SRS ASIA PACIFIC MEETING

Fukuoka, Japan • February 6-7, 2026

FINAL PROGRAM

Scoliosis Research Society

atec™
INFORMED BY EOS

REVOLUTIONIZING
THE APPROACH TO SPINE SURGERY

DECIDE WITH CLARITY.
ACT WITH CONFIDENCE.

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Scoliosis Research Society
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meetings@srs.org
www.srs.org

FUTURE SRS MEETINGS

Annual Meeting

61st Annual Meeting
October 6-10, 2026 | Sydney, Australia

International Meeting on Advanced Spine Techniques (IMAST)

33rd IMAST
April 15-17, 2026 | Toronto, ON, Canada

Regional Courses

Spine Deformity Solutions: A Hands-On Course
June 10-12, 2026 | Brno, Czechia
July 31 - August 2, 2026 | São Paulo, Brazil

MEETING DESCRIPTION

For the region, by the region, this meeting aims to engage anyone involved in the treatment of spinal deformities including surgeons of every level, residents and fellows and researchers. As part of this new effort, SRS is pleased to be partnering with 13 regional societies. Each of these societies will provide the best paper from their recent Annual Meeting to be presented in the "Best Paper" session on February 6.

The meeting is a regionally focused meeting from the presenters to the location. To support this regional emphasis, accepted abstracts include a senior author and/or presenting author and a majority of co-authors from the regions of Asia and/or Oceania.

LEARNING OBJECTIVES

Upon completion of this course, participants should be able to:

1. Increase level of knowledge in region-specific treatment practices and outcomes for AIS and ASD in Asian countries
2. Identify how socioeconomic, cultural, and healthcare system factors influence surgical decision making.
3. Identify region-specific practices in managing ASD with respect to biologics, investigations and instrumentation techniques.
4. Enhance knowledge of patient-specific surgical planning and curve classification in AIS, including the integration of 3D analysis and understanding of coronal, sagittal, and axial deformities to optimize clinical and radiographic outcomes.

TARGET AUDIENCE

Residents, fellows, orthopaedic and neurosurgeons who have an interest and are involved in spinal deformity management and treatment.

PLANNING COMMITTEE

SRS President 2025-2026

Suken A. Shah, MD

RSM/AP Committee Chairs

Dong-Gune Chang, MD, PhD
Brian Hsu, MD
Kota Watanabe, MD, PhD

Faculty (in alphabetical order)

Sam Yeol Chang, MD
Marinus de Kleuver, MD, PhD
Jose Manuel F. Ignacio, MD
Tokumi Kanemura, MD, PhD
Noriaki Kawakami, MD, DMSc
Hyoungmin Kim, MD, PhD
Kenny Yat Hong Kwan, BMBCh(Oxon), FRCSEd
Mun Keong Kwan, MBBS, MS Orth
Ronald A. Lehman, Jr., MD
Yong Qiu, MD
Monchai Ruangchainikom, MD
Yudha Mathan Sakti, MD
Suken A. Shah, MD
Ajoy Prasad Shetty Tonse, MS Orth
Hee-Kit Wong, MD
Yu-Cheng Yao, MD
Qianyu Zhuang, MD

GENERAL MEETING INFORMATION

Venue & Headquarter Hotel

Hilton Fukuoka Sea Hawk
2 Chome-2-3 Jigyohama, Chuo Ward,
Fukuoka, 810-8650
Japan

Admission to Sessions

Official name badges will be required for admission to all sessions. All course attendees will receive a name badge with their registration materials. Name badges should be worn at all-times inside the Hilton Fukuoka Sea Hawk meeting space, as badges will be used to control access to sessions and activities. Attendees are cautioned against wearing their name badges while away from the venue, as badges draw unwanted attention to your status as visitors to the city.

Attire

Business (suits) or business casual attire (polo or dress shirt, sport coat) are appropriate for all sessions; ties are not required.

Cell Phone Protocol

Please ensure that cell phone ringers, pagers and electronic devices are silenced or turned off during all sessions.

