms of perioperative indicators, postoperative functional recovery, radiological outcomes, and complication rates.

Method: A single-center retrospective cohort design was employed, involving 180 patients with comparable baseline characteristics across the three groups. According to the surgical method, the patients were divided into three groups: M-ACDF (n=60), C-ACDF (n=60), and NC-ACDF (n=60). The operation time, intraoperative blood loss, Japanese Orthopedic Association (JOA) score, visual analogue scale (VAS) score, neck disability index (NDI) score, ROM, HAVB and Cobb angle were systematically compared. The shortest follow-up time was 12 months.

Results: Results indicated that the C-ACDF group had the longest operative time (100.78±16.43 min) and the least intraoperative blood loss (73.25±15.20 mL), while the M-ACDF group demonstrated the shortest operative time (88.47±17.42 min) but the highest blood loss (93.24±14.04 mL). Postoperatively, significant improvements in visual analog scale (VAS), Japanese Orthopaedic Association (JOA), and Neck Disability Index (NDI) scores were observed in all groups, with C-ACDF showing faster pain relief. Imaging outcomes revealed that C-ACDF achieved superior alignment and stability as evidenced by improved Cobb angle and adjacent segment vertebral height at 3 and 12 months post-surgery. Although complication rates were low and comparable among groups, the findings underscore the potential of C-ACDF to enhance functional recovery and patient satisfaction.

Conclusion: In conclusion, C-ACDF and NC-ACDF may represent more effective surgical approach for cervical spondylopathy, warranting further investigation into long-term outcomes and broader applicability in clinical practice.

Quick fire 9

OP-125

Cervical confluent root variation

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Purpose: Cervical nerve root variations are rarely reported compared to the relatively common variations in the lumbar spine. We identified confluent root or double root, which refers to the ventral root and dorsal root emerging through two separate dural sleeves and joining at the dorsal root ganglion. This study aims to analyze the frequency and characteristics of cervical nerve root variations observed during Posterior Endoscopic Cervical Foraminotomy(PECF) and discectomy(PECD) using Full-endoscope and to evaluate their clinical significance.

Materials and Methods: This retrospective study included 250 patients who underwent PECF or PECD using a Full-endoscope at a single institution between January 2022 and December 2024. Data were collected on sex, age, surgical level, surgical side (right/left), and the presence or absence of nerve root variations. A Full-endoscope was utilized to enable precise visualization and identification of nerve root variations.

Results: Among the 250 patients included in this study, the overall incidence of confluent root variations was 13.6%(34/250). For levels, C6-7 showed the highest rate(16.35%), while C4-5(5.56%) and C5-6(13.27%) showed lower rates (chi-square p=0.668). Males had a confluent root incidence of 11.36%, while females showed a slightly higher rate of 18.92% (chi-square p=0.301, z-test p=0.215). Regarding sides, the incidence was 14.71% on the left side and 12.28% on the right side(chi-square p=0.802, z-test p=0.660). Although variations were observed, none of the factors showed statistically significant differences.

Conclusion: Confluent root variations were previously difficult to identify due to the limitations of imaging modalities such as MRI, as well as the constraints of earlier surgical techniques. Due to the limited recognition of cervical nerve root variations in previous literature, this study is significant as it provides the first detailed quantification of these variations, with C6-7 showing the highest incidence(16.35%). These variations are clinically significant as they may be mistaken for herniated discs or ligamentous structures, potentially leading to iatrogenic nerve root injury. The much closer view of Full-endoscope compared to other surgical techniques (e.g., Microscope, Biportal endoscope) enables more accurate visualization of neural structures, facilitating the identification of these variations and ensuring safe surgical procedures.

Quick fire 9

OP-126

Taking advantages of Unilateral Biportal Endoscopy in thoracic spinal stenosis decompression

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Purpose: Miniamlly invasive surgery are increasingly popular to challenge thoracic spinal stenosis (TSS). Unilateral biportal endoscopy (UBE) is recognized to exceptionally address spinal stenosis for its broad view and operability. This study purposed to report the surgical outcomes of unilateral biportal endoscopy (UBE)-assisted decompression for TSS and clarify its advantages versus traditional open laminectomy.

Methods: From Mar 2021 to Mar 2024, patients diagnosed with TSS induced by short-segment thoracic ossification of ligamentum flavum underwent UBE-assisted thoracic decompression at our spine unit were included (UBE-arm). The peri-operative electronic records and surgical outcomes including clinical presentations and radiological index during the period of at least 1-year follow-up were retrospectively analyzed and subsequently compared with the matched cohort underwent traditional open laminectomy (TOL-arm) from Jan 2016 to Feb 2021.

Results: The basic demographic characteristics and clinical presentations were comparable between the UBE-arm (28 cases) and the TOL-arm (38 cases). All cases were successfully managed per the surgical plan by the same surgical team. For peri-operative index, the UBE-arm vs TOL-arm showed obvious advantages in mean operation time, postoperative hospital stay, and rate of intra- and post-operation complications(88.6 vs 135.2min, $P< .05$; 5.0 vs 13.4 day, $P< .05$; 10.7% vs 36.0%, $P< .05$, and 7.1% vs 18.0%, $P< .05$; respectively). The decompression ratio of spinal canal area of interest at horizontal CT images were comparable between those two arms (2.97±0.52 vs 3.15±0.43, $t=-2.28$, $P> .05$). At the last follow-up, the ODI improvement were significantly favorable in the UBE-arm while MacNab recovery rate also significant higher in the UBE-arm vs TOL-arm (12.60±4.25 vs 21.38±7.43, $t=-13.20$, $P< .05$; 89.3% vs 64%, $P< .05$). No revision surgery occurred in both arms.

Conclusion: With plenty experiences and proficient skills, UBE-assissted thoracic decompression is safe and efficient, while show obvious advantages in minimal invasion, less complications, and favorable recovery vs traditional open laminectomy. Further cohort study is required to clarify its clinical significance vs other minimally invasive techniques.

Key Words: Unilateral biportal endoscopy; Thoracic spinal stenosis; Miniamlly invasive surgery; Open laminectomy; Spinal canal decompression;

Quick fire 10

OP-127

A New Pilot Hole Preparation System for Percutaneous Pedicle Screw Placement A Randomized Controlled Study

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Purpose: To introduce a new pilot hole preparation system for percutaneous pedicle screw placement and investigate its efficiency and safety in comparison with the conventional method.

Methods: A total of 60 patients (180 screws) were included in this study. All patients were randomized into two groups (new system vs. conventional method) and performed single-level minimally invasive percutaneous fixation, interbody fusion, and unilateral decompression. Basic information, time of pilot hole preparation, time of screw placement, and fluoroscopy time were recorded. Screw placement accuracy was graded based on the Gertzbein-Robbins scale, and the angle between the screw axis and the pedicle axis was collected in postoperative CT.

Results: There was no statistical difference in basic information between the 2 groups. The mean time of single pilot hole preparation was 4.08 ± 1.01 minutes in the new system group and 5.34 ± 1.30 minutes in the conventional method group ($P < 0.001$). The time of single screw placement was significantly shorter in the new system group (0.82 ± 0.20 vs. 1.72 ± 0.33 min), and the fluoroscopy time was also less in the new system group (13.70 ± 3.42 vs. 19.95 ± 5.50 s) ($P < 0.001$). Screw placement accuracy assessment showed that there were 85 (94.45%) A-grade screws in the new system group while 76 (84.44%) A-grade screws in the conventional method group ($P = 0.027$).

Conclusion: The new pilot hole preparation system has shown significant reductions in the time of pilot hole preparation, time of screw placement, and radiation exposure, and has good clinical application value

Quick fire 10

OP-128

The efficacy of biportal endoscopic decompression for thoracic ossification of ligamentum flavum with occupancy ratio >60%

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Purpose: To evaluate the clinical and radiological outcomes of unilateral biportal endoscopy assisted unilateral laminotomy for bilateral decompression (UBE-ULBD) for the treatment of severe thoracic spinal stenosis (TSS) caused by ossification of ligamentum flavum (OLF) with ossification occupancy ratio>60%.

Methods: The retrospective cohort study enrolled 60 patients of TSS with OLF from January 2021 to April 2023. All the patients presented with typical thoracic spine compressive symptoms with radiological one or two level thoracic OLF with ossification occupancy ratio>60%.. The UBE-ULBD surgery under general anesthesia was performed and all the patients were followed up at least for 2 years. Preoperative and postoperative clinical and radiological data were reviewed and analyzed. Clinical outcomes included visual analogue scale (VAS) scores, modified Japanese Orthopaedic Association (mJOA) score and recovery rate (RR). Radiological measurements included area of dural sac and dural expansion rate. In addition, operation time, postoperative drainage, postoperative length of stay and complication were also recorded.

Results: There were 52 cases of TSS with single level OLF and 8 cases with double level OLF. The UBE-ULBD surgery was successfully performed for all the patients with average follow-up of 28.2±5.4 months. The average operative time was 94.5 min/level. The VAS score for back pain (1.2±1.0 vs 4.1±1.4), leg pain (1.3±0.8 vs 4.3±1.2) and mJOA score (8.2±2.0 vs 5.4.±1.9) were significantly improved at last follow-up comparing with preoperative score. The mean RR was 64.5% (25%~84%), including excellent for 46 cases, good for 10 cases, fair for 4 cases. For the complication, dural tear occurred in 5 cases, which were diagnosed with OLF and dural ossification. Intraoperative dural repair was not performed and no spinal hypertension symptoms happened after postoperative anesthesia wakefulness. Postoperative CT and MRI showed the ossified lesion were removed and excellent decompression was achieved with the mean dural expansion rate of 97%.

Conclusions: UBE-ULBD is a technically demanding and a feasible, efficient, and minimally invasive option for the treatment of severe one or two level OLF-TSS with high ossification occupancy rate>60% with excellent clinical and radiological outcomes.

Quick fire 10

OP-129

Efficacy and radiographic analysis of oblique lumbar interbody fusion in treating lumbar spondylolisthesis with sagittal imbalance.

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Background(s): The aim of this study was to evaluate the effectiveness of OLIF(Oblique lumbar interbody fusion) in the treatment of lumbar spondylolisthesis with sagittal imbalance.

Method(s): 59 patients were included in our analysis. Included patients were divided into 2 groups according to the surgical techniques : PLIF(posterior lumbar interbody fusion)(n = 31), OLIF+PSF(OLIF combined with posterior spinal fixation)(n = 28). Perioperative radiographic parameters, complications, and clinical outcome from each group were assessed and compared

Result(s): The operation time for both groups was 165.1 min in the OLIF group and 182.1 min in the PLIF group ($P < 0.05$). The intraoperative blood loss was 190.6 ml in the OLIF group and 356.3 ml in the PLIF group ($P < 0.05$). The number of intraoperative and post-operative complications for both groups was 7 in the OLIF group and 11 in the PLIF group. Significant clinical improvement was observed in VAS scores and ODI when comparing pre-operative evaluation and final follow-up. The pre-operative SVA (the distance from the posterosuperior corner of S1body to the C7 plumb line), PI(pelvic incidence), LL(lumbar lordosis), PI-LL mismatch, DH(disc height), and lumbar Cobb angles of both groups were similar. The post-operative and final follow-up SVA, LL, PI-LL mismatch and disc height were improved in both groups, and a statistical difference was found between both groups ($P <0.05$). An improvement of SVA, LL, PI-LL mismatch and disc height at the OLIF group was better than that found at the PLIF group.

Conclusion(s): An improvement in radiographic and clinical outcomes for the OLIF group was better than that seen for the PLIF group. Then, OLIF had a more curative effect in lumbar spondylolisthesis with sagittal imbalance.

Key Words: lumbar spondylolisthesis, sagittal imbalance, Oblique lumbar interbody fusion, posterior lumbar interbody fusion

Quick fire 10

OP-130

Association of Open Transforaminal Lumbar Interbody Fusion with Increased Postoperative Complications Compared to Minimally Invasive Transforaminal Lumbar Interbody Fusion

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Purpose: The purpose of this study is to compare the postoperative complication rates between open and minimally invasive surgical (MIS) transforaminal lumbar interbody fusion (TLIF) procedures.

Methods: This retrospective cohort study utilized data from the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database for the years 2022–2023. Patients who underwent TLIF for lumbar spondylolisthesis were identified using CPT codes 22630 and 22633. A total of 3,371 patients were initially identified. After excluding patients with missing or incorrect surgical approach records (n = 313), emergency or urgent unplanned cases (n = 34), those aged <18 or ≥90 years (n = 5), and those undergoing ≥3-level fusion (n = 16), a final cohort of 3,003 patients was included. Patients were categorized into two groups based on surgical approach: open TLIF (n = 2,712) and MIS TLIF (n = 291). The primary outcome was the occurrence of any postoperative complication within 30 days. Multivariable Cox regression analysis was performed to estimate adjusted hazard ratios (HRs), controlling for baseline demographics, comorbidities, and operative variables.

Results: A total of 3,003 patients who underwent TLIF for one- or two-level lumbar spondylolisthesis were identified, with 291 (9.7%) undergoing MIS TLIF and 2,712 (90.3%) undergoing open TLIF. Baseline demographics and comorbidities were comparable between groups, though open TLIF was associated with a significantly longer median operative time (193 vs. 169 minutes, $p < 0.01$). The overall complication rate was significantly lower in the MIS group (6.5%) compared to the open group (13.1%). Multivariable analysis revealed that minimally invasive TLIF was associated with a significantly reduced risk of postoperative complications (adjusted hazard ratio [HR]: 0.51; 95% CI: 0.32–0.80). Kaplan-Meier analysis confirmed a significantly higher complication-free survival probability in the MIS group ($p < 0.01$, log-rank test).

Conclusion: MIS TLIF is associated with a significantly lower risk of postoperative complications compared to the open approach. These findings support the potential benefits of MIS techniques in reducing surgical morbidity and improving short-term outcomes in patients undergoing TLIF for lumbar spondylolisthesis.

Quick fire 10

OP-131

OLIF with Anterolateral screws : Is it necessary to do Anterior /Posterior Surgery

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Introduction : Indirect neurological decompression in form of increased foraminal opening and central canal opening has been the central concept in lateral surgeries of spine. These Minimal invasive procedure also preserve both the ALL and PLL providing efficient reduction of vertebral body through ligamentotaxis.

Purpose : To assess clinical and radiological outcomes of oblique lumbar Inter body fusion technique in single stage single anterior approach with anterolateral screw without going posterior (OLIF-AL)

Material and methods : observational type study of 3 years duration.

Inclusion criteria:

1.Degenerative spinal diseases,
2.failed conservative management for over 2 months.
3. Revision surgery following failed posterior surgery

Exclusion criteria :

1. L5-S1 level involvement .
2. Higher iliac crest.
3. more than 2 level involvement .
4. presence of congenital deformities.

Clinical assessment was done using Numeric Rating scale score (NRS) and Oswestry disability Index score. Operating time and blood loss was also monitored.

Radiological assessment of disc height , foraminal height and foraminal area on standing lateral radiography. Segmental lordotic angle . Fusion status analysed using modified Birdwell fusion criteria.

Results: 55 patients in our study Mean age was 54.5 yrs .Mean preoperative NRS score for back pain and leg pain was 4.6 and 5.9 will was reduced to 2.3 and 1.8 respectively at final follow up. ODI score decreased from 48.8% to 24.0% . In Radiological outcome Birdwell fusion criteria at 1 yr and final follow up was 70 % and 90%. Disc height increased from mean of 8.6 mm to 13.4 mm. Average increase in foraminal area was 30%.Segmental lordotic angle increased from mean of 10.1 degree to 15.2 degree. We observed about 30% in operation time and significant reduction in blood loss. Complication in 3 patients , which was approach related injury to psoas muscle(Hip flexor weakness) which improved completely over the period of 3 months.

Conclusion: Single stage single anterior approach OLIF for degenerative lumbar diseases showed favourable clinical and radiological outcome . It helps avoids various complications of second procedure in standard OLIF. Overall OLIF with anterolateral screw is safer faster and efficient.

Quick fire 10

OP-132

ENDOSCOPIC SPINE SURGERY : OUR INITIAL EXPERIENCE- A YOUNG SURGEON'S PERSPECTIVE

Sagar Gawali

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Our institute favors the Destandau technique for minimally invasive endoscopic spine surgery, facilitating **early discharge,** for various spinal conditions. This report presents initial findings from a young neurosurgeon's perspective on the first 20 cases performed over eight months at a tertiary hospital. The cohort included 11 males and 9 females with a mean age of 42 years. Diagnoses comprised single-level lumbar disc herniation (n=6), single-level lumbar canal stenosis (n=6), two-level lumbar canal stenosis (n=6), recurrent disc herniation (n=1), and canal stenosis with a synovial cyst (n=1). Procedures performed included nerve root decompression, bilateral decompression via a unilateral port, discectomy, and foraminotomy. The average operative time was 142 minutes with 90ml of blood loss. All patients were mobilized within four hours post-surgery and discharged on the next day, reporting significant symptom relief. In conclusion, despite the technical demands and learning curve, the Destandau technique yields gratifying results regarding postoperative recovery and rehabilitation..

Abstracts

Poster Presentation

PASMISS 2025

The 25th Pacific and Asian Society of Minimally Invasive Spine Surgery

Poster

EP-01

Dysregulated lipid metabolism and intervetebral disc degeneration: the important role of ox-LDL/LOX-1 in endplate chondrocyte senescence and calcification

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Objective: Lipid metabolism disorders are closely linked to senescence in multiple tissues, yet the molecular mechanisms underlying their crosstalk with bone and joint degeneration remain poorly understood. This study aimed to investigate the role of oxidized low-density lipoprotein (ox-LDL) and its receptor LOX-1 in cartilage endplate (CEP) degeneration and intervertebral disc degeneration (IDD) under hyperlipidemia (HLP) conditions, focusing on cellular senescence, calcification, and associated signaling pathways.

Methods: A combination of TMT-labelled quantitative proteomics and in vivo/experimental models was employed. Proteomic analysis of intervertebral discs from lipid metabolism-disordered mice identified enriched pathways, including cell cycle regulation, endochondral bone morphogenesis, lipid transport, and inflammation. Human degenerative CEP tissues and a rat HLP model were used to validate ox-LDL/LOX-1 expression and senescence markers. In vitro experiments on endplate chondrocytes (EPCs) utilized β -galactosidase staining, flow cytometry, western blot, and immunofluorescence to assess senescence and calcification. Mechanistic studies further explored the ROS/P38-MAPK/NF-κB pathway.

Results: High expression of ox-LDL/LOX-1 was observed in human degenerative CEP tissues, correlating with HLP. In vivo, HLP induced CEP senescence, calcification, and elevated ox-LDL/LOX-1 levels in rats. In vitro, ox-LDL triggered EPC senescence and calcification via LOX-1 receptor activation, evidenced by increased β -galactosidase activity, senescence-associated secretory phenotype (SASP), and calcification markers (e.g., ALP and RUNX2). Mechanistically, ox-LDL/LOX-1 activated the ROS/P38-MAPK/NF- κ B axis, driving oxidative stress and inflammatory responses.

Conclusion: This study establishes ox-LDL/LOX-1 as a critical mediator of CEP senescence and calcification in lipid metabolism disorders, highlighting the ROS/P38-MAPK/NF- κ B pathway as a central regulatory mechanism. These findings bridge lipid dysregulation with IDD pathogenesis and propose LOX-1 as a therapeutic target to delay disc degeneration, aligning with broader insights on lipid metabolic reprogramming in degenerative joint diseases. The results advance understanding of how systemic metabolic disturbances drive localized tissue aging and degeneration.

Keywords: Lipid metabolism disorders; Oxidized low-density lipoprotein; Lectin-like oxidized low-density lipoprotein receptor 1; Intervertebral disc degeneration; senescence and calcification.

Poster

EP-02

A guide to Non-Laminotomy Bilateral Decompression and its subsequent future-oriented goals

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Recently, when describing lumbar decompression surgery, most presenters tend to use the term 'decompressive surgery,' and the use of the term 'ULBD' has been declining. It is generally agreed that the lamina, particularly in the lateral recess, should be removed along with osteophytes. However, if the lamina truly needs to be resected as a pathological structure, can we really argue that it always requires just unilateral removal? Laminotomy performed solely for visualization purposes should be distinguished from pathology-driven laminotomy, and the term 'ULBD' is inherently contradictory in this context.