Electricity

Japan uses two-flat-pin plugs (Type A) and occasionally a three-pin version (Type B), which are similar to those in North America but operate on a lower voltage of 100V.

Emergency & First Aid

The Hilton Fukuoka Sea Hawk Hotel is fully prepared to handle emergency requests and first aid. Contact a SRS staff person for support. Remember to note all emergency exits within the venue.

Language

English will be the official language of the Asia Pacific Meeting.

Smoking Policy

Smoking is not permitted during any meeting activity or event.

Time Zone

Fukuoka is on Japanese Standard Time (JST) and is +09:00 from GMT.

Evaluations

Please take time to complete the online evaluation forms. Your input and comments are essential in planning future Courses.

Navigate to: https://forms.cloud.microsoft/r/seUhyxw3ce

Lost & Found

Please feel free to stop by the SRS Registration Desk if you have lost or found an item during the meeting.

Registration Desk

Location: Argos D Foyer

Hours:		
	Thursday, February 5	17:00 - 19:30
	Friday, February 6	07:00 - 17:30
	Saturday, February 7	06:30 - 17:00

Speaker Ready Room

Location: Kusu

Hours:		
	Thursday, February 5	17:00 - 19:30
	Friday, February 6	07:00 - 17:00
	Saturday, February 7	07:00 - 16:30

Special Needs

If you have any health issues for which you may require special accommodations or assistance, please notify the SRS staff at the Registration Desk. We will make every effort to accommodate any special needs.

Video Recording Prohibited

SRS does not allow personal video recording of the presentations of any kind. SRS holds the right to confiscate any and all recordings taken of any of the presentations.

Simultaneous Translation

Scan the QR code to connect to real-time translation during the sessions.

*Please use your own headphones

GENERAL MEETING INFORMATION

Welcome Reception

Friday, February 6
16:50 - 18:45
Exhibit Hall, Argos EF

All registered delegates are invited to attend the Welcome Reception on Friday, February 6. The reception will be hosted in the Exhibit Hall where beverages and light hors d'oeuvres will be served. There is no charge for registered delegates, though your name badge is required for entrance. Dress for the Welcome Reception is business casual.

Wireless Internet

Wireless internet access will be available throughout the entire meeting space.

Network: Hilton Honors
Password: RSM2026AP

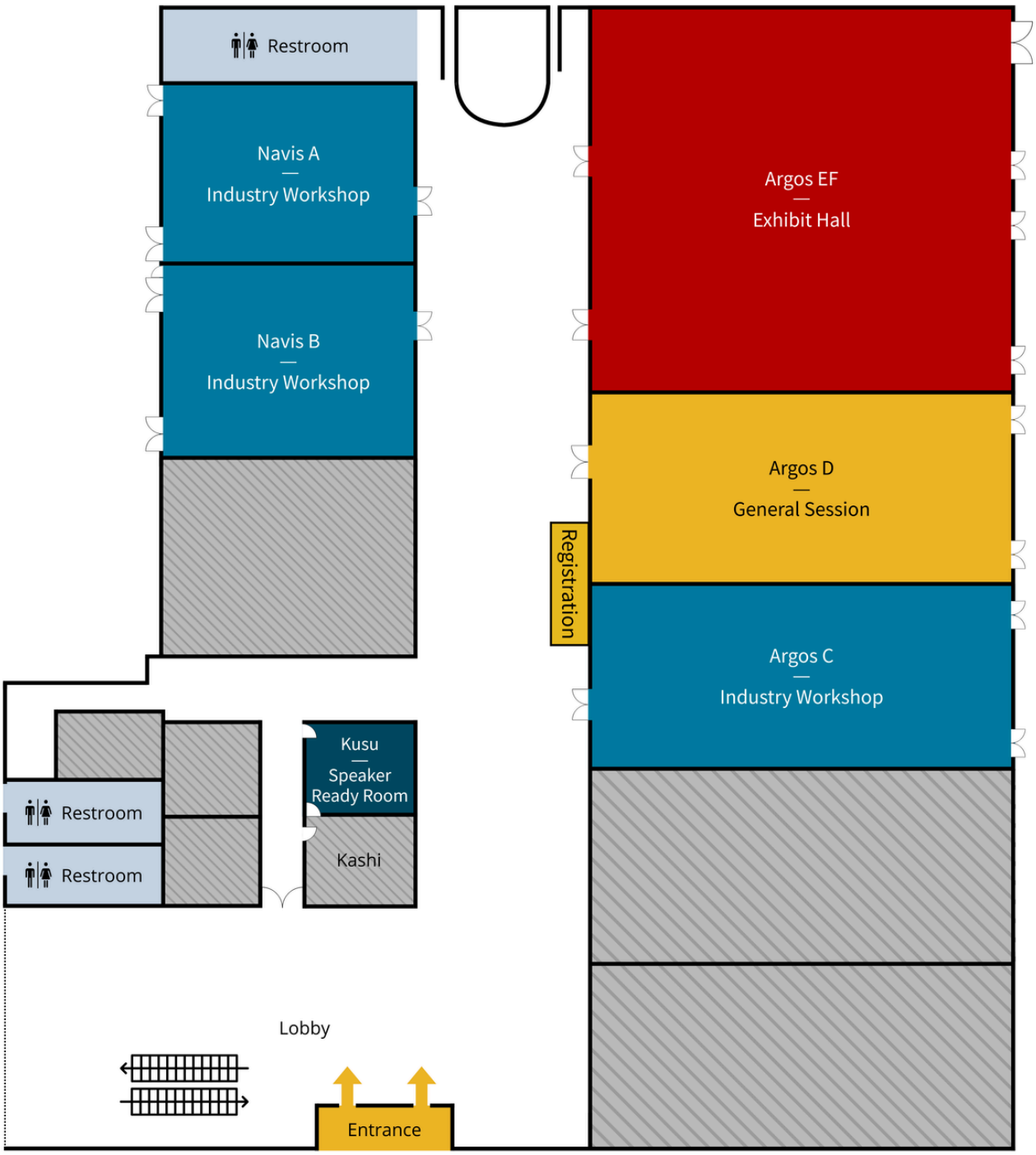
FDA Statement (United States)

Some drugs and medical devices demonstrated during this course have limited FDA labeling and marketing clearance. It is the responsibility of the physician to be aware of drug or device FDA labeling and marketing status.

Insurance/Liabilities and Disclaimer

SRS will not be held liable for personal injuries or for loss or damage to property incurred by participants at the SRS Asia Pacific Meeting. Participants are encouraged to take out insurance to cover loss incurred in the event of cancellation, medical expenses or damage to or loss of personal effects when traveling outside of their own countries. SRS cannot be held liable for any hindrance or disruption of course proceedings arising from natural, political, social or economic events or other unforeseen incidents beyond its control. Registration of a participant implies acceptance of this condition. The materials presented at this activity are made available for educational purposes only. The material is not intended to represent the only, nor necessarily best, methods or procedures appropriate for the medical situations discussed, but rather is intended to present an approach, view, statement or opinion of the faculty that may be helpful to others who face similar situations. SRS disclaims any and all liability for injury or other damages resulting to any individual attending the SRS Asia Pacific Meeting and for all claims that may arise out of the use of techniques demonstrated therein by such individuals, whether these claims shall be asserted by a physician or any other person.