Non-laminotomy bilateral decompression (NLBD) is a novel technique that presents a new paradigm, published in the Asian Spine Journal in 2024. However, we, the authors, do not claim that NLBD is a magical solution or a universally applicable procedure. What we can confidently state is how NLBD can be appropriately applied to selected indications.

NLBD is no longer a distant concept; it is a tangible reality, and we propose several directions for further advancement: The following are the key topics we intend to present at PASMISS.

First, a comparative clinical study following our initial technical note.

Second, just as NLBD can be applied to central stenosis, non-facetectomy foraminal decompression (NFFD) can also be performed in selected indications. The technique has previously been applied using both open and minimally invasive approaches. We have reported on endoscopic NFFD, published in the Asian Spine Journal in 2025. By combining NLBD and NFFD, there may be appropriate indications even in cases with two or more concomitant lesions within a single segment. With this combined surgical technique(NLBD+NFFD), it is expected that fusion can be avoided in certain indications, and a new approach is being taken under the concept of non-osteotomy lumbar decompression(NOLD).

Furthermore, if NLBD is indeed feasible for specific indications, decompressive surgery may be more appropriately viewed as a soft tissue procedure. In such cases, local anesthesia could be considered, similar to the Wide-Awake Local Anesthesia No Tourniquet (WALANT) technique commonly used in hand surgery. In our clinical practice, we perform surgery under local nerve block and sedation without the use of urinary catheterization. Most patients are able to begin ambulation as early as two hours postoperatively. While it is difficult to determine the exact extent of surgical procedures that can be performed under nerve block and sedation alone, adequate anesthesia must be ensured in consultation with the anesthesiology team. However, if decompression surgery can be performed under local anesthesia in selected indications, it would be more patient-friendly and may allow for faster postoperative recovery, aligning with the principles of Enhanced Recovery After Surgery (ERAS), potentially reducing overall societal healthcare costs.

Poster

EP-03

Application of unilateral biportal endoscopy technique in lumbar infection

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Objective: Surgical treatment for lumbar infection remains controversial. This study aims to evaluate the safety and clinical efficacy of unilateral biportal endoscopy (UBE) surgery in treating lumbar infectious diseases.

Methods: We retrospectively analyzed ten patients diagnosed with lumbar infection who underwent spinal canal decompression and debridement & irrigations using UBE technique between December 2023 and December 2024. Postoperative sensitive antibiotic therapy was administered based on bacterial culture results. Clinical outcomes were evaluated by the Visual Analogue Scale (VAS) scores, Oswestry Disability Index (ODI), modified MacNab criteria (MNC), regular serological tests (CRP, ESR, WBC), and radiography (X-ray, MRI) at pre- and post-operation.

Results: All 10 patients experienced a significant improvement in their clinical symptoms after UBE surgery. Compared to those before the operation, CRP, ESR, and WBC were significantly reduced at 3 days, 3 months, and last follow-up postoperative ($P < 0.05$). Similarly, the VAS score and ODI index were markedly decreased at 3 days, and significantly lower than those before operation at each time point after operation ($P < 0.05$). At the last follow-up, according to the modified MacNab criteria, the excellent and good rate was 100%. Postoperative MRI imaging revealed the abnormal signals in the vertebral body and intervertebral disc had significantly improved, and the epidural and/or paravertebral abscesses had completely resolved. No postoperative complications such as dural sac tear, cerebrospinal fluid leakage, spinal nerve injury and segmental instability were occurred.

Conclusion: The UBE surgery demonstrates favorable efficacy in our spinal infection cases with advantages including minimal invasiveness, rapid recovery, and promising clinical outcomes. We recommend that UBE technique is a safe and effective surgical option in lumbar infection.

Keywords: Spinal infection; Unilateral biportal endoscopy; Minimally invasive surgery

Poster

EP-04

Increased risk of depression and anxiety in patients with chronic back pain following COVID-19 infection based on a nationwide population-based study

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Using a nationwide database from the Korean National Health Insurance Service database, this retrospective cross-sectional study investigated how COVID-19 affects the onset of depression and anxiety in individuals with pre-existing back pain. Patients were enrolled between 2019 and 2020 using the International Classification of Diseases, Tenth Revision code. Ultimately, 28,593 and 24,777 eligible patients were classified into depression and anxiety groups, respectively. Further group subdivisions were made according to back pain and no back pain, established through a 1:3 ratio. The Cox proportional-hazards regression model was used to explore the risk of depression or anxiety developing in patients with back pain, adjusting for basic characteristics. Compared with individuals without back pain, those with back pain had higher crude hazard ratios (HRs) for depression (HR 1.877, 95% confidence interval [CI] 1.165–3.025, P = 0.01) and anxiety (HR 3.256, 95% CI 1.809–5.859, P < 0.001). Moreover, the back pain group had relatively high adjusted HRs for depression (HR 1.768, 95% CI 1.092–2.862, P = 0.02) and anxiety (HR 3.493, 95% CI 1.916–6.365, P < 0.001). COVID-19 is associated with a relatively high risk of developing depression and anxiety in patients with back pain than in those without.

Keywords: COVID-19, back pain, depression, anxiety

Poster

EP-05

Single portal Full Endoscopic decompression surgery : advantage, limitation and future

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Purpose of this presentation: To analyze beneficial feature and limitation of single portal FESS in decompression surgery.

Methods: To date, over 380 cases were treated with FESS single portal decompression for lumbar canal stenosis and those cohorts were retrospectively reviewed.

Results: There were five cases with incidental dural tear in the series. Transient muscle weakness was observed in one case. Overall results were successful with little wound pain immediately after surgery.

Discussion: There's no doubt that Full Endoscopic Spine Surgery is a most effective and least invasive procedure for lumbar disc herniation. Whereas decompression surgery with monoportal approach can be tough, especially in severe degenerative cases. This predominantly due to limited shape and motion of the surgical instruments.

Thus UBE, in which size and shape of surgical instruments are less limited and can be controlled with more freedom of motion has been rapidly catching on.

Maximizing the feature of single portal surgery, treatment of stenosis, even accompanied with unilateral foraminal stenosis can be successfully done with less bone resection and soft tissue damage. Adequate bone resection is the key to guide cannula to the intended direction and depth. Initial orientation is the key.

As its drawbacks, perfusion volume is limited in FESS compared to UBE, which requires more strict control of drilling and hemostasis to obtain clearer view.

Both adhesion or proliferation of fibrous tissue are common feature with severe and long history of stenosis, they might require more sensitive technique in monoportal surgery.

Limitation of the range of device motion in monoportal FESS can serve as a stabilizer of the devices, making drilling more comfortable and precise.

Conclusion: Full endoscopic monoportal FESS surgery is extremely useful in its versatility and truly low invasiveness to soft tissue, with just single small incision.

In this presentation, keys for stable decompression with single portal approach might be discussed to maximize its advantage.

Poster

EP-06

Automated Differentiation of Vertebral Compression and Burst Fractures from X-ray Images Using a Novel Machine Learning Model

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Purpose: Vertebral fractures, particularly compression and burst types, are common yet challenging to differentiate on X-ray images. Burst fractures, often linked to high-energy trauma, may require urgent surgical intervention. Current AI tools for vertebral fracture detection do not distinguish between fracture types. To our knowledge, this is the first study to propose and validate an AI-based model that not only detects vertebral fractures from X-ray images but also differentiates between compression and burst fractures, thereby addressing a critical diagnostic gap in clinical radiology.

Methods: We developed a deep learning model using YOLOv4 for initial vertebral body localization and ResUNet for segmentation, followed by random forest classification to identify normal vertebrae, compression fractures, and burst fractures. A total of 390 lateral thoracolumbar X-ray images were used, verified with corresponding CT or MRI to ensure accurate labeling and ground truth validation.

Results: Our model achieved precision scores of 99%, 74%, and 94% for detecting normal vertebrae, compression fractures, and burst fractures, respectively. Overall performance metrics for fracture detection were: accuracy 92.0%; precision 93.2%; recall 95.7%; F1-score 94.4%. Notably, this is the first report to demonstrate AI-based differentiation between burst and compression fractures on plain X-rays with validated cross-modality support.

Conclusion: This novel AI model shows strong potential for supporting frontline clinicians in distinguishing fracture types on X-ray images, enabling faster triage and appropriate imaging escalation (e.g., to CT or MRI). Our work establishes a foundation for future AI-enhanced fracture classification frameworks and highlights the value of integrating clinically meaningful labels into model training.

Poster

EP-07

Efficacy and High Patient Satisfaction of Ultra-Minimally Invasive Trans-Sacral Canal Plasty (TSCP) in Elderly Patients with Systemic Comorbidities

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Purpose: With an aging population, there is growing concern about postoperative complications following general anesthesia in spine surgery. Traditional spine surgeries may pose significant risks for elderly patients with systemic comorbidities, necessitating alternative approaches. The purpose of this study is to evaluate the three-month efficacy and patient satisfaction of Trans-Sacral Canal Plasty (TSCP), an ultra-minimally invasive epidural adhesiolysis technique, in patients with high anesthetic risk as assessed by ASA classification.

Method: Twenty-one patients with lumbar spinal stenosis or post-surgical stenosis underwent TSCP and completed self-administered questionnaires at three months post-procedure. Patients were divided into high-risk (ASA ≥3; H-group) and low-risk (ASA ≤2; L-group) groups. Improvement rates in Visual Analog Scale (VAS) scores for low back pain, leg pain, and leg numbness, along with satisfaction VAS scores were compared between groups using Fisher's exact test.

Results: Ten patients (47.6%) were classified as ASA ≥3. The H-group was significantly older than the L-group (77.5 vs. 67.5 years). There were no significant differences between groups in improvement rates for low back pain VAS (H-group: 62.9% vs. L-group: 34.4%), leg pain VAS (H-group: 55.2% vs. L-group: 67.9%), and leg numbness (H-group: 57.9% vs. L-group: 32.2%). Satisfaction VAS scores were similarly high in both groups (H-group: 6.9 vs. L-group: 7.5).

Conclusion: TSCP demonstrated comparable effectiveness and high satisfaction rates in both high-risk and low-risk patients, despite nearly half of the surgical candidates being classified as ASA ≥3. This ultra-minimally invasive technique appears to be a safe and effective option for elderly patients with systemic comorbidities who might not be suitable candidates for conventional spine surgery under general anesthesia.

Poster

EP-08

The current status of minimally invasive surgery for adolescent idiopathic scoliosis: a narrative review of current literature

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Purpose: Adolescent Idiopathic Scoliosis (AIS) is a common spinal deformity, affecting approximately 0.47% to 5.2% of the adolescent population. Surgical correction is indicated in progressive cases, with the open posterior midline (OPM) approach traditionally serving as the standard technique. In recent years, minimally invasive surgical (MISS) approaches have gained traction due to potential perioperative benefits. However, the comparative effectiveness of MISS versus OPM remains under investigation. This study aims to evaluate and synthesize existing evidence on the clinical and radiographic outcomes of MISS compared to OPM in the surgical treatment of AIS.

Methods: A narrative review was conducted using literature published from 2009 to 2024. Databases searched included PubMed, EMBASE, and the Cochrane Library. The search incorporated keywords such as "Adolescent Idiopathic Scoliosis," "minimally invasive surgery," and "open posterior midline approach." Studies included were peer-reviewed articles directly comparing MISS and OPM techniques in AIS patients. A total of 13 studies met the inclusion criteria and were reviewed for surgical outcomes, radiographic parameters, perioperative metrics, and complications.

Results: The review demonstrated that both MISS and OPM approaches achieved similar outcomes in coronal plane deformity correction. Sagittal alignment results varied among studies, with some favoring MISS, though the clinical impact of these differences remains uncertain. MISS procedures were associated with higher pedicle screw density. Functional and patient-reported outcomes were largely comparable between approaches. Notably, MISS was consistently linked to reduced intraoperative blood loss and shorter postoperative hospital stays, though it was associated with longer operative times. Complication rates were similar between the two groups, with no consistent evidence favoring one approach over the other in terms of safety.

Conclusion: MISS represents a promising alternative to the traditional OPM approach for AIS, offering comparable deformity correction and clinical outcomes with the added benefits of reduced blood loss and shorter hospitalization. These findings suggest that MISS may be particularly advantageous in selected patient populations. Nevertheless, further high-quality, long-term studies with standardized outcome measures are necessary to confirm these benefits, address current limitations in the literature, and better define optimal patient selection criteria.

Poster

EP-09

Surgical Strategy for Iatrogenic Flatback After Short-Level Fusion Surgery (≤3 level fusion): Indications for Additional Pedicle Subtraction Osteotomy

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Purpose: To evaluate the effectiveness of anterior column realignment (ACR) surgery in patients with flatback syndrome following short-level (≤3 levels) fusion, in addition to investigating the indications for additional pedicle subtraction osteotomy (PSO).

Methods: 49 patients who underwent deformity corrective surgery for iatrogenic flatback that occurred after short-level (≤3 levels) fusion were finally enrolled. We divided all patients into group A (n= 33, only ACR) and group B (n= 16, ACR combined with PSO) according to surgical procedure. Among group A patients, additional analysis was performed by dividing the patients into two groups: those (Excessive group) who developed excessive distraction of anterior disc height (EADH) during perioperative surgery and those (Non-excessive group) who did not. Radiological spinopelvic parameters, postoperative complications, and patient-reported outcomes were compared between the two groups. The Receiver Operating Characteristic (ROC) curve was used to determine the cut-off values for spinopelvic parameters associated with the decision to perform additional PSO.

Results: Group A had a significantly lower number of previously fused levels compared to Group B (1.1 ± 0.2 vs. 2.2 ± 0.8, $p < 0.001$). Preoperative C7 sagittal vertical axis (C7SVA, 219.8±76.4mm vs 293.8±90.3 mm, p=0.026) and its correction (-157.9±84.9 mm vs-263.0±79.9 mm, p=0.003) in group B were greater than those in group A. Group B showed a significantly more kyphotic preoperative fused segment angle (FSA) compared to Group A (–7.2 ± 7.5° vs. 5.1 ± 8.0°, $p = 0.001$). Postoperatively, EADH occurred in 7 patients (21.2%) in Group A, while no cases were observed in Group B. Subgroup analysis revealed that the dynamic segment angle (DA) was significantly lower in the Excessive group compared to the Non-excessive group (2.8 ± 1.1° vs. 9.1 ± 3.4°, $p < 0.001$). The optimal cut-off values of preoperative radiographic parameters for selecting PSO were: C7-SVA > 242.8mm, FSA > -3.2°, and DA < 4.3°. Both groups showed significant improvement in VAS (Visual Analogue Scale) low back and ODI (Oswestry Disability Index), postoperatively($p<0.05$).

Conclusions: ACR alone and ACR combined with PSO showed satisfactory outcomes in patients with iatrogenic flat back. In particular, we highly recommend ACR combined with the PSO in patients with preoperative C7SVA > 242.8 mm, FSA > -3.2°, or DA < 4.3°

Poster

EP-10

Dynamic Interspinous Radiology as a Predictor for Early-Onset Adjacent Segment Degeneration After Multilevel Lumbar Interbody Fusion (L2-ilium)

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Purpose: To evaluate dynamic interspinous radiology (DIR) as a predictor of early-onset adjacent segment degeneration (ASD) following multilevel lumbar interbody fusion (L2-ilium).

Materials & Methods: From 2018 to 2022, 52 patients who underwent L2-ilium surgery for degenerative spinal disease at a single institution were enrolled. The patients were divided into two groups: Group A, consisting of those who developed ASD (n = 25), and Group B, those who remained normal (n = 27). Patients with preoperative high-grade adjacent-level disc degeneration (Pfirrmann grade ≥ III) were excluded. DIR was defined as the difference in the distance between the midpoints of the superior aspects of the spinous processes during flexion and extension. Demographic data and radiological spinopelvic parameters were compared between the two groups. Adjacent-level muscle quality and flexibility were additionally assessed and compared.

Results: The follow-up period was 13.2 ± 6.3 months in Group A and 11.7 ± 6.8 months in Group B (P = 0.522). There were no significant differences in demographic data between the two groups. In both groups, spinopelvic parameters were improved compared to preoperative measurements (P > 0.05), except for cervical lordosis and pelvic incidence. The correction of sagittal vertical alignment (SVA) in Group A was greater than in Group B, but the difference was not statistically significant (P = 0.05). There was no difference in adjacent-level muscle quality between the groups (P > 0.05). Changes in the proximal junctional angle during flexion and extension were also not significantly different between the two groups (P > 0.05). However, Group A exhibited a significantly larger DIR compared to Group B (10.1 ± 4.1 mm vs. 6.0 ± 3.5 mm, P = 0.004). The optimal cut-off value of preoperative DIR as a risk factor for ASD was >8.1 mm.

Conclusion: Our study demonstrated that patients who developed ASD had significantly larger DIR compared to those who did not, with an optimal preoperative DIR cut-off value of >8.1 mm as a potential risk factor for ASD.

Poster

EP-11

The change of cervical spine alignment along with aging in asymptomatic population: a preliminary analysis

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Chinese PLA General Hospital

Study design A cross-sectional study.

Objective : To investigate the correlation of cervical spine alignment changes with aging in asymptomatic population.

Background : Previous studies demonstrated the influence of lumbar and thoracic spine on cervical spine alignment, but few has reported the cervical spine alignment change along with aging in asymptomatic population.

Methods : Asymptomatic population were divided into four groups according to different ages (Group A: B20 years; Group B: 21–40 years; Group C: 41–60 years; Group D: C61 years). Each group was composed of 30 subjects. The following parameters were measured: C0–1 Cobb angle, C1–2 Cobb angle, C2–7 Cobb angle, C1–7 sagittal vertical axis (C1–7 SVA), C2–7 SVA, central of gravity to C7 sagittal vertical axis (CG–C7 SVA), Thoracic Inlet Angle (TIA), Neck Tilt (NT), cervical tilt, cranial tilt, T1 slope (TS), TS-CL, and ANOVA statistical method was used to analyze the differences among four groups, and then, linear regression analysis was performed to analyze correlation of the cervical spine alignment with the aging.

Results : C1–7 SVA, C2–7 SVA, CG–C7 SVA, TIA, NT, TS, and cranial tilt were found statistically different among four groups (P \ 0.01). From Group A to Group D, the mean C1–7 SVA were 30.7, 26.0, 21.8, and 36.9 mm, the mean C2–7 SVA were 18.7, 14.7, 11.9, and 24.7 mm, and the mean CG–C7 SVA were 19.6, 16.6, 9.4, and 26.7 mm. The mean TIA were 62.4°, 65.0°, 71.8°, and 76.9°, the mean NT were 39.4°, 43.8°, 46.3°, and 48.2°, the mean TS were 23.0°, 21.1°, 25.5°, and 28.7°, and the mean cranial tilt were 5.7°, 4.8°, 3.0°, and 9.5°. Further linear regression indicated that TIA (r = 0.472; P \ 0.0001), NT (r = 0.337; P = 0.0006), and TS (r = 0.299; P = 0.0025) were positively correlated with aging.

Conclusion : A gradual increase of TIA, NT, and TS, accompanied with an increased CL, is found along with aging in asymptomatic population, among which TIA, NT, and TS are significantly correlated with physiological nature of aging.

Keywords : Cervical spine alignment · Radiology · Aging · Asymptomatic population

Poster

EP-12

De´bridement and Reconstruction Improve Postoperative Sagittal Alignment in Kyphotic Cervical Spinal Tuberculosis

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Background : Cervical spinal tuberculosis is relatively common in some developing countries. It erodes vertebrae and discs, which sometimes results in cervical kyphosis and myelopathy. However, to our knowledge, no studies have evaluated improvements to patient-reported outcomes among patients who undergo surgical cervical sagittal realignment after kyphotic cervical spinal tuberculosis has been treated by de´bridement and reconstruction.

Questions/Purposes : (1) Can a spine with kyphotic cer- vical spinal tuberculosis be returned to normal alignment and fused successfully? (2) Will patient-reported outcomes be improved with this intervention? (3) Are patient-re- ported outcomes correlated with realignment?