HILTON FUKUOKA SEA HAWK



Location: 1F (Floor 1)

Argos D | General Session

Argos EF | Exhibits & Registration

Argos C, Navis A, Navis B | Industry Workshops

ASIA PACIFIC MEETING PROGRAM AGENDA

Friday, February 6, 2026

08:00 - 09:00 **Argos D**

Abstract Session 1: Award-Nominated Papers

Moderators: Dong-Gune Chang, MD, PhD; Brian Hsu, MD & Kota Watanabe, MD, PhD

08:00 - 08:04 **Welcome**

08:04 - 08:08 **Paper #1: Risk Factors associated with Degeneration of Unfused Lumbar Intervertebral Disc over Ten Years after Posterior Spinal Fusion for Thoracic Idiopathic Scoliosis**
Satoshi Suzuki, MD, PhD; Kazuki Takeda, MD, PhD; Takahito Iga, MD, PhD; Toshiki Okubo, MD, PhD; Masahiro Ozaki, MD, PhD; Narihito Nagoshi, MD, PhD; Morio Matsumoto, MD, PhD; Masaya Nakamura, MD, PhD; Kota Watanabe, MD, PhD

Paper #2 has been WITHDRAWN

08:08 - 08:12 **Paper #3: Proximal Junctional Kyphosis Following Long Instrumentation for Degenerative Kyphosis: Different Failure Modes or Different Patterns of Imbalance**
Yong Qiu, MD; Jie Li, MD, PhD; Zhen Liu, MD, PhD; Zezhang Zhu, PhD

08:12 - 08:19 **Discussion**

08:19 - 08:23 **Paper #4: Constructing a Visualizable Model to Predict Mechanical Complications After Spinal Deformity Surgery for Adult Spine Deformity Based on Machine Learning Algorithms**
Jie Li, MD, PhD; Zhen Liu, MD, PhD; Zezhang Zhu, PhD; Yong Qiu, MD

08:23 - 08:27 **Paper #5: Modified global alignment and proportion scoring with body mass index and bone mineral density and paraspinal muscle (GAPBM) for improving predictions of mechanical complications after adult spinal deformity surgery**
Sung Hyun Noh, MD, PhD

08:27 - 08:31 **Paper #6: The Impact of Postoperative Gait Patterns on Patient-Reported Outcomes in Adult Spinal Deformity**
Jung-Hee Lee, MD, PhD; Ki Young Lee, MD, PhD; *Woo-Jae Jang, MD*; Hong-Sik Park, MD

08:31 - 08:39 **Discussion**

08:39 - 08:43 **Paper #7: Association of Circulatory Proteins with Adult Spinal Deformity Risks: a Mendelian Randomization Study**
Gabriel Chun Yin Sung; Kenny Yat Hong Kwan, BMBCh (Oxon), FRCSEd

Paper #8 has been WITHDRAWN

08:43 - 08:47 **Paper #9: Development and internal validation of the Avoid Surgery Predictive Score (ASPS) as a predictive tool to assess surgical risk in spinal metastasis patients undergoing surgery**
Warunyu Limmaneevichitr, MD; Siravich Suvithayasiri, MD; Nath Adulkasem, MD; Sirichai Wilartratsami, MD; Borriwat Santipas, MD; Pinprapha Boonhyad, MD; *Panya Luksanapruksa, MD*

08:47 - 08:55 **Discussion**

08:55 - 08:58 **Closing Remarks from Moderators**
Dong-Gune Chang, MD, PhD; Brian Hsu, MD & Kota Watanabe, MD, PhD

08:58 - 09:00 **Award Voting**
Please follow the link below to cast your vote for the SRS Regional Scientific Meeting Award before 23:59 on February 6th!
SRS Asia Pacific Meeting Awards Voting

09:00 - 09:30 **Argos EF**

Refreshment Break & Exhibit Viewing

ASIA PACIFIC MEETING PROGRAM AGENDA

09:30 - 10:30 **Argos D**

Abstract Session 2: Adolescent Idiopathic Scoliosis

Moderators: Seung-Jae Hyun MD, PhD & Takahashi Kaito MD, PhD

09:30 - 09:34 **Paper #10: Will Coronal Imbalance impact surgery strategy in Lenke 5C AIS patients with poor thoracic compensatory ability?**
Zongshan Hu, PhD; Chunxiao Chen, MD