Methods : Forty-six patients with kyphotic cervical spinal tuberculosis were evaluated in this retrospective study. We generally performed surgery on patients with this condition when patients with cervical spinal tuberculosis presented with cervical kyphosis with or without neurologic deficits. Patients who did not meet these criteria were treated with other surgical procedures during the study period. Study patients were evaluated with cervical imaging, patient-re- ported outcomes questionnaires (Neck Disability Index [NDI], and the Japanese Orthopaedic Association [JOA] score), and physical examinations. Scores were collected by fellows preoperatively and at followup. No patient died during the followup. The mean followup was 26.8 months (range, 20–35 months). Preoperative and 2-year followup radiologic parameters were measured, including C0–2 Cobb angle, C2–7 Cobb angle, C2–7 sagittal vertical axis, center of gravity (CG) to C7 sagittal vertical axis (CG–C7 sagittal vertical axis), thoracic inlet angle, T1 slope, and

neck tilt. The correlations between cervical alignment and the NDI and JOA score were analyzed. Factors correlated with the NDI and JOA score improvements were identified by multiple stepwise regression analysis. CT was used to assess bone fusion after surgery.

Results : All 46 patients showed bone fusion on CT scans. The preoperative C0–2 Cobb angle improved after surgery (mean difference, 5.0°; 95% CI, 2.3°–7.7°; p = 0.0068), as did C2–7 Cobb angle (mean difference, —33°; 95% CI, —35° to —31°; p = 0.0074), C2–7 sagittal vertical axis (mean difference, —28 mm; 95% CI, —30 mm to —26 mm; p = 0.0036), CG–7 sagittal vertical axis (mean difference, —26 mm; 95% CI, —28 mm to —24 mm; p = 0.0049), T1 slope (mean difference, 6.0 ; 95% CI, 3.7°–8.3°; p = 0.0053) and the thoracic inlet angle (mean difference, 8.0°; 95% CI, 3.7°–12°; p = 0.0072). With the numbers available, the neck tilt angle did not improve (mean difference, —0.2°; 95% CI, —1.0° to 0.6°; p = 0.079). The preoperative NDI of 34 ± 5.1 decreased to 17 ± 4.6 (p = 0.0096) at followup. Improvements in NDI were correlated with the magnitude of correction of the cervical deformities, including C0–2 Cobb angle (r = —0.357, p = 0.007), C2–7 Cobb angle (r = 0.410, p = 0.002), T1 slope (r = —0.366, p = 0.006, thoracic inlet angle (r = —0.376, p = 0.005), C2–7 sagittal vertical axis (r = 0.450, p = 0.001), and CG–C7 sagittal vertical axis (r = 0.361, p = 0.007). The JOA score improved to 13 ± 2.6 from 7.2 ± 1.9, which did not correlate with postoperative cervical realignment. After controlling for potential confounding variables like Cobb angles and T1 slope, we found C2–7 sagittal vertical axis was the most influential factor correlated with NDI improvement (r = 0.450, p = 0.002).

Conclusion : When treating kyphotic cervical spinal tuberculosis by de´bridement, decompression, and recon- struction, more attention should be drawn to realigning the cervical spine, in particular to restoring the C2–7 sagittal vertical axis. However, how best to restore the C2–7 sagittal vertical axis and cervical alignment in a kyphotic cervical spine needs further study. Level of Evidence Level III, therapeutic study.

Poster

EP-13

Enhanced Hemostatic and Procoagulant Efficacy of PEG/ZnO Hydrogels: A Novel Approach in Traumatic Hemorrhage Management

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Keywords: Hemostasis, Polyethylene Glycol, Zinc Oxide, Trauma Care, Visceral Injuries.

Abstract: Managing severe bleeding, particularly in soft tissues and visceral injuries, remains a significant challenge in trauma and surgical care. Traditional hemostatic methods often fall short in wet and dynamic environments. This study addresses the critical issue of severe bleeding in soft tissues, proposing an innovative solution using a Polyethylene Glycol (PEG)-based hydrogel combined with zinc oxide (ZnO). The developed hydrogel forms a dual-network structure through amide bonds and metal ion chelation, resulting in enhanced mechanical properties and adhesion strength. The hydrogel, exhibiting excellent biocompatibility, is designed to release zinc ions, promoting coagulation and accelerating hemostasis. Comprehensive characterization, including gelation time, rheological properties, microstructure analysis, and swelling behavior, demonstrates the superior performance of the PEG/ZnO hydrogel compared to traditional PEG hydrogels. Mechanical tests confirm increased compression strength and adhesive properties, crucial for withstanding tissue dynamics. In vitro assessments reveal excellent biocompatibility and enhanced procoagulant ability attributed to ZnO. Moreover, in vivo experiments using rat liver and tail bleeding models demonstrate the remarkable hemostatic performance of the PEG/ZnO hydrogel, showcasing its potential for acute bleeding treatment in both visceral and peripheral scenarios.

Poster

EP-14

Posterolateral full-endoscopic debridement and irrigation for thoraco-lumbar pyogenic spondylodiscitis.

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Purpose: The present study investigated the efficacy of posterolateral full-endoscopic debridement and irrigation (PEDI) surgery for thoraco-lumbar pyogenic spondylodiscitis and poor prognostic factors.

Methods: Seven patients diagnosed with thoraco-lumbar pyogenic spondylodiscitis who underwent PEDI over a 3-year period were enrolled. The average age of patients was 75.9 (49-90) years and there were 4 men and 3 women. Five patients (71.4%) had diabetes mellitus. Pathogenic bacteria were MSSA in 2 patients, difficult to treat bacteria were Escherichia coli in 2 patients, Klebsiella in 1, and Bacteroides in 1, and bacteria were unknown in 1 patient. These patients did not improve following 2 weeks of treatment with antibiotics and, thus, underwent PEDI. Three patients underwent PEDI with fusion. Patients who were not successfully treated by the first surgery underwent PEDI again. We retrospectively investigated the outcomes and complications of PEDI. Statistical analyses were performed using the Wilcoxon signed-rank test, with significance being set as $P < 0.05$.

Results: The average surgery time was 63.9 (42-90) minutes for PEDI without fusion and 171.7 (157-183) minutes for PEDI with fusion. Average CRP before surgery (=6.4) significantly decreased 2 weeks after surgery (=1.8). In patients who underwent PEDI again, average CRP before surgery (=5.1) significantly decreased 2 weeks after surgery (=0.93). Average CRP before surgery (=3.87) in three patients decreased after surgery (=0.46). Since deep venous thrombosis (DVT) developed as a pre- and postoperative complication in 4 patients (57.1%), these patients were needed for a minimally invasive procedure.

Conclusion: PEDI is an effective, minimally invasive procedure for pyogenic spondylodiscitis. If PEDI is unsuccessful, it may be repeated to achieve a cure. In cases in which endoscopic drainage alone may have a poor prognosis, spinal fixation surgery may be considered with a minimally invasive procedure.

Poster

EP-15

Application of Biportal Endoscopic Spine Surgery in the Thoracic Spine

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Purpsoe: To explore the extended applications of Biportal Endoscopic Spine Surgery (BESS) in treating thoracic spinal pathologies, which are traditionally challenging due to the complex anatomy and high risk of neural injury.

Methods: This case series describes five thoracic spine surgeries performed using BESS.

Case 1: A 50-year-old male with T11–12 ossification of the ligamentum flavum (OLF) underwent posterior interlaminar decompression.

Case 2: A 75-year-old female with myelopathy due to T12–L1 paracentral disc herniation was treated via a far-lateral transforaminal approach.

Case 3: A 69-year-old female with intercostal neuralgia after a T12 compression fracture underwent palliative decompression under epidural anesthesia due to poor general condition.

Case 4: A 77-year-old female with proximal junctional failure (PJF) at T10–11 following previous lumbar fusion underwent BESS-assisted interbody cage insertion and extended posterior instrumentation.

Case 5: A 76-year-old female with a calcified far-lateral disc at T6–7 causing left thoracic radiculopathy was treated via a transforaminal approach.

Results: All patients showed clinical improvement with no major perioperative complications. The OLF and far-lateral disc patients achieved rapid pain relief. The PJF case demonstrated successful interbody fusion and neurological recovery. The T6–7 case confirmed the feasibility of decompression even at upper thoracic levels using BESS. Early mobilization and shortened hospital stays were observed across all cases.

Conclusion: BESS allows for safe and effective surgical management of a wide spectrum of thoracic spinal disorders, including complex cases like far-lateral calcified discs and revision interbody fusion. It minimizes tissue disruption while providing sufficient decompression and surgical control. With refined technique and growing experience, thoracic BESS represents a valuable addition to the minimally invasive spine surgery field.

Poster

EP-16

Single cell RNA sequencing reveals temporal diversity and dynamics after intervertebral disc degeneration

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Purpose: Immunomodulation in the microenvironment of the intervertebral disc is considered to be a key pathological mechanism and a potential target for intervention in the development of IDD. It is necessary to further elucidate the spatial and temporal dynamics of immune cell-stromal cell interactions in order to establish precise intervention strategies.

Methods: This study integrated a total of 22,822 single-cell data including normal (NT), 7 days (IDD7) and 14 days (IDD14) after disc degeneration. Resolving cellular dynamics: Screened 2000 highly variable genes, downscaled and clustered using Louvain clustering, combined with Single R for cell type annotation to obtain marker genes for each subgroup. Compare the differentially expressed genes among NT, IDD7, IDD14 (threshold |logFC|>0.5, p<0.05). Cluster Profiler and enrich R enriched the differentially expressed genes for GO biological process and KEGG pathway respectively (p<0.05, number of genes ≥2), and screened for the significantly related pathways. Cell Chat and Cell Phone DB were applied to analyse ligand-receptor interactions, calculate the cellular communication probability (compute Commun Prob), and visualize the dynamics of key signaling pathways (e.g. cytokines, growth factors) between NT and IDD. Immunofluorescence staining verified the changes in the expression of SPP1, VEGFa, and MMP14 in macrophages.

Results: The single-cell data identified nine major cell populations: myeloid cells (NP), fibrocytes (AF), macrophages (Mφ), monocytes, neutrophils, T cells, fibroblasts, endothelial cells, and smooth muscle cells. Macrophage subpopulations were classified into pro-inflammatory (Mφ1, Mφ2, Mφ3) and fibrotic (Mφ4, Mφ5) based on CCR5 and DCN expression levels.SPP1+ macrophages were significantly enriched in the late stage of disc degeneration (14 days) and were closely associated with the fibrotic remodelling process, similarly the expression ratio of MMP14+ macrophages and VEGF+ macrophages peaked in the late stage of degeneration (14 days).

Conclusion: Macrophages are involved in different pathological processes such as inflammatory cascade response, stromal degradation fibrosis, and neovascularisation in IDD.SPP1-CD44 interaction is a key cellular communication between macrophage-stromal cells during degeneration, with both inflammatory amplification and pro-fibrotic effects, and the dual roles of this pathway make it an ideal target for specific therapy.

Poster

EP-17

Efficacy Analysis of Ligamentum Flavum Preservation Technique Under UBE in the Treatment of Lumbar Disc Herniation

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Purpose: For patients with lumbar disc herniation, unilateral biportal endoscopic (UBE) surgery offers advantages such as minimal invasiveness and rapid postoperative recovery. Reducing iatrogenic injury is key to minimizing postoperative complications. This study retrospectively evaluates the effectiveness of the ligamentum flavum preservation technique under UBE for lumbar disc herniation and explores its technical application and clinical significance.

Methods: From November 2023 to September 2024, 48 patients with lumbar disc herniation underwent unilateral biportal endoscopic surgery (UBE) via a single-side approach. The study included 23 males and 25 females, aged 61.5 ± 6.3 years. A total of 48 surgical decompression levels were treated: 4 at L3/4, 21 at L4/5, and 23 at L5/S1. The ligamentum flavum preservation technique was applied intraoperatively by separating only the lateral edge of the ligamentum flavum from the articular process. Preoperative and postoperative follow-up assessments included the Visual Analog Scale (VAS) for low back pain and leg pain, Oswestry Disability Index (ODI), and modified MacNab criteria for clinical efficacy. Surgical duration, postoperative drainage volume, hospitalization time, and complications were recorded.

Results: The mean operative time was 35.6 ± 15.4 minutes, postoperative drainage volume was 21.3 ± 12.4 mL, and postoperative hospitalization duration was 3.6 ± 1.2 days. The mean follow-up period was 11.3 ± 4.8 months. Preoperative and postoperative VAS scores for low back pain were 3.8 ± 1.1, 3.2 ± 0.7, 1.7 ± 0.6, 1.3 ± 0.7, and 1.2 ± 0.9 at preoperative ,1 day, 3 months, 6 months, and final follow-up, respectively. For leg pain, VAS scores were 6.2 ± 1.0, 2.0 ± 1.0, 1.5 ± 0.8, 1.3 ± 0.7, and 1.1 ± 0.9 at the same intervals. Preoperative and postoperative ODI scores were (66.8 ± 9.4) %, (19.6 ± 6.0)%, (13.4 ± 4.6)%, and (11.7 ± 3.8)% at preoperative ,3 months, 6 months, and final follow-up, respectively. Both VAS and ODI scores showed significant improvement postoperatively ($P < 0.01$). According to the modified MacNab criteria at final follow-up, outcomes were excellent in 40 cases, good in 5, fair in 3, yielding an excellent-good rate of 93.75%.

Conclusion: The ligamentum flavum preservation technique under unilateral biportal endoscopy achieves thorough removal of herniated disc material in lumbar disc herniation. It demonstrates minimal invasiveness, rapid recovery, and favorable clinical outcomes. Additionally, it simplifies surgical procedures, shortens operative time, and holds potential for reducing postoperative dural adhesions.

Poster

EP-18

Oblique Lumbar Interbody Fusion Combined with Anterolateral Screw Fixation for Treating Severe Lumbar Spinal Stenosis

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Background: Oblique lumbar interbody fusion (OLIF) combined with anterolateral screw fixation (AF) has been proven safe and effective for treating multiple lumbar degenerative diseases. However, is OLIF-AF suitable for treating severe lumbar spinal stenosis (SLSS) is still controversial.

Purpose: To evaluate the effectiveness and safety of OLIF-AF for treating SLSS.

Outcome Measures: Clinical outcomes including visual analog scale (VAS) score of the lower back pain (VAS-LBP) and leg pain (VAS-LP), and Oswestry Disability Index (ODI) were evaluated preoperatively, 3 months, 12 months and 24 months postoperatively, and compare with former counterparts. Radiographic outcomes such as disk height (DH), foraminal area (FA), ligamentum flavum thickness (LF), difference of left and right facet angle (DFA), and cross-sectional area (CSA) were evaluated preoperatively and 1day, 3 months, 12 months and 24 months postoperatively.

Methods: This study utilized a retrospective design. 82 patients underwent OLIF-AF. Clinical and radiographic outcomes were analyzed between each pre- and postoperative time point.

Results: FA increased from preoperative 102.29±37.01 mm2 to 143.58±33.05 mm2 after the operation, and then gradually decreased to 142.46±28.66 mm2, 140.50±30.02 mm2 and 138.67±32.05 mm2 at 3, 12 and 24 months postoperatively, respectively. LF thinned from 4.52±0.95 mm to 3.81±0.73 mm after the operation, and 3.63±0.66 mm at 12 months postoperatively, 3.59±0.65 mm 24 months postoperatively. DFA reduced from 9.93±6.69° to 3.71±2.53° 1 day postoperatively, 3.66±2.74° 3 months postoperatively, 3.64±2.50° and 3.59±2.62° at postoperative 1 and 2 years respectively. CSA expanded from preoperative 56.65±16.08 mm2 to 108.79±23.92 mm2 on postoperative day 1, and continued to expand to 117.81±25.79 mm2 at 1 year postoperatively. Then reached 119.95±27.71 mm2 at 2 year postoperatively. VAS-LBP improved from 6.25±0.97 to 2.44±0.81 ($p<0.05$) at 3 months postoperatively, then reached 1.58±0.60 ($p<0.05$) and 1.08±0.65 each annual follow-up. VAS-LP gradually improved from a preoperative 6.00±1.27 to 2.14±0.72 ($p<0.05$) ,1.19±0.58 ($p<0.05$) and 1.06±0.67 ($p<0.05$) at each time point. ODI increased from 38.19±5.53 to 16.53±2.81 ($p<0.05$) after surgery. And recovered to 10.61±1.46 ($p<0.05$) and 9.67±1.35 ($p<0.05$) at 1 and 2 years postoperatively.

Conclusions: This study showed OLIF-AF is safe with no severe negative influence on treating SLSS. And is effective for thinning hypertrophic ligamentum flavum, reducing vertebra rotation and stay stable, expanding foramen and spinal canal, and improving clinical outcomes of SLSS.

Keywords: Oblique lumbar interbody fusion, Lumbar degenerative disease, Severe lumbar spinal stenosis, Anterolateral screw fixation.

Poster

EP-19

Combination of Evenity and Sacroplasty in sacral insufficiency fracture, cases series and literature review

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Purpose: Sacral insufficiency fracture is a relatively uncommon presentation of osteoporotic fractures, often neglected in the early stages. This condition can significantly impact patients' quality of life and functional outcomes. While conservative management remains the standard, sacroplasty has been used since 2002, offering both pain relief and improved functional recovery. However, some elderly patients exhibit suboptimal outcomes despite undergoing sacroplasty. In a retrospective review of our cases, we adjusted the treatment approach by introducing the combination use of romosozumab (Evenity). This study aims to evaluate whether combining sacroplasty with the anabolic osteoporosis agent romosozumab can enhance treatment outcomes in such patients. Notably, we observed improved pain control and functional recovery in all three cases.

Methods: Between 2020 and 2024, we reviewed six cases of sacral insufficiency fractures treated with sacroplasty. We recorded the time from initial consultation to sacroplasty, visual analog scale (VAS) pain scores, and functional status from the first visit to the last clinical follow-up. After modifying the treatment protocol, we monitored three additional patients who received combination therapy with romosozumab following sacroplasty and present their outcomes.

Results: All six patients experienced pain relief and regained functional abilities post-sacroplasty. However, two of the six, both older patients, exhibited suboptimal pain control during follow-up. Consequently, we revised our treatment protocol, incorporating the use of the anabolic osteoporosis agent romosozumab within the first month after sacroplasty. From 2024 to 2025, three patients were treated with this revised protocol, demonstrating improved functional outcomes and VAS scores. To our knowledge, no existing literature reports the combination of anabolic osteoporosis agents with sacroplasty. We present this preliminary report of a novel treatment protocol, yielding promising results.

Conclusion: For patients with sacral insufficiency fractures, combining anabolic osteoporosis agents with sacroplasty may lead to more favorable outcomes in terms of early pain relief and functional recovery. Osteoporotic fracture management should not only focus on fracture stabilization but also address the underlying low bone mineral density. Early intervention with anabolic agents like romosozumab can enhance bone remodeling with minimal disruption, potentially improving long-term outcomes.

Poster

EP-20

The Role of CT Hounsfield Units as a Predictive Factor for Progression of Osteoporotic Thoracolumbar Fracture and its Implication for Surgical Treatment

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Purpose: To determine the relationship between computed tomography (CT) Hounsfield units (HU) and conservative management failure in acute osteoporotic vertebral fractures (OVFs) in thoracolumbar junction.

Methods: A total of 256 patients diagnosed with thoracolumbar OVF at a single institution were retrospectively analyzed. Among them, 36 patients (Group I) who underwent surgical treatment after conservative treatment failure and 40 patients (Group II) who successfully obtained conservative treatment were included. Demographic data, radiographic data including sagittal spinopelvic parameters, and paraspinal muscle degeneration and CT HU around fracture site were analyzed. Relative difference of HU (ΔrHU) was defined as the difference between HU of the fracture site and average value of HU in the vertebral body above and below the fracture site.

Results: Patients in Group I underwent surgical treatment due to fracture progression approximately 8 weeks after injury. There were no significant differences between the two groups in demographic data including BMD, and paraspinal muscle degeneration around fracture site. In terms of radiologic parameters, follow-up height loss (Group I: 60.09%, Group II: 35.74%) and local kyphotic angle (Group I: 26.34°, Group II: 18.27°) were significantly higher in Group I. Logistic regression analysis showed that ΔrHU (OR: 1.08, 95% CI: 1.01-1.17, p <0.05) was significant risk factor for fracture progression requiring surgical treatment. On receiver operating characteristic curve analysis, the cut-off value of ΔrHU requiring surgical treatment was 100 (95% CI, p=0.021).

Conclusions: As a predictor regarding progression of thoracolumbar OVF, CT HU is useful. Especially, relative difference of HU (ΔrHU) is a risk factor for worsening thoracolumbar OVF, and surgical treatment may be necessary when the value is over 100.

Poster

EP-21

Epidural Gas-containing Pseudocyst Leading to Lumbar Radiculopathy

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Purpose: To document and provide evidence that an epidural gas-containing pseudocyst can be the sole cause of lumbar radiculopathy, a phenomenon rarely reported and previously obscured by concurrent osteophytes in documented cases.

Methods: An 87-year-old man presenting with a 3-week history of right leg radiating pain underwent CT and MRI, revealing a vacuum phenomenon and low-signal lesions correlating with the pain location. Crucially, an abdominal CT performed 40 days prior (when the patient was asymptomatic) was reviewed and showed no epidural gas. To achieve complete nerve decompression with minimal invasiveness, percutaneous endoscopic lumbar nerve decompression surgery was performed, allowing direct visualization and removal of the lesion.

Results:

1. Preoperative imaging (CT/MRI) confirmed epidural gas accumulation (vacuum phenomenon) matching the symptomatic area.
2. Retrospective analysis of the prior abdominal CT (40 days pre-symptom onset) confirmed the absence of epidural gas when the patient was pain-free.
3. Endoscopy definitively identified and removed a gas-containing pseudocyst.
4. Postoperatively, the patient's radiating pain resolved completely.
5. Follow-up CT and MRI confirmed the total disappearance of the epidural gas and low-signal lesions.
6. Histology of the excised tissue identified it as fibrous connective tissue.

Conclusion: This case provides definitive evidence that an epidural gas-containing pseudocyst alone can cause lumbar radiculopathy. The confirmation stems from the documented absence of epidural gas prior to symptom onset and the complete resolution of symptoms and imaging abnormalities following the surgical removal of the gas pseudocyst, isolating gas accumulation as the primary causative factor in this instance.

Poster

EP-22

An injectable magnesium-loaded hydrogel releases hydrogen to promote osteoporotic bone repair via ROS scavenging and immunomodulation

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Background: The repair of osteoporotic bone defects remains challenging due to excessive reactive oxygen species (ROS), persistent inflammation, and an imbalance between osteogenesis and osteoclastogenesis.

Methods: Here, an injectable H2-releasing hydrogel (magnesium@polyethylene glycol-poly(lactic-co-glycolic acid), Mg@PEG-PLGA) was developed to remodel the challenging bone environment and accelerate the repair of osteoporotic bone defects.

Results: This Mg@PEG-PLGA gel shows excellent injectability, shape adaptability, and phase-transition ability, can fill irregular bone defect areas via minimally invasive injection, and can transform into a porous scaffold in situ to provide mechanical support. With the appropriate release of H2 and magnesium ions, the 2Mg@PEG-PLGA gel (loaded with 2 mg of Mg) displayed significant immunomodulatory effects through reducing intracellular ROS, guiding macrophage polarization toward the M2 phenotype, and inhibiting the IκB/NF-κB signaling pathway. Moreover, in vitro experiments showed that the 2Mg@PEG-PLGA gel inhibited osteoclastogenesis while promoting osteogenesis. Most notably, in animal experiments, the 2Mg@PEG-PLGA gel significantly promoted the repair of osteoporotic bone defects in vivo by scavenging ROS and inhibiting inflammation and osteoclastogenesis.

Conclusions: Overall, our study provides critical insight into the design and development of H2-releasing magnesium-based hydrogels as potential implants for repairing osteoporotic bone defects.

Poster

EP-23

A "biomimetic bone-magnet" alliance of accurate target collection nanoparticles for osteosarcoma magnetothermally driven chemotherapy

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Purpose: To address the limitations of current treatments for malignant bone tumours (high disability/mortality, stress-induced bone loss, unsatisfactory efficacy of standalone magnetic hyperthermia, and systemic toxicity of combined chemotherapy) by developing a targeted therapeutic strategy using a biomimetic bone magnet (BBM).

Methods: We engineered a Biomimetic Bone Magnet (BBM) by incorporating permanent magnetic materials into polymethyl methacrylate (PMMA) bone cement. This BBM was minimally invasively injected to create an intrinsic tumour magnetic field. The magnetic field serves two functions: (1) enabling magnetic hyperthermia therapy, and (2) magnetically targeting and accumulating circulating drug-loaded magnetic phase change nanoparticles (mCNPs) within the tumour for magnetothermally triggered chemotherapy. The PMMA component simultaneously provides mechanical support for bone reconstruction.

Results:

1. The BBM successfully generated a strong intrinsic magnetic field within the tumour.
2. This magnetic field facilitated effective magnetic hyperthermia therapy.
3. The field efficiently targeted and accumulated mCNPs carrying chemotherapeutic agents specifically at the tumour site.
4. Magnetothermal triggering enabled controlled drug release from the mCNPs locally.
5. The PMMA-BBM composite provided essential mechanical support for bone structure.
6. Both in vitro and in vivo experiments demonstrated the efficacy of this combined hyperthermia and targeted chemotherapy approach via minimally invasive BBM injection.

Conclusion: The BBM strategy represents a novel and effective approach for treating malignant bone tumours. By creating an internal tumour "biomagnet," it achieves highly targeted magnetic hyperthermia and magnetically guided chemotherapy, overcoming depth limitations and minimizing systemic side effects. The concurrent provision of mechanical support by the PMMA cement addresses osteolytic bone loss. This integrated method opens new avenues for minimally invasive, targeted treatment of malignant bone tumours.

Poster

EP-24

Injectable Biomimetic Porous Hydrogels for Accelerating Bone Regeneration via Shape-Adaptable Scaffolds, Controllable Magnesium Ion Release, and Enhanced Osteogenic Differentiation

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Chongqing Traditional Chinese Medicine Hospital

The repair of bone defects with irregular shapes, particularly in a minimally invasive manner, remains a major challenge. For synthetic bone grafts, injectable hydrogels are superior to conventional scaffolds because they can adapt satisfactorily to the defect margins and can be injected into deeper areas of injury via a minimally invasive procedure. Based on the poly(lactide-co-glycolide)(PLGA)/1-methyl-2-pyrrolidinone solution reported in our previous study, we successfully synthesized injectable MgO/MgCO3@PLGA (PMM) hydrogels, namely, injectable biomimetic porous hydrogels (IBPHs), to accelerate bone regeneration. In addition to exhibiting excellent injectability, PMM hydrogels could transform into porous scaffolds in situ through a liquid-to-solid phase transition and completely fill irregular bone defects via their superb shape adaptability. Moreover, sustainable and steady release of Mg2+ was achieved by regulating the weight ratio of the incorporated MgO and MgCO3 particles. Via controlled release of Mg2+, PMM hydrogels significantly promoted proliferation, osteogenic differentiation, migration, and biomineral deposition of immortalized mouse embryonic fibroblasts. More importantly, micro-CT imaging and histological analysis indicated that concomitant with their gradual degradation, PMM hydrogels effectively stimulated in situ bone regeneration in rat calvarial defects with an increase in the bone volume fraction of almost 2-fold compared with that in the control group. These findings suggest that injectable PMM hydrogels can satisfactorily match bone defects and form porous scaffolds in situ and can significantly promote bone regeneration via controllable Mg2+ release. The remarkable features of IPBHs may open a new avenue for the exploration of in situ repair systems for irregular bone defects to accelerate bone regeneration and have great potential for clinical translation.

Poster

EP-25

Engineering a triple-functional magnetic gel driving mutually-synergistic mild hyperthermia-starvation therapy for osteosarcoma treatment and augmented bone regeneration

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Purpose: To develop a triple-functional magnetic bone repair hydrogel (MBR) that synergistically combines magnetic hyperthermia, starvation therapy, and bone regeneration capabilities for treating malignant bone tumors while overcoming limitations of conventional hyperthermia (HSP-mediated resistance) and enabling minimally invasive defect repair.

Methods:

1. Material Design: Synthesized Fe3O4/GOx/MgCO3@PLGA magnetic hydrogels (MBRs) with liquid-solid phase transition capability
2. Therapeutic Mechanisms:
   - o Magnetic hyperthermia triggers on-demand glucose oxidase (GOx) release
   - o GOx consumes glucose → depletes ATP → inhibits HSP expression → overcomes thermoresistance
   - o Mg^{2}+release enhances osteogenesis for bone defect repair
3. Validation Models:
   - o In vitro: HSP inhibition, ATP depletion, and osteogenic differentiation assays
   - o In vivo:
     - 143B osteosarcoma tumor-bearing mice (tumor suppression efficacy)
     - Rabbit tibial plateau in-situ bone tumor model (tumor therapy + defect reconstruction)

Results:

1. Synergistic Therapy:
   - o Magnetic hyperthermia (↑) + starvation therapy (↑) created reciprocal strengthening:
     - Hyperthermia enhanced GOx efficacy in hypoxic tumor microenvironment
     - ATP depletion reduced HSP90 expression by 68.3% (vs. hyperthermia alone)
2. Tumor Suppression:
   - o Significant tumor growth inhibition in mice:
     - Tumor volume reduction: 92.1% vs. control ($p < 0.001$)
     - Complete ablation in 5/8 rabbits at 28 days
3. Bone Regeneration:
   - o Liquid MBRs perfectly conformed to irregular bone defects
   - o Mg^{2}+release enhanced osteogenic differentiation (ALP↑ 3.2-fold, Runx2↑ 4.1-fold)
   - o New bone volume increased 2.8-fold vs. PLGA control in rabbit defects (micro-CT)

Conclusion: The MBR system pioneers a triple-action therapeutic strategy that:

1. Overcomes HSP-mediated thermoresistance via hyperthermia-triggered ATP depletion
2. Achieves synergistic tumor ablation through reciprocal enhancement of magnetic hyperthermia and starvation therapy
3. Enables concurrent bone reconstruction via Mg^{2}+ driven osteogenesis and defect-conforming scaffolding This minimally invasive approach represents a paradigm shift in malignant bone tumor treatment, integrating curative and reparative functions in a single platform.

Poster

EP-26

Clinical Efficacy and Safety of Percutaneous endoscopic lumbar discectomy for Degenerative Spine Scoliosis: A retrospective study

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Background: Elderly patients with degenerative scoliosis combined with spine stenosis present significant treatment challenges. Traditional open fusion surgery carries high risks and complications in this population. This study evaluates the clinical efficacy and safety of percutaneous endoscopic lumbar discectomy as a minimally invasive alternative.

Methods: A retrospective case series of 32 elderly patients (≥60 years) with degenerative lumbar scoliosis (Cobb angle 10°-30°) undergo percutaneous transforaminal endoscopic decompression between January 2022 and December 2023. All procedures are performed under local anesthesia without internal fixation. Clinical outcomes are assessed using Visual Analog Scale (VAS) for pain and Oswestry Disability Index (ODI) for functional status. Radiographic evaluation includes measurement of scoliosis Cobb angles and adjacent intervertebral height. Follow-up is conducted at 1 week, 1 month, and 1 year postoperatively.

Results: The study includes 14 males and 18 females with a mean age of 68.5±6.1 years. The average operative time is 99.26±13.17 minutes. VAS scores improve significantly from 7.4±1.3 preoperatively to 2.1±0.7 at final follow-up ($P<0.01$). ODI decreases from 55.0±10.2% preoperatively to 15.8±5.0% at final follow-up ($P<0.01$). According to modified Macnab criteria, 93% of patients achieve excellent or good outcomes. Minor complications occur in 2 patients (6.25%) with no major neurological complications. Radiographic analysis shows no significant progression of scoliosis (Cobb angle: 15.4±6.2°vs. 15.7±6.5°, $P>0.05$) and no evidence of adjacent segment degeneration.

Conclusions: PELD provides effective symptom relief and functional improvement for elderly patients with degenerative scoliosis, while maintaining spine stability. This minimally invasive approach offers a safe alternative to traditional open surgery in carefully selected patients with moderate scoliosis and primarily compressive symptoms.

Poster

EP-27

Percutaneous Endoscopic Lumbar Discectomy via Transverse Process Approach for the Treatment of Far Lateral Disc Herniation at L5/S1 : A technical note

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Objective: To evaluate the feasibility and clinical outcomes of percutaneous endoscopic lumbar discectomy (PELD) via the transverse process approach for treating far lateral disc herniation at the L5/S1 level, a challenging condition often complicated by anatomical obstructions such as a high iliac crest.

Methods: A total of 15 patients with far lateral L5/S1 disc herniation were retrospectively reviewed. Patients were selected based on clinical and imaging findings, and those with previous lumbar surgery or central herniations were excluded. Surgery was performed under general anesthesia with the patient prone, using fluoroscopic guidance. The transverse process approach was utilized to create a corridor between the L5 transverse process and S1 sacral ala for endoscopic access to the extraforaminal disc space. Surgical outcomes, including operation time, complication rate, and clinical improvements, were assessed.

Results: The mean age of patients was 48.3 ± 6.9 years, with a follow-up duration of 4.33 ± 1.18 months. The average operative time was 64.33 ± 3.96 minutes. Significant improvements were observed in pain relief and functional recovery, with leg pain (VAS leg) decreasing from 6.53 ± 0.92 preoperatively to 1.87 ± 0.83 at follow-up, back pain (VAS back) improving from 6.47 ± 1.25 to 2.33 ± 0.82, and the Oswestry Disability Index (ODI) improving from 48.40 ± 4.72 to 20.33 ± 3.64. No complications were reported in any patients.

Conclusion: PELD via the transverse process approach is a safe and effective minimally invasive technique for treating far lateral disc herniations at L5/S1. It allows for direct access to the extraforaminal space, bypassing obstacles such as the high iliac crest, and offers significant clinical improvements in pain and function with minimal bone removal and no need for fusion. This technique shows promise as a viable alternative to traditional surgical approaches, especially in challenging anatomical conditions.

Poster

EP-28

Symptomatic epidural hematoma after UBE surgery

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Objective: To report the rare acute postoperative epidural hematomas (PEDH) caused by muscular hemorrhage after unilateral biportal endoscopic (UBE) unilateral laminotomy and to analyze its etiology through a literature review.

Methods: The clinical data, including pre- and postoperative Visual Analog Scale (VAS) and Japanese Orthopaedic Association (JOA) scores, were recorded at key timepoints: preoperatively, pre-surgical drain removal, post-surgical drain removal, and post-emergency debridement. A literature review was conducted to contextualize the findings.

Results: From April 2022 to December 2024, a total of 538 patients who underwent lumbar UBE (Unilateral Biportal Endoscopy) were included. Among them, two patients were reported as PEDH. For case one, a 56-year-old man had left lower limb pain (VAS 6) and intermittent claudication (100 meters). After UBE-ULBD surgery at L3-4, his symptoms improved initially, but severe pain (VAS 10) returned postoperatively due to a PEDH with a MRI examination after the remove of drainage tube. Emergency debridement resolved the issue, and the patient recovered well (VAS 3) without sequelae. For case two, A 57-year-old female patient underwent UBE-ULBD surgery at the L4-5 level for lumbar spinal stenosis. At the first postoperative day, the drainage tube was removed, however, the patient developed left lower limb pain (VAS 5) at the second postoperative day. Postoperative MRI demonstrated a hematoma at the L4-5 level with compression of the left nerve root, but the patient was managed conservatively without surgical intervention. After one week of observation, the patient's left lower limb pain significantly alleviated (VAS 2).

Conclusion: Spinal postoperative epidural hematomas have been reported in 0.1%–3% of cases, and our data suggested the PEDH was 0.37%. Hemorrhage from the muscular layer is identified as a potential etiology, underscoring the necessity for meticulous intraoperative hemostasis, particularly after restoration of baseline blood pressure prior to wound closure. Routine placement of a drainage tube is therefore recommended. Immediate intervention, e.g. surgical debridement or conservative treatment, preferably within 24 hours, is crucial for alleviating neurological compression, as emphasized by expert consensus, and significantly improves functional outcomes.

Keywords: Unilateral biportal endoscopy (UBE); Epidural hematoma; Muscular hemorrhage; Spinal stenosis

Poster

EP-29

Diffusion tensor imaging based fiber tractography : a credible predictor of annulus tears

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Purpose: Annulus tear is the primary intervertebral disc degeneration (IDD) phenotype in the low lumbar spine. Identifying potential risk factors for annulus tears is important to understand the lumbar IDD mechanism better. Recently, diffusion tensor imaging (DTI) based fiber tractography technique has been used to judge the integration of structures with fiber content. Based on the histological characteristics of the annulus, this study was designed to verify if the DTI-based fiber tractography technique can well judge the integration status of the annulus.

Methods: Clinical data from 107 patients treated by percutaneous endoscopic lumbar discectomy have been reviewed in this study. Annulus integration status has been judged based on intra-operative observation. Imaging-based parameters, including annulus tractography, the high-intensity zone (HIZ), and Pfirrmann classification-based IDD grades, were recorded in these patients; Regression analyses identified potential independent predictors for annulus tears separately. The area under the receiver operating characteristic curve (AUC) was computed to evaluate predictive performance.

Results: Patients with intra-operative observable annulus tears suffer significantly higher rates of fiber tractography-judged annulus tears. This parameter has also been proved to be an independent predictor for annulus tears. The AUC of the fiber tractography judged annulus tears when predicting annulus tears was 0.719. By contrast, other imaging-based parameters could not effectively predict the incidence of intra-operative observed annulus tears.

Conclusions: DTI-based fiber tractography is a credible predictor of annulus tears. This parameter can be promoted in corresponding studies when identifying potential risk factors for annulus tears.

Poster

EP-30

Disc fibrosis and sagittal orientation of articular process simultaneously contribute to the progression of cranial motion segmental zygapophyseal joint osteoarthritis : a case-comparative study and biomechanical simulation

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Purpose: Zygapophyseal joint osteoarthritis (ZJOA) is often initiated by facet cartilage stress concentration. While disc degeneration (DD) and facet orientation changes are known to affect local spinal segment mechanics and ZJOA progression, their influence on ZJOA in adjacent segments remains unclear. This study aimed to investigate the impact of L4-L5 DD phenotypes (disc collapse and fibrosis) and facet orientation on the development of ZJOA in neighboring L3-L4 and L5-S1 segments.

Methods: A retrospective analysis was conducted on CT scans of 95 patients. Facet orientation angles and ZJOA grades were assessed at L3-L4, L4-L5, and L5-S1 levels. Patients were categorized based on L4-L5 DD phenotypes. Numerical models were developed to simulate facet cartilage stress distribution under physiological loading conditions, considering varying L4-L5 disc conditions and facet orientations.

Results: Patients with mild ZJOA at L3-L4 demonstrated significantly lower L4-L5 facet orientation angles and higher facet asymmetry (FA) values. These factors at L4-L5 were identified as independent risk factors for severe L3-L4 ZJOA progression but showed minimal association with L5-S1 ZJOA severity. Biomechanical simulations corroborated these clinical findings, demonstrating that a more sagittal L4-L5 facet orientation and disc fibrosis led to increased stress concentration on the L3-L4 facet cartilages, with negligible impact on the L5-S1 segment.

Conclusion: This study suggests that disc fibrosis and a more sagittal orientation of the L4-L5 facets significantly influence the development and progression of ZJOA in the cranial adjacent L3-L4 segment. These findings highlight the biomechanical interplay between adjacent spinal levels and have implications for understanding the pathogenesis and potential treatment strategies for multi-level ZJOA. Further research is warranted to explore the long-term effects and clinical relevance of these findings.

Poster

EP-31

Facet tropism and IDD phenotype can simultaneously trigger higher incidence of zygapophyseal joint osteoarthritis: a clinical review and biomechanical simulation

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Purpose: Zygapophyseal joint osteoarthritis (ZJOA) is often initiated by stress concentration on facet cartilages. While facet tropism and intervertebral disc degeneration (IDD) phenotypes like disc collapse and fibrosis are implicated in local biomechanical deterioration leading to ZJOA, the combined effect and biomechanical interactions of these factors in ZJOA progression remain unclear. This study aims to investigate whether facet tropism and IDD phenotypes simultaneously contribute to ZJOA progression and to elucidate their biomechanical interactions.