09:34 - 09:38 **Paper #11: Utility of Preoperative Fulcrum-Side Bending Assessment for Predicting Distal Adding-On in Adolescent Idiopathic Scoliosis Lenke Types 1 and 2**
Masashi Miyazaki, MD, PhD; Noriaki Sako, MD

09:38 - 09:42 **Paper #12: Development and Validation of Transformer-Based Deep Learning Models to Predict Curve Progression in Idiopathic Scoliosis**
Shinji Takahashi, MD, PhD; Kei Watanabe, MD, PhD; Haruki Ueda, MD, PhD; Hideyuki Arima, MD, PhD; Yu Yamato, MD, PhD; Takumi Takeuchi, MD, PhD; Naobumi Hosogane, MD; Hiroki Oba, MD, PhD; Shoji Seki, MD, PhD

09:42 - 09:49 **Discussion**

09:49 - 09:53 **Paper #13: Classification of Adolescent Idiopathic Scoliosis Using Contrastive Clustering: An Unsupervised Machine Learning Approach**
Chang Ju Hwang, MD, PhD; *Sehan Park, MD, PhD*

09:53 - 09:57 **Paper #14: Exploring the psychosocial effects of Adolescent Idiopathic Scoliosis treatment in Hong Kong: A 24-month study**
Anjaly Saseendran, MS, BS; Kenny YH. Kwan, MD, FRCS(C)

09:57 - 10:01 **Paper #15: Utilizing Stable Vertebra on Push-Prone Traction Radiographs for the Determination of the Lowest Instrumented Vertebra: A Novel Approach for AIS Patients with Lenke Type 3C and 6C**
Tinnakorn Pluemvitayaporn, MD

10:01 - 10:08 **Discussion**

10:08 - 10:12 **Paper #16: Dynamic Bone Metabolism Evaluated by Bone Histomorphometry in Patients with Primary Thoracic Adolescent Idiopathic Scoliosis**
Masayuki Sato, MD; Masayuki Ohashi, MD, PhD; Yohei Shibuya, MD; Hideki Tashi, MD; Toru Hirano, MD, PhD; Kei Watanabe, MD, PhD

10:12 - 10:16 **Paper #17: The Risk of Coronal Imbalance at 2 Years Follow-up in Lenke 6C Idiopathic Scoliosis with Distal Fusion to L3: Does Preop Coronal Pattern Matter?**
Abdukahar Y. Kiram, PhD; Yinyu Fang, MS; Jie Li, MD, PhD; Zhen Liu, MD, PhD; *Zezhang Zhu, PhD*; Yong Qiu, MD

10:16 - 10:20 **Paper #18: Posterior Spinal Corrective Surgery for Lenke 1 AIS with Anatomically Designed Pre-Bent Rods: A Comparative Study with the Conventional Simultaneous Double-Rod Rotation Technique**
Katsuhisa Yamada, MD, PhD; Akira Fukushima, MD; Hiroyuki Tachi, MD; Terufumi Kokabu, MD; Manabu Ito, MD, PhD; Kuniyoshi Abumi, MD, PhD; Hideki Sudo, MD, PhD

10:20 - 10:27 **Discussion**

10:27 - 10:30 **Closing Remarks from Moderators**
Seung-Jae Hyun MD, PhD & Takahashi Kaito MD, PhD

10:30 - 10:40

Break & Exhibit Viewing

ASIA PACIFIC MEETING PROGRAM AGENDA

10:40 - 12:35 **Argos D**

Education Session 1: Adolescent Idiopathic Scoliosis: From Natural History to Advanced Treatment Strategies

Moderators: Marinus de Kleuver, MD, PhD & Suken Shah, MD

This session is planned in collaboration with the Asia Pacific Spine Society (APSS).