Methods: Clinical data from 95 patients were retrospectively analyzed. Facet tropism angles and disc collapse were assessed using CT scans. Zygapophyseal joint degeneration was quantified by T2* values derived from IDEAL-IQ MRI sequences. Correlation analyses were performed to evaluate the relationship between facet tropism, IDD phenotype, and T2* values on both sides. Linear regression analyses identified independent risk factors for ZJOA progression (lower T2*). Finite element models of the L4-L5 segment, with and without facet tropism, were developed to simulate disc collapse and fibrosis. Stress distribution on facet cartilages under physiological loading was then computed for each condition.

Results: Consistent with prior research, larger facet tropism angles and lower disc height ratios showed significant correlations with ZJOA progression (lower T2* values). However, multivariable linear regression identified larger facet tropism angle as the sole independent risk factor for ZJOA progression. Biomechanical modeling demonstrated that facet tropism induces stress concentration on facet cartilages. Furthermore, the presence of IDD phenotypes (disc collapse and fibrosis) exacerbated this stress concentration in the models with facet tropism under physiological loading conditions.

Conclusion: The progression of IDD phenotypes, characterized by disc collapse and fibrosis, synergistically interacts with facet tropism to accelerate ZJOA advancement by compromising the local biomechanical environment. This study reveals an amplification effect between IDD phenotypes and facet tropism in contributing to ZJOA progression, highlighting the importance of considering these factors together

Poster

EP-32

Sagittal oriented articular processes and IDD phenotypes can concurrently lead to an increased incidence of annulus tears in the cranial adjacent motion segment biomechanically

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Purpose: Lumbar intervertebral disc degeneration (IDD), characterized by disc collapse and fibrosis, and facet joint orientation significantly influence the biomechanics of individual lumbar motion segments. While local biomechanical interactions are established, the impact of these factors in one segment on the risk of annulus tears in adjacent segments remains poorly understood. This study aims to investigate whether IDD phenotype and facet orientation in the L4-L5 segment are associated with annulus tears in the adjacent L3-L4 and L5-S1 segments.

Methods: A retrospective analysis was conducted on data from 95 patients. Disc collapse was quantified by the disc height ratio, and fibrosis was assessed using fractional anisotropy (FA) values in the L4-L5 segment. Facet orientation was also measured at L4-L5. Annulus integrity in the adjacent L3-L4 (cranial) and L5-S1 (caudal) segments was evaluated using diffusion tensor fiber tractography to identify annulus tears. Statistical analyses compared groups with and without annulus tears, and regression analyses identified independent predictors for tears in the cranial and caudal adjacent segments. Finite element models of the L3-S1 spinal segment, incorporating variations in disc condition and facet orientation, were developed to simulate stress distribution under physiological loading.

Results: Patients with annulus tears in the cranial adjacent segment (L3-L4) exhibited significantly lower L4-L5 facet orientation angles (more sagittal orientation) and disc height ratios, along with higher L4-L5 FA values, compared to patients without cranial annulus tears. Regression analysis identified these factors as independent risk factors for cranial annulus tears, but not for caudal (L5-S1) annulus tears. Numerical simulations revealed that models with more sagittally oriented facet joints (35°) and features of IDD (disc collapse and fibrosis) in the L4-L5 segment experienced increased stress concentration in the annulus of the cranial adjacent disc (L3-L4) under load, compared to models with more coronally oriented facets (65°) and healthy discs.

Conclusion: The findings suggest that a more sagittal orientation of the articular processes and the presence of IDD phenotypes (disc collapse and fibrosis) in the L4-L5 segment may jointly elevate the risk of annulus tears in the cranially adjacent L3-L4 segment by altering the local biomechanical environment. This highlights the potential for inter-segmental biomechanical influences in the progression of IDD and warrants further investigation into these interactions for developing targeted preventative and therapeutic strategies.

Poster

EP-33

Facet tropism induces cranial segmental disc degeneration through the mediating effect of zygapophyseal joint osteoarthritis progression: a functional MRI based clinical review and biomechanical verification

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Purpose: Disc degeneration (DD) is often initiated by a compromised biomechanical environment. While the biomechanical interplay between adjacent lumbar segments is well-documented, clinical observations suggest that facet tropism (FT) is associated with more severe DD in the cranial adjacent segment. This study aims to investigate and validate the hypothesis that FT exacerbates cranial segmental DD by promoting zygapophyseal joint osteoarthritis (ZJOA) in the caudal segment, leading to increased stiffness.

Methods: Retrospective imaging data from 95 patients were analyzed. DD in the L3-L4 segment was quantified using fractional anisotropy (FA) values derived from diffusion tensor imaging. The severity of ZJOA in the L4-L5 segment was assessed using T2* values from IDEAL-IQ MRI sequences. FT in the L4-L5 segment was determined by measuring the difference in orientation angles of the left and right facet joints. Regression analysis was performed to evaluate the mediating effect of ZJOA on the relationship between FT and cranial DD. Additionally, finite element models of the L3-S1 spinal segment, with and without FT and ZJOA at L4-L5, were developed to analyze stress distribution on the L3-L4 disc under various loading conditions.

Results: Statistical analysis revealed that the effect of FT on cranial segmental FA values (indicating DD progression) was fully mediated by the average T2* values of the caudal segment, suggesting ZJOA as a complete mediator. Furthermore, numerical simulations demonstrated elevated stress levels in the L3-L4 disc in models exhibiting ZJOA at the L4-L5 level, irrespective of the presence of FT.

Conclusion: This study provides evidence that FT contributes to the progression of cranial segmental DD through its mediating effect on ZJOA. The increased stiffness associated with ZJOA progression in the caudal segment appears to be a key biomechanical factor driving accelerated degeneration in the cranial adjacent disc. These findings highlight the clinical significance of considering ZJOA as a potential pathway for DD propagation across lumbar motion segments and suggest that interventions targeting ZJOA progression may have implications for mitigating adjacent segment degeneration in patients with FT.

Poster

EP-34

Real-Time Locating System (RTLS) analysis of early postoperative recovery : A comparison between biportal endoscopic spine surgery (BESS) decompression and traditional open decompression

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Purpose: While biportal endoscopic spine surgery (BESS) has been widely recognized for enabling early recovery due to enhanced visualization and minimal structural disruption, previous studies primarily relied on subjective outcomes such as VAS, ODI, or length of hospital stay, which are prone to bias. This study aimed to objectively compare early postoperative recovery between BESS and open decompression in patients with lumbar spinal stenosis using real-time locating system (RTLS)–derived mobility data.

Methods: A total of 323 patients who underwent either BESS or open unilateral laminotomy for bilateral decompression (ULBD) at our institution between March 2020 and May 2024 were included. RTLS was used to continuously track patient movement from postoperative day (POD) 1 to POD 4. Four activity metrics were analyzed: total daily walking distance, mean walking speed, top 20% active movement ratio (≥0.98 m/s), and top 50% active movement ratio (≥0.301 m/s). Data were analyzed using Mann–Whitney U test or chi-square/Fisher's exact test. Additional age-adjusted analysis was performed using quantile regression due to a baseline age difference between groups.

Results: In unadjusted analysis, the BESS group showed significantly higher values across all RTLS-derived metrics from POD1 onward compared to the open group. The proportion of top 20% active movers was nearly double in the BESS group. After age adjustment, gait speed and high-activity ratios remained significantly higher in the BESS group. Subgroup analysis revealed that the advantages of BESS were more pronounced in multilevel decompression cases. No significant differences were found in demographic factors other than age.

Conclusion: RTLS is a feasible and objective tool for quantifying early postoperative recovery. Our findings demonstrate that BESS leads to superior early physical recovery compared to open decompression, especially in multilevel surgeries. Future research should explore its applicability in more invasive procedures such as interbody fusion and include preoperative activity tracking to enhance baseline comparison.

Poster

EP-35

A two year retrospective analysis of management of Intradural extramedullary tumors of the spinal cord in a tertiary care setting in Southern India : A case series and descriptive analysis

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Background: Intradural extramedullary tumors (IDEMTs) are relatively rare neoplasms that occur outside the spinal cord but within the dural sac. Their clinical presentation can range from asymptomatic incidental finding on the MRI taken for lower back pain , motor or sensory deficits, compressive myelopathy and bowel and bladder involvement. They can be challenging in view of the location and also the structure it arises from .Hence not only diagnosis but also the surgical management is a challenge in itself. This case series reviews the management of IDEMTs, type of tumor, clinical outcomes and followup of a minimum of 6 months in a tertiary care centre over a two-year period.

Methods: A retrospective analysis was conducted of 11 patients diagnosed with intradural extramedullary spinal tumors at our institute between 2022 and 2024. Patient demographics, clinical presentation, diagnostic imaging findings, surgical outcomes, and post-operative complications were reviewed. Data was collected from medical records, surgical logs, and follow-up consultations.

Results: The case series comprised of 7 male and 4 female patients, with a mean age of 42.7 years .

The most common presenting symptom was lower back pain (n=6), followed by unsteady gait (myelopathy symptoms) (n=4) and lower limb pain (n=1). Magnetic resonance imaging (MRI) was the primary diagnostic tool, revealing tumors most commonly located in the lumbar spine (n=7), followed by thoracic (n=3) and cervical regions (n=1). Histopathological diagnoses included schwannomas (n=6) being the most common, meningiomas (n=2), ependymoma (n=1), intraneural capillary hemangioma (n=1) and gangliocytic paraganglioma (n=1). Gross total resection was performed in all cases. Post-operatively those with low back pain as their chief complaint had improved VAS scores and ODI scores as compared to preopeartive status in which one had post opeartive L4 weakness that was managed with physiotherapy and muscle strenghthening. Those patients with myelopathy symptoms of unsteady gait had improved by one nurick grade amongst which one patient had persistent post operative right C8 paraesthesia on long term followup. Two patients developed wound dehiscence which was treated by debridement and primary closure and one had a pseudomeningocele which was treated by aspiration under imaging.

Conclusion: This case series highlights the diverse presentation and successful management of spinal tumors. The most common presenting symptoms were lower back pain and myelopathy-related symptoms, with MRI serving as a critical tool in identifying tumors primarily located in the lumbar spine. Schwannomas were the most prevalent histopathological diagnosis, with other tumor types such as meningiomas and ependymomas and a rare type such as gangliocytic paraganglioma were also identified. Surgical intervention with gross total resection was performed in all cases, with favorable postoperative outcomes for most patients, particularly those with lower back pain. Improvement was noted in myelopathy patients, although some had residual symptoms, such as persistent paraesthesia. Complications, such as wound dehiscence and pseudomeningocele, were managed effectively with appropriate interventions.In conclusion, early diagnosis through MRI and complete tumor resection typically leads to favorable outcomes in patients with IDEMTs of the spinal cord . However, the presence of high grade myelopathy symptoms may result in partial recovery, and careful postoperative monitoring is essential to address any complications.

Poster

EP-36

Primary repair of incidental durotomy using Non-Penetrating titanium ligating clips during Unilateral Biportal Endoscopic Transforaminal Lumbar Interbody Fusion : A case report

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Purpose: As we see a shift from traditional open surgeries to endoscopic spine surgeries the incidence of incidental durotomy during endoscopic surgeries has also increased. Traditional primary repair techniques by suturing are not feasible and hence new and innovative approaches have to be used to tackle such complications. Incidental durotomy and leak of the cerebrospinal fluid is one of the most frequent intraoperative complications of endoscopic spine surgery. The consequences of which include nausea, vomiting, headache, wound dehiscence, meningitis, pseudomeningocele and durocutaneous fistula to name a few. The purpose of this case report is to demonstrate the usefulness of titanium clips in repairing the durotomy from the same working portal .

Methods: We present a case of a dosrsolateral vertical dural tear during Unilateral Biportal Endopscopic Transforaminal Lumbar Interbody fusion (UBE-TLIF) which was successfully repaired using non-penetrating titanium ligating clips. A 53 year old male underwent UBE-TLIF for L4-L5 disc herniation, Schizas Grade C lumbar canal stenosis and Type 2 modic changes. During the procedure an inadvertent vertical dural tear was noted at the left dorsolateral Dura mater. This tear was primarily repaired with the help of non-penetrating titanium ligating clips through the same endoscopic working portal. Post repair valsalva confirmed watertight repair. The UBE-TLIF was completed as per the usual steps and at the end of procedure it was noted that there was no further cerebrospinal fluid leak .

Results: The postoperative period was uneventful and the patient was mobilised on the first postoperative day. There was no headache, nausea or vomiting following mobilisation. On routine followup, the patient was symptomatically better, surgical wound had healed well, there were no signs and symptoms of cerebrospinal fluid leak and he was able to do his activities of daily living without any complications .

Conclusion: The outcome of this case report indicates that a dural tear that occurs during endoscopic spine surgery (UBE-TLIF) can be effectively treated using non-penetrating Titanium ligating clips before deciding to undergo open exploration and dural repair. This method can be a viable option for primary dural repair in endoscopic spine surgeries.

Poster

EP-37

Revolution of Spinal Surgery: Intelligent Robotic System for Endoscopic Procedures

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Background: Endoscopic spine surgery (ESS) has been widely used in the treatment of spinal diseases and has achieved remarkable surgical results and satisfactory clinical efficacy. However, traditional percutaneous endoscopic spine surgery has clinical problems such as poor instrument flexibility, weak perception ability, and difficult to guarantee surgical safety and therapeutic effects. Meanwhile, rapid technological advancements have allowed intelligent robotic technologies to assist surgeons in improving the accuracy and safety of ESS.

Methods: Aiming at the clinical bottleneck of traditional percutaneous ESS in the narrow water environment, intelligent robotic system for ESS would break through the rigid-flexible coupling design technology of the surgical actuator with integrated structure-perception, propose the in-situ perception of intraoperative information and the endoscopic image enhancement method, and resolve the problems of safe interaction and master-slave/autonomous collaborative control. Our project includes the following 5 sub-topics: Creation of the multi-freedom rigid-flexible coupling surgical actuator mechanism; Multi-source information perception and visual enhancement in the operation area under narrow water environment; Human-machine safe interaction and intelligent cooperative control of surgical robots; Transforaminal approach navigation positioning and robot system integration; The operation process specification and experimental verification of the surgical robot system.

Conclusion: Our project intends to develop an intelligent robotic system for percutaneous endoscopic spine surgery, initially build related core components and key software technology system. Moreover, surgical procedures and specifications would be established and experimental verification would be carried out. Accurate navigation and positioning for endoscopic spine surgical approach, nucleus pulposus removal and nerve decompression would be achieved.

Poster

EP-38

Relationship between abdominal pressure, sagittal alignment of the spine, muscle mass, and low back pain indicators

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Purpose: Abdominal pressure (AP) has been proposed as a physiological parameter associated with trunk stability, and several studies have reported its improvement through core training in patients with low back pain (LBP). However, the underlying mechanisms remain unclear. Specifically, the relationship between AP and structural or subjective factors such as spinal sagittal alignment, trunk muscle mass, and clinical symptoms has not been well established. This study aimed to investigate the associations between AP, trunk muscle mass, spinal sagittal alignment, and indices of pain and disability.

Methods: We prospectively enrolled 116 patients with lumbar spinal disorders from April 1, 2023, to March 31, 2025. Seated abdominal pressure was measured using the RECORE® device. Trunk and limb muscle mass were assessed via bioelectrical impedance analysis. We evaluated correlations between AP and spinal sagittal parameters (PI–LL mismatch, SVA, PT), as well as clinical outcomes including LBP visual analog scale (VAS) and Oswestry Disability Index (ODI). We also compared AP values across groups stratified by Schwab sagittal alignment classification and the presence of sarcopenia.

Results: The mean AP was 3.4 ± 2.1 kPa. A moderate positive correlation was observed between AP and both trunk and lower limb muscle mass ($r = 0.4$). However, no significant correlations were found between AP and spinal sagittal parameters (PI–LL, SVA, PT), VAS scores, or ODI. Similarly, no significant differences in AP were found based on sagittal imbalance classification or sarcopenia status.

Conclusion: Abdominal pressure showed a moderate association with muscle mass but was not correlated with sagittal alignment or pain-related outcomes. These findings suggest that AP may function as an independent physiological indicator distinct from conventional structural or symptomatic assessments. Given prior evidence linking AP to motor control mechanisms, further research is warranted to explore its potential role in neuromuscular regulation.

Poster

EP-39

Effectiveness of Annular Closure in Reducing Recurrence Rate After Lumbar Discectomy: A Prospective Randomized Controlled Trial

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Objective: To investigate whether the addition of an annular closure (AC) technique during lumbar discectomy effectively reduces the rates of postoperative symptomatic disc herniation recurrence and reoperation, and to assess its impact on clinical functional improvement and safety.

Methods: This study was designed as a prospective, multicenter randomized controlled trial. Between January 2020 and December 2023, 380 patients scheduled for primary single-level lumbar discectomy meeting the inclusion criteria were enrolled. Patients were randomly assigned in a 1:1 ratio to either the annular closure group (AC group, n=190) or the standard discectomy group (Control group, n=190). In the AC group, the annular defect was repaired using a fully endoscopic direct suture technique after nucleus pulposus removal. The primary endpoint was the rate of symptomatic recurrence within 2 years post-surgery, defined as same-level, ipsilateral recurrence necessitating surgical re-intervention. Secondary endpoints included Visual Analog Scale (VAS) scores for leg and back pain, Oswestry Disability Index (ODI) scores (measured preoperatively and at 3 months, 1 year, and 2 years postoperatively), operative time, intraoperative blood loss, and the incidence of complications (such as nerve injury, infection, endplate damage, and device-related issues). An intention-to-treat (ITT) analysis was used for statistical assessment.

Results: A total of 362 patients (183 in the AC group and 179 in the Control group) completed a minimum 2-year follow-up, achieving a follow-up rate of 95.3%. The 2-year symptomatic recurrence rate requiring reoperation was significantly lower in the AC group at 4.4% (8/183) compared to 10.6% (19/179) in the control group ($p=0.028$), representing a relative risk reduction of 58.5%. Both groups showed significant improvements in VAS leg pain scores (AC group: 7.6±1.2 pre-op vs. 1.5±1.1 at 2 years; Control group: 7.5±1.3 pre-op vs. 1.7±1.3 at 2 years) and ODI scores (AC group: 58.2±10.5 pre-op vs. 14.8±8.9 at 2 years; Control group: 57.5±11.1 pre-op vs. 16.2±9.5 at 2 years) compared to baseline (all $p<0.001$). There were no statistically significant differences between the groups at the 2-year follow-up regarding VAS leg pain ($p=0.31$) or ODI ($p=0.25$). The mean operative time was slightly longer in the AC group (65.8±15.2 min vs. 55.1±12.8 min, $p<0.001$), while intraoperative blood loss showed no significant difference. The overall complication rates were comparable between the two groups (AC group 6.0% vs. Control group 5.0%, $p=0.65$). Two patients (1.1%) in the AC group experienced transient nerve root irritation related to the sutures, which resolved with conservative management.

Conclusion: In appropriately selected patients undergoing lumbar discectomy, the addition of an annular closure technique significantly lowers the 2-year rate of symptomatic recurrence requiring reoperation. This benefit is achieved without negatively impacting long-term pain relief or functional improvement. Although associated with a modest increase in operative time, the procedure demonstrates a good safety profile. Annular closure represents a promising approach to reduce the risk of recurrence following lumbar discectomy.

Keywords: Lumbar disc herniation; Discectomy; Annular closure; Recurrence; Randomized controlled trial.

Poster

EP-40

Treatment of Lumbar Spondylolysis in Adolescents

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Objective: This review aims to outline the current understanding of the diagnosis and treatment of lumbar spondylolysis in adolescents. It covers the epidemiology, pathophysiology, diagnostic methods, staging systems, and therapeutic strategies, while also analyzing the effectiveness of both conservative and surgical treatments. Furthermore, it discusses existing challenges and proposes future directions, serving as a clinical reference.

Methods: A comprehensive review of relevant literature was conducted to consolidate data on the epidemiology, pathological mechanisms, diagnostic technologies (MRI/CT), and staging systems associated with adolescent lumbar spondylolysis. We compared the indications, efficacy, and risks of conservative treatments (including immobilization and rehabilitation) and surgical interventions (such as direct repair, fusion techniques, and minimally invasive surgery). The primary outcomes assessed were bone healing and pain management.

Results: Lumbar spondylolysis is a frequent cause of low back pain in adolescents, especially among athletes engaged in high-intensity training. Its etiology is complex, linked to biomechanical stresses and skeletal development, fundamentally manifesting as an acquired stress fracture. Early diagnosis hinges on clinical evaluation supported by imaging. Magnetic Resonance Imaging (MRI) is effective in identifying early bone marrow edema, whereas Computed Tomography (CT) offers detailed bone visualization, crucial for accurate staging and subsequent treatment planning. Conservative management is the preferred initial approach for early-stage or stable spondylolysis, yielding significant bone healing rates (approximately 74-76%), with early-stage lesions showing high healing potential (>95%). The success of conservative treatment is, however, dependent on the disease stage (healing rates <15% in terminal stages) and patient adherence. Surgical treatment, involving either direct repair or fusion, is indicated for patients who fail conservative management or experience disease progression, offering substantially higher healing rates (60-90%). Minimally invasive techniques are emerging as a promising surgical direction, though their risks and benefits must be carefully weighed. Therapeutic success is measured by both bone union and pain relief; while structural repair typically alleviates pain, recurrences (around 13%) can occur even after healing. Key challenges in clinical practice include difficulties in early detection, lack of uniform staging criteria, poor patient compliance, inherent surgical risks, and the absence of standardized clinical guidelines.

Conclusion: The management of adolescent lumbar spondylolysis necessitates an individualized and staged approach. While conservative treatment proves effective for early-stage cases, surgical intervention is reserved for refractory conditions. Treatment efficacy must be evaluated through a combination of bone healing assessment and functional recovery. Future research should aim to refine minimally invasive surgical techniques, develop precise rehabilitation protocols, establish prognostic models, and formulate standardized guidelines. This will help balance structural integrity with functional requirements, ultimately facilitating a safe return to athletic activities for young patients.

Keywords: Lumbar Spondylolysis; Adolescent; Conservative Treatment; Surgical Treatment; Athlete; Bone Healing

Poster

EP-41

Application of Deep Learning-Driven MRI Analysis for Early Diagnosis and Healing Prediction of Lumbar Spondylolysis in Adolescents

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Background: Lumbar spondylolysis is a frequent cause of low back pain among young athletes, with a reported prevalence as high as 47% in those seeking medical attention for this symptom. Early and accurate diagnosis is paramount for optimizing treatment strategies and promoting successful healing. Current clinical practice faces challenges in identifying subtle, early-stage fracture lines. Magnetic Resonance Imaging (MRI) has emerged as a crucial initial screening tool due to its absence of ionizing radiation and high sensitivity in detecting early stress responses, primarily bone marrow edema visualized as high signal intensity in the pars interarticularis or adjacent pedicle on Short Tau Inversion Recovery (STIR) or fat-suppressed T2-weighted imaging (T2WI) sequences. MRI can identify "pre-fracture" states (stress reactions or very early fractures) often missed by Computed Tomography (CT), thus providing a vital window for early intervention. Nonetheless, MRI's lower spatial resolution compared to CT limits its precision in depicting incomplete, non-displaced micro-fractures, and it can sometimes be challenging to distinguish between simple bone marrow edema (stress reaction) and an early fracture accompanied by micro-fissures. Furthermore, existing models for predicting bone healing outcomes following conservative treatment predominantly rely on clinical experience and a limited set of imaging signs, resulting in limited accuracy for individualized predictions. To address these limitations, this study aimed to employ deep learning (DL) methodologies. Specifically, we utilized the U-Net architecture for precise lesion segmentation and localization and integrated it with the feature extraction capabilities of Convolutional Neural Networks (CNNs) to automatically mine complex, quantitative features and potential imaging biomarkers from MRI data that are indicative of fracture lines and healing potential. The objective was to surpass the constraints of traditional MRI interpretation, enhance diagnostic accuracy to levels approaching CT, and develop a more robust prognostic model, ultimately enabling radiation-free, precise diagnosis and guiding individualized treatment.

Methods: This retrospective study involved N=100 adolescents and N=50 adults diagnosed with lumbar spondylolysis. Data, including MRI, CT scans, clinical information, and follow-up records, were collected. An Attention U-Net model was developed for fracture detection. A multimodal CNN was constructed, integrating imaging and clinical variables to predict healing outcomes. Transfer learning with specific layer fine-tuning and data augmentation techniques were implemented. Model performance was evaluated using metrics such as sensitivity, specificity, and the Area Under the Curve (AUC), alongside appropriate statistical tests.

Results: When compared against the CT gold standard, the Attention U-Net model demonstrated a sensitivity of 92% (95% Confidence Interval [CI]: 88%-95%), a specificity of 95% (95% CI: 91%-98%), and an accuracy of 93% for identifying fracture lines on standard MRI sequences. This performance was significantly superior to a ResNet-based Faster R-CNN model (sensitivity 89%, specificity 93%, accuracy 91%; $P < 0.05$, McNemar's test). The inclusion of MR bone imaging sequences further boosted the Attention U-Net model's sensitivity to 94% and specificity to 97%, bringing it closer to CT-level performance. In a control group of 100 normal pars, the specificity reached 99.5%. For healing prediction, the multimodal CNN model achieved an overall AUC of 0.82 (95% CI: 0.78-0.86). Subgroup analyses indicated an AUC of 0.88 for early-stage unilateral lesions and 0.71 for advanced bilateral lesions ($P < 0.01$). SHAP (SHapley Additive exPlanations) analysis identified AI-quantified edema volume, DL-estimated fissure width, and the status of contralateral terminal-stage lesions as the most critical predictive features. The multimodal model significantly outperformed a baseline model that relied solely on clinical variables (AUC: 0.68; $P < 0.001$, paired t-test).

Conclusion: Deep learning-driven analysis of MRI data achieves diagnostic accuracy for spondylolysis fractures comparable to CT, significantly reducing radiation exposure. The developed multimodal model effectively predicts healing outcomes, providing valuable insights for guiding individualized treatment plans. Future prospective validation is necessary to confirm these findings and enhance the robustness and interpretability of the models.

Poster

EP-42

Micro-Endoscopic Discectomy (MED) Surgery in Minimally Invasive Spine Surgery (MISS), is it still useful in this era?

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Purpose: Minimally Invasive Spine Surgery (MISS) is increasingly used worldwide and for various spinal condition. MISS has been influenced by advances in lasers, endoscopy, and image guidance systems. The milestone of spine surgery in Indonesia was initially started on open spine surgery in early 1970. In later decades, MISS was started as MED in 2008 and the latest advancement in MISS was Robotic Spinal Surgery in 2021. Further advancement in artificial intelligent, robotic surgery, and virtual reality has been used integrative. This study aims to determine whether MED in MESS is still effective for use as a treatment modality.

Methods: We learn and observe that MED in MISS still exist. We are currently using this technique in Ulin General Hospital Banjarmasin. The patient had been followed up and evaluated post operatively for Quality of Life (QOL) and Visual Analogue Scale (VAS). The number of cases evaluated for 2 years were 31 patients.

Result: Cases was selected from patient with lumbar pain and referred pain (to ipsilateral and both limb), especially in patient that had been done with stable lumbar instability. Post operative follow up was performed by means SF-36 questionnaire and VAS Scale. The study shown that QOL after MED-MISS technique is still promising. QOL was

From 31 cases analysis, patient with MED-MIS had been done. MED in MISS leading to significant improvement in quality of life and reduced pain levels, as measured by VAS scores. Therefore it is still helpful in our hospital with limited resources.

Conclusions: MED in MISS from our study and literature is still promising and applicable for selected cases with decompression only on posterior stability for lumbar instability.

Keywords: "Micro-Endoscopic Discectomy (MED) Surgery", "Minimally Invasive Spine Surgery (MISS)", "Quality of Life (QOL)", "Visual Analogue Scale (VAS)","Lumbar instability".

Poster

EP-43

The characteristics of spinal imbalance in patients with lumbar disc herniation and the recovery after endoscopic discectomy

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Purpose: The purpose of the study was to analyze the characteristics of spinal imbalance in patients with lumbar disc herniation (LDH) and the recovery after endoscopic discectomy.

Methods: We retrospectively analyzed the records of LDH patients with spinal imbalance receiving endoscopic discectomy. They were divided to Group A (sagittal imbalance), Group B (coronal imbalance) and Group C (sagittal and coronal imbalance). The whole-spine X-ray were performed at pre-operation, immediately post-operation, 3-month and 6-month follow-up and related radiological parameters were measured.

Results: 110 LDH patients (18.3%) presented with spinal imbalance were included and there were 31 patients in Group A, 38 patients in Group B and 41 patients in Group C. 77.2% of coronal imbalance patients present with trunk shifted to contralateral side of disc herniation and 65.3% of sagittal imbalance patients present with forward trunk. Most patients present mild and moderate sagittal and coronal imbalance. The magnitude of sagittal and coronal imbalance in Group C was significantly more severe than that of Group A and Group B. Most of patients (≥75%) acquired spinal balance immediately after surgery. The sagittal imbalance improved better than coronal imbalance and single plane imbalance improved better than biplane imbalance. At the postoperative 6-month follow-up, all patients recovered to normal sagittal and coronal balance.

Conclusion: Spinal imbalance occurs in 18.3% of LDH patients receiving endoscopic discectomy. Different subgroups of spinal imbalance present different characteristic. Spontaneous correction of the spinal imbalance could be achieved immediately after surgery and well-maintained during follow-up.

Poster

EP-44

Comparison analysis of Unilateral biportal endoscopic discectomy (UBED) and Percutaneous endoscopic interlaminar discectomy (PEID) for the treatment of lumbar disc herniation at L5/S1 level

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Purpose: To comprehensively analyze and compare the clinical outcomes of unilateral biportal endoscopic discectomy (UBED) and percutaneous endoscopic interlaminar discectomy (PEID) for the treatment of lumbar disc herniation (LDH) at L5/S1 level.

Methods: The study enrolled 106 LDH patients of L5/S1 level, who underwent endoscopic discectomy in our hospital from January 2018 to December 2020. There were 51 patients underwent UBED (Group A) and 55 patients underwent PEID (Group B) with at least one year follow-up. Visual Analogue Scale (VAS) scores for the back and leg pain, and Oswestry Disability Index (ODI) were used to analyze the clinical outcomes. Surgical invasiveness was evaluated through postoperative serum creatine phosphokinase (CPK) level and change rate of lean multifidus cross sectional area (LMCSA) on magnetic resonance imaging (MRI). In addition, intraoperative anesthesia time, operative time, postoperative length of stay, intraoperative fluoroscopy times, postoperative complications were collected and analyzed.

Results: Both UBED and PEID achieved favorable clinical outcomes immediately after surgery and at follow-up, including VAS and ODI, without significant difference between the two groups. The intraoperative anesthesia time for UBED was longer than PEID ($P>0.05$), but there was no significant difference of operative time ($P > 0.05$). As for intraoperative fluoroscopy times (2.5 vs. 2.4), postoperative length of stay (2.1 vs. 2.0 days), postoperative complications (5.9% vs. 3.6%), including LDH recurrence (2.0% vs. 3.6%), there were also no significant difference between the two groups ($P > 0.05$). The serum CPK level and change rate of LMCSA for UBED was higher than PEID at postoperative 1st day. At the last follow-up, there was no significant difference in the change rate of LMCSA between the two groups ($P=0.096$).

Conclusion: Both UBED and PEID could achieve favorable clinical outcomes for the treatment of LDH at L5/S1 level, with similar operative time, postoperative length of stay, intraoperative fluoroscopy times and complications. Despite UBED is more invasive, the MRI signal changes of paraspinal muscle become similar at postoperative 1 year follow-up. UBED is a safe and innovative alternative choice for treatment of LDH at L5/S1 level.

Poster

EP-45

Cervical spondylolysis with Grade-II spondylolisthesis treated with single level ACDF

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Purpose: Cervical spondylolysis with spondylolisthesis is a rare disorder. According to previous reports, the spondylolisthesis is usually Meyerding Grade-I and there were only limited number of cases receiving surgical treatment. The purpose was to reported a special case of cervical spondylolysis with Grade-II spondylolisthesis treated with single level anterior cervical discectomy and fusion (ACDF) and conduct the literature review related to this problem.

Method: A special case of cervical spondylolysis with spondylolisthesis was presented and related literature review was made. Here, we report the case of a 52-year-old man complained of posterior neck pain and numbness of bilateral upper limb. Radiological examination showed bilateral spondylolysis of the C6 and Meyerding Grade-II spondylolisthesis of C6 on C7 with instability.

Results: The patient underwent a single level C6/7 ACDF surgery. The symptoms of neck pain and bilateral upper limb numbness were relieved immediately after surgery. The immediate postoperative radiological examination showed successful restoration of sagittal alignment. At 3-month follow-up, the patient has returned to the normal life without any symptom. At 2-year follow-up, CT showed C6-7 fusion was achieved and alignment was maintained.

Conclusion: Cervical spondylolysis, as an uncommon spinal disorder, has been regarded as congenital abnormity and has its unique radiological characteristics. As for most of the cases with cervical spondylolysis, even with Grade-II spondylolisthesis, single level ACDF could achieve good clinical and radiological outcomes.

Poster

EP-46

Is Oblique Lateral Interbody Fusion a Key to Solve Degenerative Lumbar Scoliosis?

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Purpose: Degenerative lumbar scoliosis (DLS) is an abnormal curvature of the spine affecting any of the three planes; coronal, axial, or sagittal. Oblique lateral interbody fusion (OLIF) is a minimally invasive surgical technique that has gained popularity in the correction of adult spinal deformity. The purpose of this study was to evaluate the clinical, surgical and radiological parameters of OLIF and posterior lumbar interbody fusion (PLIF) in DLS patients.

Methods: Patients who underwent three or more levels of OLIF or PLIF for DLS since September 2005 were analyzed retrospectively. A preoperative coronal Cobb angle greater than 10 degrees. Exclusion criteria were patients with concurrent OLIF and PLIF performed at altenating levels, malignancy, infectious diseases, or past histories of lumbar fusion. VAS for back and leg pain, ODI, JOABPEQ were compared for clinical outcomes at the initial and final follow-up. Cobb's angle and C7-coronal vertical axis were measured for raiological outcomes at preoperative, immediate postoperative, and postoperative one year. Postoperative complications such a PJK were also investigated.

Results: Of the 120 patients, 87 were underwet OLIF (group O), 33 PLIF (group P). In Group O, 64 patients underwent OLIF with percutaneous pedicle screw fixaion and 23 OLIF with posterior open surgery. All clinical outcomes were improved in both groups ($P < 0.05$). Both OLIF and PLIF effectively corrected the Cobb's angle ($P < 0.05$). OLIF with posterior open surgery (e.g. osteotomy) was most poweful method to correct DLS, however it was not statistically significant. OLIF entails longer surgical and anesthesia durations compared to PLIF ($P < 0.05$). However, compared to PLIF, OLIF leads to less blood loss, fewer transfusions and lower complication rate, and facilitates quicker mobilization and discharge ($P < 0.05$).

Conclusion: OLIF could be a good surgical option to correct DLS.

Key words: Oblique lateral interbody fusion, degenerative lumbar scoliosis

Poster

EP-47

Association Between Higher Body Mass Index and the Risk of Lumbar Spinal Stenosis in Korean Populations : A Nationwide Cohort Study

Ji-Hyun Ryu, Kyungdo Han, Ju-Yeong Kim

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Purpose: Despite the increasing prevalence of both spinal stenosis and obesity, their association remains controversial. This study aimed to investigate the relationship between body mass index (BMI) and the risk of lumbar spinal stenosis in the Korean population using nationwide data.

Methods: We analyzed data from 2,161,684 adults aged≥40 years who underwent health examinationsin 2009 using the Korean National Health Insurance System database. Participants were categorized by BMI into five groups: underweight (<18.5), normal weight (18.5–22.9), overweight (23.0–24.9), obesity class I (25.0–29.9), and obesity class II and above (≥30). Cox proportional hazards models were used to evaluate the association between BMI and lumbar spinal stenosis risk, adjusting for demographic characteristics, lifestyle factors, and comorbidities.

Results: During the 10-year follow-up period, the incidence rate of lumbar spinal stenosis increased progressively with higher BMI categories, from 32.77 per 1000 person-years in the underweight group to 51.51 in the obesity class II and above group. In the fully adjusted model, compared to the normal weight group, the hazard ratios (95% confidence intervals) were 0.801 (0.787–0.815) for underweight, 1.132 (1.126–1.139) for overweight, 1.245 (1.238–1.252) for obesity class I, and 1.348 (1.331–1.366) for obesity class II and above. The association was stronger in females and participants aged <65 years.

Conclusions: A higher BMI was independently associated with an increased risk of lumbar spinal stenosis in the Korean population. This association remained robust after adjusting for various confounding factors, suggesting BMI as a significant risk factor for spinal stenosis.

Keywords: spinal stenosis; body mass index; cohort study; obesity; risk factors; Korean population

Poster

EP-48

Association of smoking status with the prevalence of spinal stenosis : a nationwide population-based study

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Introduction : No study has examined the association between Lumbar spinal stenosis(LSS) and smoking. We evaluated this association using large-scale, nationwide cohort data on the Korean population from the National Health Insurance Research Database in Korea.

Method : Data source and study subjects : This nationwide cohort study included 2,133,810 adults aged 40 and above who underwent Korean National Health Insurance Service health examinations 2009. The subjects were categorized according to age, smoking status, amount smoked (pack-year), number of cigarettes smoked per day, and duration of smoking.

Outcome measures : the national database was searched to identify patients who had a primary diagnosis of (i) degenerative lumbar disc disorder (diagnosis code: M51, M512, M513, M518, M519), (ii) lumbar radiculopathy (M472, M511, or M541), (iii) degenerative lumbar spondylolisthesis (M431), or (iv) degenerative lumbar spinal stenosis (M48 or M995) were identified.

Statistical analysis : The hazard ratios (HRs) and 95% CIs for spinal stenosis were estimated using multivariable Cox proportional hazard regression analysis.

Result : Compared with nonsmokers, increased adjusted HRs of spinal stenosis were observed in current smokers (1.053, 1.044–1.061), comparable adjusted HRs of spinal stenosis in former smokers (1.047, 95% CI = 1.039–1.056). The LSS risk of current smokers is similar to that of former smokers.

The LSS risk shows a tendency to gradually increase with increasing amount smoked (pack-year) for both former smokers and current smokers. The aHRs of LSS based on the average cigarette consumption per day were not proportional to the number of cigarettes smoked per day for both current and former smokers. The aHRs of LSS based on the duration of smoking were also not proportional to the duration of smoking for both current and former smoker.

In the subgroup analysis by gender, the LSS risk of former smokers in males was similar to that of current smokers, but the LSS risk in current smokers in females was increases to that of former smokers. In the subgroup analysis by age, in current smokers and former smokers, the risk of LSS is highest in the 70s, and shows a tendency to gradually increase with increasing age.

These trends in age and sex suggest that, in females, the older the age, the greater the impact of smoking on LSS.

Conclusion : We conclude that smoking is associated with an increased incidence of spinal stenosis, both former smokers and current smokers. As in the general population, it is important for current smokers to quit or reduce smoking because the risk of spinal stenosis can be greatly associated with amount smoked (pack-year), especially in the old age.

Poster

EP-49

Is Bone Cement Still Useful in Minimally Invasive Spine Surgery for Fragility Fracture: A Brief Review

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Background: Minimally invasive techniques for spine surgery have been successfully applied since the 1990's. Bone Cement has been included in vertebroplasty & kyphoplasty. Yet, several long term complication have been present after using bone cement.

Objective: To review current understanding of bone cement in minimally invasive spine surgery, from their characteristics, usage, efficacies, & complications.

Methodology: Literature from 2005-2024 with selected keywords are searched through MEDLINE and PubMed database.

Results: To minimize complication regarding bone cement biomechanical complication, we suggest using injectable artificial bone graft although current study evidence are still limited.

Conclusion: Selecting the optimal biologic agent still needs to refer to their basic properties, considering the benefit and risk individually for each patient. Further research regarding bone cement vs artificial bone graft still needed.

Poster

EP-50

Experience of Full Endoscopic Spine Surgery for Cervical Spondylotic Radiculopathy

Tomoyuki Yamakawa

Ebie memorial hospital

Purpose: NTo investigate the outcomes and problems of cervical nerve root decompression surgery using FESS.

Methods: We investigated 22 cases of cervical radiculopathy who underwent nerve root decompression under FESS and were followed up for more than 6 months. Eleven cases were cases of intervertebral disc herniation, and in four cases, herniation removal was possible without significantly avoiding the nerve root or spinal cord. In the remaining cases, decompression was the only procedure performed, and herniation removal was not performed.

Results: The average operation time was 48 minutes, and blood loss was small in all cases. No perioperative complications were observed. The average pain and sensory disturbance on the Neurosurgical Cervical Spine Scale (NCSS) A(3) was 1.2 before surgery and 3.8 6 months after surgery. No cases required reoperation due to recurrence of symptoms.

Discussion: FESS is useful because it allows clear observation of the nerve roots and is a safe procedure, as it is performed with a field of view close to the nerve tissue. Points to keep in mind are orientation and measures to prevent bleeding, but by taking advantage of the characteristic of FESS, which allows easy visualization up to the tip of the superior articular process, unnecessary bone resection can be avoided, particularly in the cranial vertebrae.

In the cervical spine, there is a rich venous plexus just below the fibrous capsule around the nerves, so operations must be performed that damage these blood vessels as little as possible, but with FESS, which uses irrigation, dissection by water pressure can be expected. One advantage of FESS is that it allows surgical operations to reach deep areas, but on the other hand, there is a risk that the cannula, due to its small diameter, may easily fall deep into the area, so great care must be taken when holding the scope and operating the instruments.

Conclusion: Although the clinical outcomes of cervical radiculopathy surgery using FESS were good, it is advisable to gain sufficient experience before applying this procedure.

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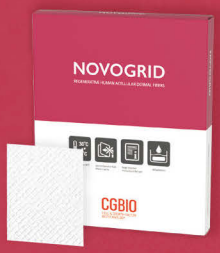


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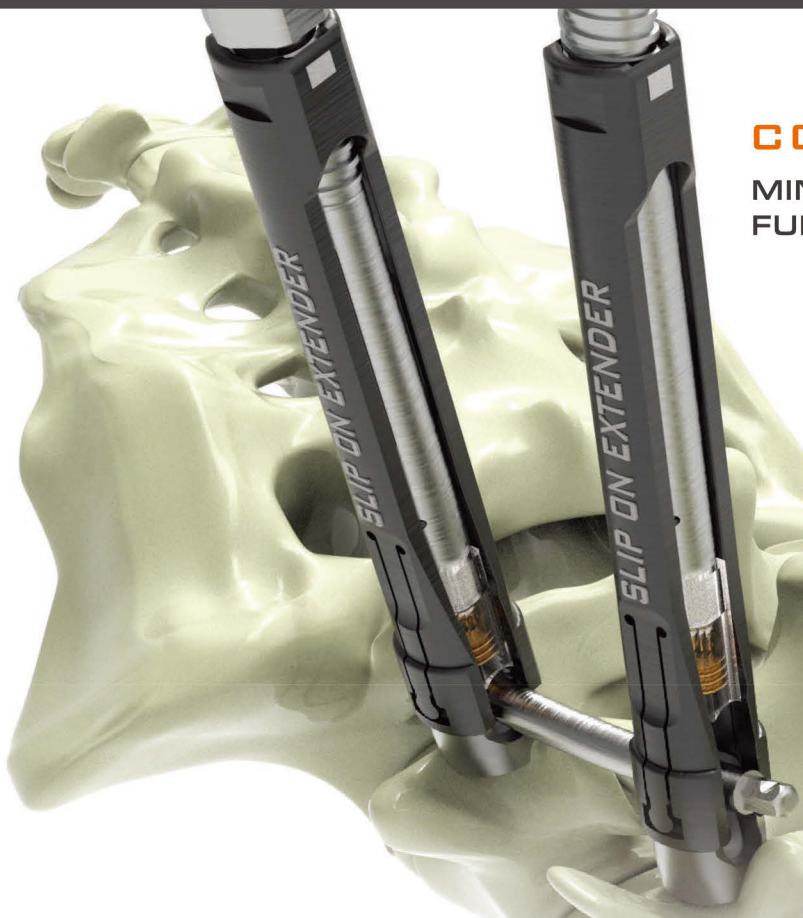
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COLONNADE

POSTERIOR SCREW FIXATION SYSTEM

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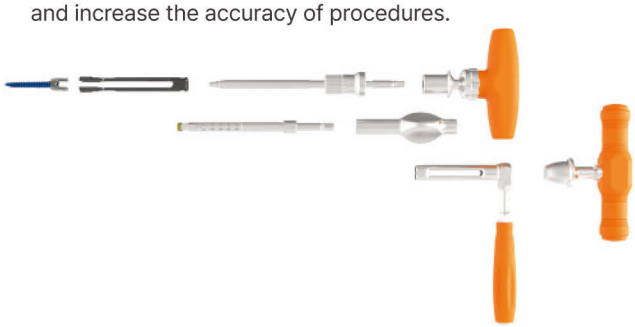


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STREAMLINED INSTRUMENTATION

- Optimized and cohesive tools for minimally invasive surgery improve performance, shorten surgery duration, and increase the accuracy of procedures.



RIGHT REDUCTION IN RIGHT PLACE

- 5 different rod reduction options
- Use a range of reduction techniques, varying from 7mm to 70mm, specifically designed for different stages of spondylolisthesis and spinal deformities.



COMPLEX CORRECTION

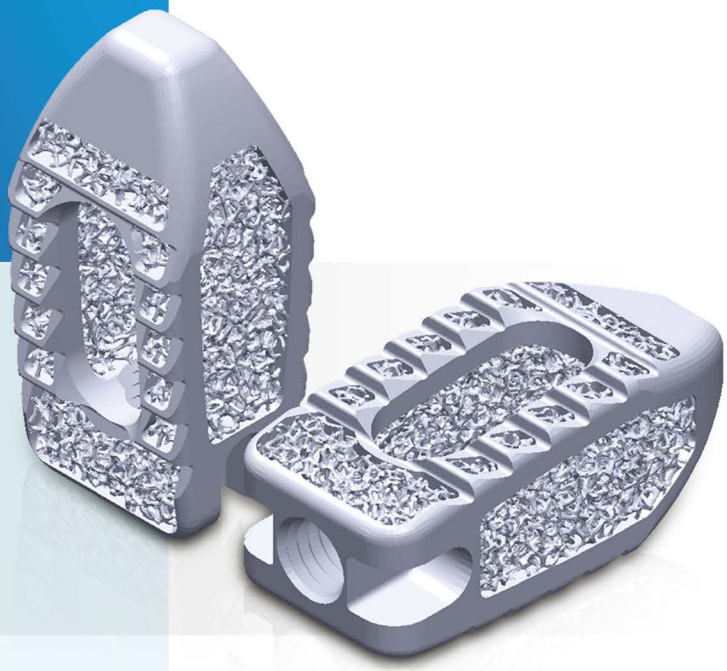
- A variety of rod connectors broaden the capabilities of your surgical techniques
- Dual rods, satellite rods, and lateral extensions are readily available for complex deformities.
- All rod connectors are compatible with both 5.5 and 6.0 rod systems.

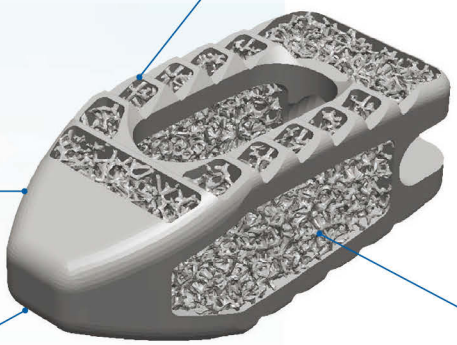


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Minimized Sharp Edge

: Designed smooth edge for minimizing damage

Smooth Wedge-Shaped Design

: Easy Insertion

Bullet-tip Nose

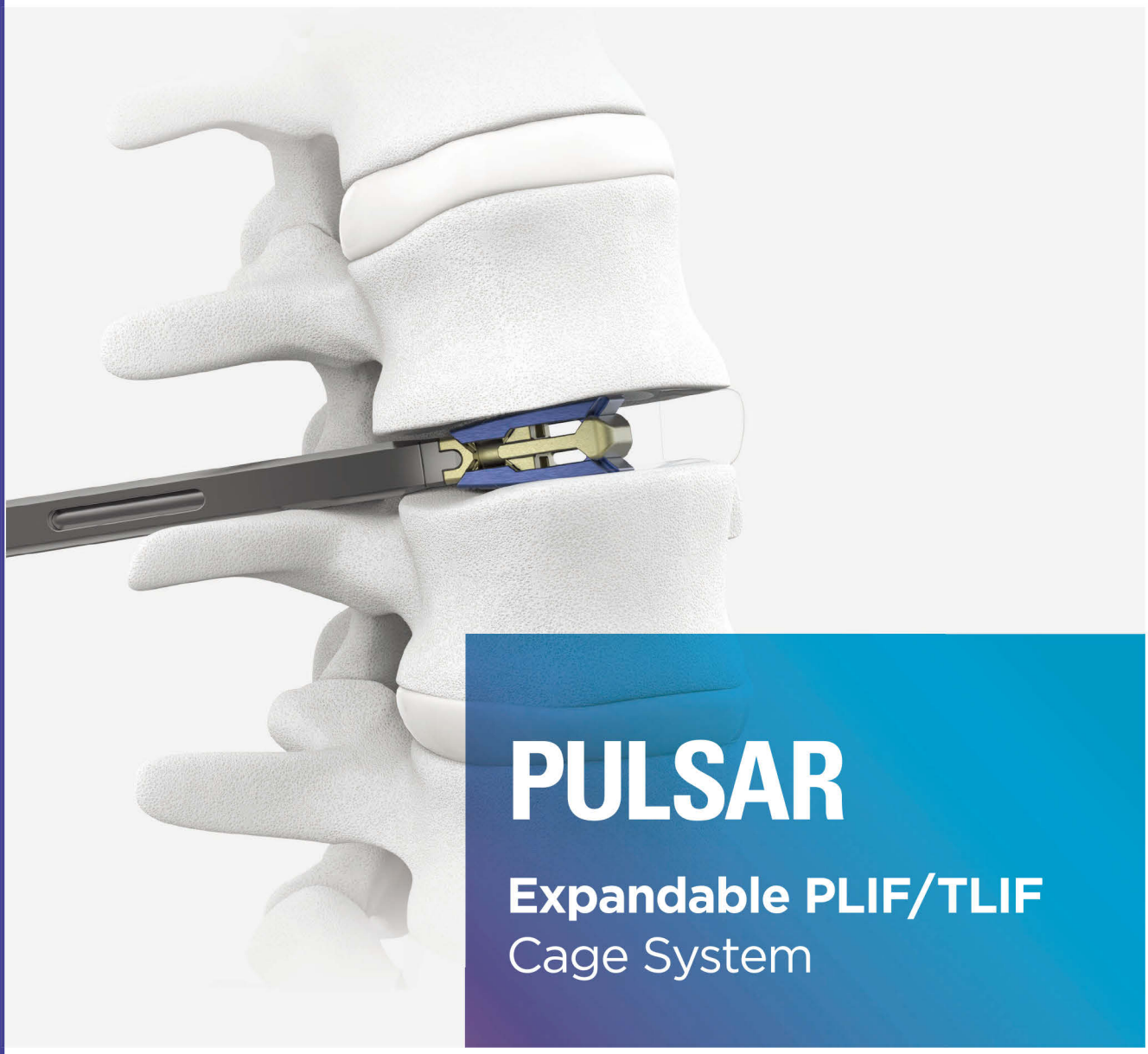
: The nose designed easy to rotational insertion

Interconnected Irregular Porous Structure

: Irregular porous structure provide optimized cellular adhesion and proliferation

GS Medical

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Tel : 82-43-237-7393 Fax : 82-43-237-7404 Homepage : www.gsmedi.com

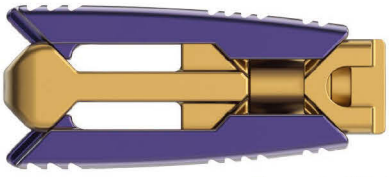


PULSAR

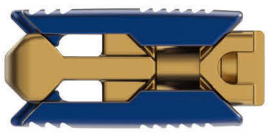
Expandable PLIF/TLIF
Cage System



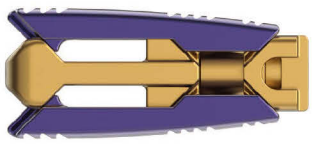
Inserted Height



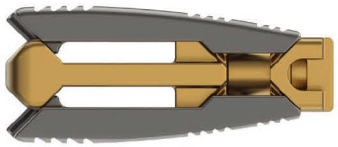
Expanded Height



10X24, 7-11mm 0°



10X28, 9-14mm 10°



12X31, 11-16mm 15°

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보행거리를 개선합니다.



OMT-23L038

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Opalmon® Tab.
Lumbar Spinal Stenosis

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4시간 동안 위에서 체류[1] *비글 대상 시험 결과
12시간 용출 지속 효과[1] *in vitro 시험 결과
1일 2회 용법[2]





Ref) 1. Kim, Jeong Soo, et al. "In vivo gastric residence and gastroprotective effect of floating gastroretentive tablet of DA-9601, an extract of Artemisia asiatica, in beagle dogs." Drug design, development and therapy (2016): 1917-1925.
2. 의약품안전나라_의약품 상세정보 : https://nedrug.mfds.go.kr/pbp/CCBBB01/getItemDetailCache?cacheSeq=201507521aupdateTs2025-04-26%2016:00:21.0b

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2. Tackett, Scott M., et al. "Real-world outcomes of hemostatic matrices in cardiac surgery." Journal of cardiothoracic and vascular anesthesia 28.6 (2014): 1558-1565.

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Ostene
BONE HEMOSTASIS MATERIAL



KO-AS19-240004

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울트라셋®세미 정 제품정보

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Reference 1. 울트라셋®정, 울트라셋®세미정, 울트라셋®이알서방정, 울트라셋®이알세미서방정 제품정보, 의약품안전나라 Available from: https://nedrug.mfds.go.kr/

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연골보호효과 확인[1, i]

장기투여 효과 확인[1,2, ii]

안전성 프로파일 확인[1,2]

제품요약정보[3]

전문의약품

【제품명】 조인스정200mg **【원료약품 및 그 분량】** 이 약 1정 중 조인스정 유효성분: 위령선·괄루근·하고초30%에탄올건조엑스(40→1)(별규) …200mg **【효능·효과】** 골관절증(퇴행관절질환), 류마티스관절염의 증상 완화 **【용법·용량】** 성인 : 1회 1정을 1일 3회 경구투여한다. 증상에 따라 적절히 증감한다. **【사용상의 주의사항】** 1. 다음 환자에는 신중히 투여할 것. 1) 감염상태 또는 감염의 원인이 있는 환자(감염에 대한 자체 저항력이 감소될 가능성이 있음을 고려해야 하며, 이런 경우에는 감염의 진행을 억제하는 처치를 취해야 한다.) 2) 임부 또는 임신하고 있을 가능성이 있는 여성 및 수유부 (후략) **【제조자】** 에스케이케미칼(주) 충청북도 청주시 흥덕구 산단로 149 **【판매자】** 에스케이케미칼㈜ 경기도 성남시 분당구 판교로 310

2011. 3. 21. 개정

※처방하시기 전 제품설명서 전문을 참고하십시오. 최신 허가사항에 대한 정보는 '식품의약품 안전처 의약품안전나라 (https://nedrug.mfds.go.kr/index)'에서 확인할 수 있습니다.

References 1. Joong Il Kim et al. Efficacy of JOINS on Cartilage Protection in Knee Osteoarthritis: Prospective Randomized Controlled Trial, knee surg relat res. 2017 sep 1;29(3):217-224. **2.** 조인스정 의약품 재심사 보고서 (2001.7.10~2005.7.9), Data on file SK 케미칼, [Updated 2005.10.07] **3.** 조인스정 허가정보, 의약품안전나라 [Cited 2023.01.20] Available from: https://nedrug.mfds.go.kr/

i) [조인스정의 4상 임상연구] 1년(시험 연장 참여 동의자의 경우 2년)의 RCT 연구에서 무릎 골관절염 환자 76명을 대상으로 MRI를 이용하여 조인스정과 위약의 연골보호효과를 비교하였음.
ii) 조인스정의 4상 임상 결과 상 2년 장기투여 대상자를, 4년간의 시판후 조사결과 상 6개월 이상 장기투여(184명, 전체의 3.09%) 대상자 포함하였음.

JNS-HA11-202301-01

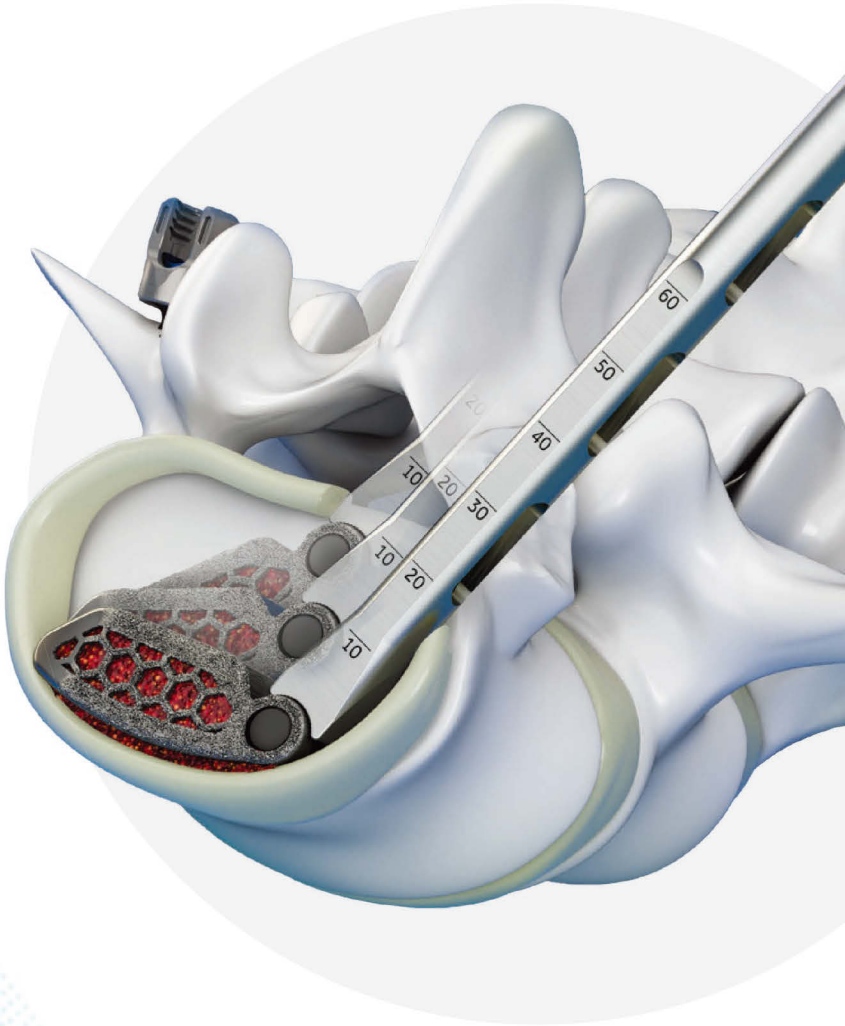
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Hanmi Hanmi Pharmaceutical Co., Ltd.

Osteoporosis treatment proven for its efficacy and safety through a clinical trial including Korean participants[1)]

Obodence® Pre-filled syringe (Denosumab) 60 mg / 1 mL



- Treatment of osteoporosis in postmenopausal women[2)]
- Treatment to increase BMD in men with osteoporosis[2)]
- Treatment of glucocorticoid-induced osteoporosis[2)]
- Treatment of bone loss in patients with non-metastatic prostate cancer receiving androgen deprivation therapy[2)]
- Treatment of bone loss in women with breast cancer receiving adjuvant aromatase inhibitor therapy[2)]

※ This information is approved by the MFDS (KR). For information approved by the FDA and EMA, please refer to the respective country's product label.

Product Information[2)]

Dosage Forms and Strengths	Injection: 60 mg/mL solution in single-dose prefilled syringe	**Dosage and Administration**	Administer 60 mg every 6 months as a SC injection	**Packaging Information**	1 X prefilled syringe(1 mL)/box
Duration of Use	36 months from the date of manufacture	**Storage Conditions**	Refrigerate at 2-8℃ in a hermetic container. Protect from light. Do not freeze.		

BMD: bone mineral density **SC:** subcutaneous

Ref 1) Langdahl B, et al. *J Clin Endocrinol Metab.* 2024 Sep;dgae611. **2)** The Ministry of Food and Drug Safety (KR). Obodence 60mg solution for injection in pre-filled syringe [product approval information]. Cheongju: MFDS; 2023 [cited 2025 Apr 16].

[Dosage forms] Injection: clear, colorless to slightly yellow solution in a single-dose prefilled syringe **[Ingredients and amounts]** Injection: 60 mg/mL solution in single-dose prefilled syringe, Active ingredient: denosumab, Inactive ingredients: histidine, histidine hydrochloride monohydrate, polysorbate 20, sorbitol, and water for injections **[Indications and usage]** **1.** Treatment of osteoporosis in postmenopausal women **2.** Treatment to increase BMD in men with osteoporosis **3.** Treatment of glucocorticoid-induced osteoporosis **4.** Treatment of bone loss in patients with non-metastatic prostate cancer receiving androgen deprivation therapy **5.** Treatment of bone loss in women with breast cancer receiving adjuvant aromatase inhibitor therapy **[Dosage and administration]** The recommended dose of Obodence is 60 mg administered as a single subcutaneous injection once every 6 months. Administer Obodence via subcutaneous injection in the upper arm, the upper thigh, or the abdomen. All patients should receive calcium 1000 mg daily and at least 400 IU vitamin D daily. If a dose of Obodence is missed, administer the injection as soon as the patient is available. Thereafter, schedule injections every 6 months from the date of the last injection. **[Precautions for use]** Obodence(denosumab) is biosimilar to Prolia (denosumab).(omitted) **[Packaging information]** 1 X prefilled syringe(1mL)/box **[Storage Conditions]** Refrigerate at 2-8°C in a hermetic container. Protect from light. Do not freeze. **[Duration of use]** Do not use Obodence after the expiry date printed on the label. **[Importer]** Samsung Bioepis Co., Ltd., 76, Songdogyoyuk-ro, Yeonsu-gu, Incheon, 21987, Republic of Korea **[Legal manufacturer]** Samsung Bioepis Co., Ltd., 76, Songdogyoyuk-ro, Yeonsu-gu, Incheon, 21987, Republic of Korea

※ For detailed drug information, please refer to the Ministry of Food and Drug Safety's Drug Integrated Information System (https://nedrug.mfds.go.kr → 'Drug Information' → 'Drug and Cosmetic Product Information' → 'Drug Information Search').

※ Any changes made after the date of this document's creation (revision) can be found on the Ministry of Food and Drug Safety's Drug Integrated Information System (https://nedrug.mfds.go.kr).

C_KR_202505_004_250516 HM Design 2505_01 OBO-H-2504-01

Hanmi 한미사이언스

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Absorbable Active Hemostatic Agent
Thrombin + Carboxymethyl Starch



3ml(기본형/복강경형), 6ml(기본형/복강경형)

ActiClot은 트롬빈과 식물성 전분 성분의 흡수성 지혈제로, 혈액 내 피브리노겐의 피브린 전환을 촉진하여 빠른 지혈을 유도하며 전분 성분이 물리적 장벽을 제공함으로써 출혈을 억제합니다.

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HM·Design 2402_01

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ONLY*

신경병증성 통증 치료제 국내 처방량 부분 판매 1위[1]
(UBIST D1 Sales 2022년 2월부터 2024년 1월까지 기준)

투여 1주차 부터 나타난 위약 대비 유의한 통증감소 효과[2]
(리리카를 투여 받은 당뇨병성 말초신경병증성 통증 환자 기준)

다양한 국내/외 가이드라인†에서
신경병증성 통증 1차 치료제 중 하나로 권고된 리리카[3-12]

안전성 프로파일 확인[13]

* **ONLY**는 Original Lyrica의 약어입니다. ※ 단, 리리카® CR 서방정의 경우 말초 신경병증성 통증의 치료에 한합니다.[14]

† **Abbreviations: AAN,** American Academy of Neurology; **ADA,** American Diabetes Association; **CPS,** Canadian Pain Society; **EFNS,** European Federation of Neurological Societies; **ESMO,** European Society for Medical Oncology; **IASP,** International Association for the Study of Pain; **JSPC,** Japan Society of Pain Clinicians; **KSSS,** Korean Society of Spine Surgery; **NICE,** National Institute for Health and Care Excellence; **KDA,** Korean Diabetes Association.

References 1. UBIST D1 Sales (2022.02 ~2024.01) **2.** R Freeman, et al. Diabetes Care. 2008 Jul;31(7)1448-54. **3.** 2010 EFNS Attal N, et al. 2010 revision. Eur J Neurol. 2010 Sep;17(9):1113-e88 **4.** 2011 KSSS: KJ Chung, et al. J Korean Soc Spine Surg 2011 Dec;18(4):246-253. **5.** 2015 IASP: Finnerup NB, et al. Lancet Neurol. 2015 Feb;14(2):162-73. **6.** 2018 JSPC: Sumitani M , et al. Journal of Anesthesia 2018;32:463-478. **7.** 2017 CPS: D Moulin, et al. Pain Res Manag. Nov-Dec 2014;19(6):328-35. **8.** 2018 ESMO: M Fallon, et al. Ann Oncol. 2018 Oct 1;29(Suppl 4):iv166-iv191. **9.** 2020 NICE: Bril V, et al. Neurology. 2011 May 17;76(20):1758–1765 **10.** 2023 ADA: ElSayed NA, et al. Diabetes Care 2023;46(Suppl. 1):S203–S215 **11.** 2021 AAN: Price R, et al. Neurology. 2022 Jan 4;98(1):31-43. 2021 **12.** 2023 당뇨병 진료지침 제8판 **13.** Freynhagen R, et al. Pain Practice. 2015;15(1):47-57. **14.** 리리카® CR 서방정 제품설명서. 최종변경허가일: 2025.3.18

[수입자/판매자] 비아트리스 코리아㈜
[04527] 서울특별시 중구 세종대로14, 비동 15층 (남대문로5가, 그랜드센트럴)
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START SMART, TITRATE with CONFIDENCE



제품정보는 QR코드를 통해 확인하세요!

P25-018-2027.01-V1

Study design | 1. This study evaluated the efficacy and safety of mirogabalin, a novel, potent, selective ligand the α2δ subunit of voltage-dependent Ca2+ channels, for the treatment of diabetic peripheral neuropathic pain(DPNP). During this double-blind, multisite, placebo-controlled phase III study, Asian patients aged ≥20 years with type 1 or 2 diabetes and DPNP were randomized 2:1:1:1 to a placebo, mirogabalin 15, 20 or 30mg/day for up to 14 weeks, with a 1-to 2-week titration. The primary endpoint was the change from baseline in average daily pain score(ADPS) at week, defined as a weekly average of daily pain. 2. This study investigated the safety and efficacy of mirogabalin, a novel, potent, selective ligand of the α2δ subunit of voltage-dependent Ca channels, for the treatment of postherpetic neuralgia (PHN). In this multicenter, double-blind, placebo-controlled phase 3 study, Asian patients ≥20 years with PHN were randomized 2:1:1:1 to a placebo, mirogabalin 15, 20 or 30mg/day for up to 14 weeks. The primary efficacy endpoint was the change from baseline in average daily pain score at week 14, defined as a weekly average of daily pain. 3. This randomized, double-blind, multisite, placebo-controlled, phase 3 study investigated mirogabalin efficacy and safety for the treatment of central neuropathic pain in patients with traumatic spinal cord injury. Adult patients were randomized (1:1) to receive placebo or mirogabalin. The primary efficacy endpoint was change from baseline in the weekly average daily pain score (ADPS) at week 14.

Reference | 1. Baba, Masayuki et al. "Mirogabalin for the treatment of diabetic peripheral neuropathic pain: A randomized, double-blind, placebo-controlled phase III study in Asian patients." Journal of diabetes investigation Vol. 10,5 (2019) 2. Kato, Jitsu, et al. "Mirogabalin for the management of postherpetic neuralgia: a randomized, double-blind, placebo-controlled phase 3 study in Asian patients." Pain 160.5 (2019): 1175-1185. 3. Ushida, Takahiro, et al. "Mirogabalin for central neuropathic pain after spinal cord injury: a randomized, double-blind, placebo-controlled, phase 3 study in Asia." Neurology 100.11 (2023): e1193-e1206. 4. 탈리제® 허가사항 5. "탈리제 정제 이미지." 약학정보원

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특허증

CERTIFICATE OF PATENT

특 허 Patent Number 제 10-2117215 호

출원번호 Application Number 제 10-2019-0124910 호

출원일 Filing Date 2019년 10월 08일

등록일 Registration Date 2020년 05월 26일

발명의명칭 Title of the Invention

복합 생약 추출물 및 세레콕시브를 포함하는 약학 조성물

특허권자 Patentee

주식회사 한국피엠지제약(131411-*******)



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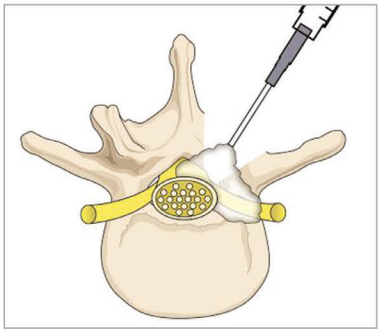
Oxiplex®

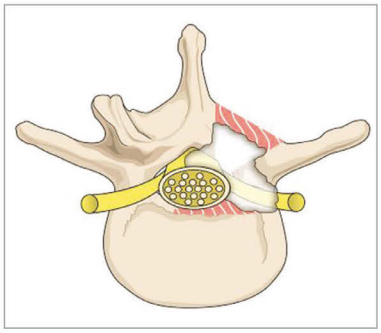
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The Leading Adhesion Barrier for Spine Surgery Worldwide

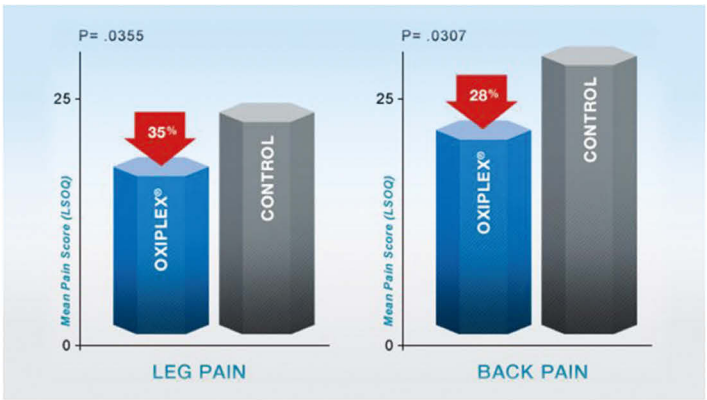
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Oxiplex is intended to be placed around neural tissues following spine surgery to reduce adhesion formation and related symptoms such as pain.



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[제조의뢰자] 온코닉테라퓨틱스

[제조판매원] 제일약품

[공동판매원] 동아ST

의약품상세정보 QR코드

Abbreviation. P-CAB Potassium-Competitive Acid Blocker.

Reference. 1. 국내 개발신약 허가현황, 한국신약개발연구조합 Available at https://www.kdra.or.kr/website/03web02.php accessed May-27-2025. 2. Hwang I *et al.*, Randomised clinical trial: Safety, tolerability, pharmacodynamics and pharmacokinetics of zastaprazan (JP-1366), a novel potassium-competitive acid blocker, in healthy subjects. *Aliment Pharmacol Ther.* 2023;57(7):763-772.

[제조의뢰자] 온코닉테라퓨틱스㈜ 서울특별시 강남구 테헤란로 26길 12, 11층 **[제조판매원]** 제일약품㈜ 공장: 경기도 용인시 처인구 백암면 청강가창로 7 (B동 외) 본사 : 서울특별시 서초구 사평대로 343 Tel. 080-555-7171

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  (than placebo) (than comparator groups)
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* Based on time-adjusted SPID48, calculated from VAS pain intensity scores recorded up until the time of consumption of the first dose of rescue.[1] ** Based on the total oral Morphine Milligram Equivalent (MME) dose of all rescue medication over the full 48 hour study period.[1]
*** According to VAS pain intensity, Pain Intensity Differences and Pain Relief scores. Dosed as one vial every 6 hours over 48 hour period.[1]

References : 1. Daniels, S.E, Playne, R., Stanescu, I., Zhang, J., Gottlieb, I.J, Atkinson, H.C. (2019). Efficacy and safety of an intravenous acetaminophen/ibuprofen fixed-dose combination after bunionectomy: A randomized, double-blind, factorial, placebo-controlled trial. Clinical Therapeutics https://doi. org/10.1016/j.clinthera.2019.07.008 . Research sponsored by AFT Pharmaceuticals.

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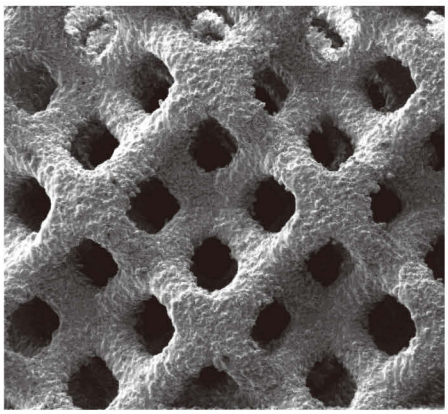
GENOSS™

3d Cage Cervical / Lumbar

Consists of ~88% porosity and a diamond pore size of 250μm~1,200μm Suitable elastic modulus avoids stress shielding and bone resorption Produced with Selective Laser Melting[SLM] technique

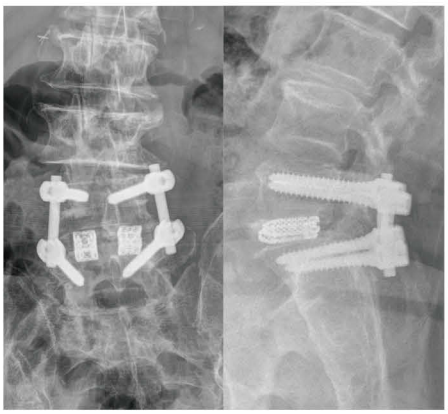
Structure for Fusion

GENOSS™ 3d Cage consists of ~88% porosity and a diamond pore size of 250μm~1,200μm, mimicking bone structure



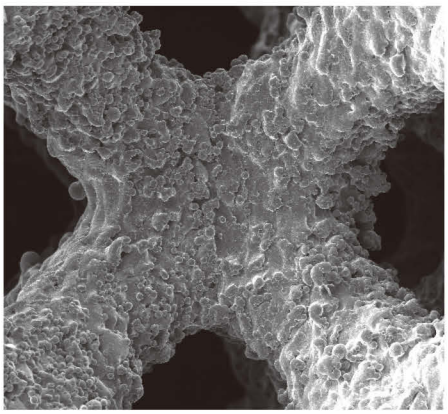
Enhanced Visibillity

Excellent imaging characteristics Implant con tours visible under x-ray, fusioin area clearly visible due to high Implant porosity MRI and CT compatible



Initial Stability

Rough elevated surface provides high primary stability



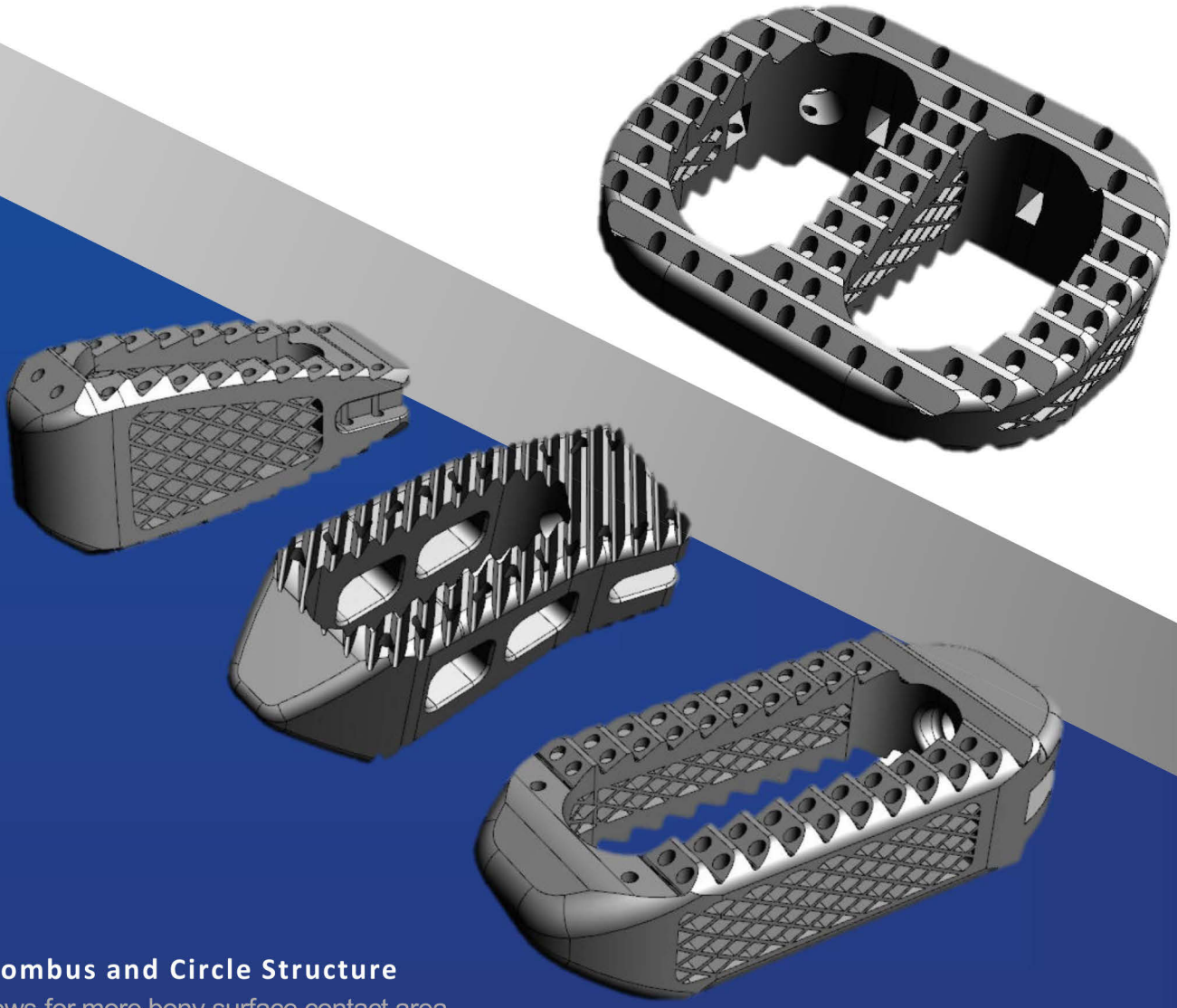
Minimized Subsidence Design

GENOSS 3d Cage™ is designed to minimize subsidence by offering a wide range of angles and sizes that allow for increased contact area with the endplate. A specialized wing-type design is also available, maximizing the superior contact surface, providing surgeons with the flexibility to select the optimal configuration for each patient.

ACE

Ti Cage System

Titanium Lumbar Interbody Fusion System



***Rhombus and Circle Structure**

-Allows for more bony surface contact area.
-Designed to minimize the stress load onto the end plates.
-Designed to decrease subsidence.
-Acts as an osteo-conductive scaffold for bony growth into the implant.

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