10:40 - 10:48	**From Hippocrates to Modern Surgery: A Historical Journey Through AIS Treatment Evolution** *Jose Manuel Ignacio, MD*
10:48 - 10:56	**Understanding the Natural History of AIS: Key Studies and Clinical Implications** *Hee-Kit Wong, MD*
10:56 - 11:04	**Pulmonary Function in AIS: Clinical Relevance and Emerging Insights** *Marinus de Kleuver, MD, PhD*
11:04 - 11:14	**Discussion**
11:14 - 11:22	**Bracing in AIS: Evolution of Evidence-Based Treatment Strategies** *Sam Yeol Chang, MD*
11:22 - 11:30	**Beyond the Brace: Emerging Non-Surgical Interventions for AIS** *Noriaki Kawakami, MD, DMSc*
11:30 - 11:38	**Surgical Innovation in AIS: From Spinal Fusion to Motion-Preserving Techniques** *Suken A. Shah, MD*
11:38 - 11:48	**Discussion**
11:48 - 11:56	**Correction Mechanics and Maneuvers in AIS for Ideal Alignment** *Chee Kidd Chiu, MBBS, MSOrth*
11:56 - 12:04	**Defining Fusion Level and Goals: How Far Should We Go?** *Mun Keong Kwan, MBBS, MS Orth*
12:04 - 12:12	**Adding-On Phenomenon and Decompensation: Managing Unexpected Curve Progression** *Kenny Yat Hong Kwan, BMBCh(Oxon), FRCSEd*
12:12 - 12:20	**AIS and Long-Term Outcomes: Predicting Function, Pain, and Quality of Life** *Ajoy Prasad Shetty Tonse, MS Orth*
12:20 - 12:32	**Discussion**
12:32 - 12:35	**Closing Comments** *Marinus de Kleuver, MD, PhD & Suken Shah, MD*

12:35 - 12:50 **Argos EF**

Lunch Pick-Up

ASIA PACIFIC MEETING PROGRAM AGENDA

12:50 - 13:50
Industry Workshops
Each workshop is programmed by a single-supporting company and will feature presentations on topics selected by the company.

DEPUY SYNTHES **Navis A**

AIS Case Discussions: Innovations and Practical Insights
Moderator: Suken Shah, MD
Faculty: Suken Shah, MD; Masayuki Ohashi, MD, PhD; Yu-Cheng Yao, MD

This workshop will focus on Adolescent Idiopathic Scoliosis (AIS) cases, offering practical insights and evidence-based strategies for diagnosis, surgical planning, and postoperative care. Faculty will present challenging AIS cases and share their approaches to optimizing outcomes. The session will also explore the role of advanced technologies, including navigation and robotic-assisted systems.

Dr. Suken A. Shah will highlight his experience using the latest VELYS™ Navigation and Robotic system in AIS cases, providing a unique perspective on how technology can enhance surgical precision and patient results. Participants will gain clinically useful knowledge through diverse insights shared by leading experts.

GLOBUS MEDICAL **Navis B**

Topics in Spinal Deformity Care: A Novel 3D Classification System for AIS and Cellular Senescence in Adult Spinal Deformity
Chair: Akira Matsumura, MD, PhD
Faculty: Takashi Kaito, MD, PhD

This lecture highlights two emerging topics in spinal deformity care: a novel 3D classification system for adolescent idiopathic scoliosis (AIS) and the role of cellular senescence in adult spinal deformity. AIS is a complex 3D deformity with substantial rotational components, yet current surgical planning still relies largely on 2D imaging and the Lenke system. The SRS 3D Classification Task Force has proposed a clinically meaningful system that adds two transverse-plane descriptors—orientation of the regional plane of deformation (ORPD) and apical vertebral rotation (AVR)—to maintain continuity with current practice while capturing previously unrecognized 3D differences.

In adult deformity, cellular senescence has gained attention as a key factor in age-related bone fragility. Using an osteoblast-specific senescence mouse model in a separate line of research, we demonstrated that senescent osteoblasts contribute to age-related osteoporosis. Additionally, we investigated how senescent cell accumulation affects the response to osteoporosis therapies such as teriparatide. These findings suggest that targeting senescence may enhance fusion biology and reshape future treatment strategies

ASIA PACIFIC MEETING PROGRAM AGENDA

MEDTRONIC **Argos C**

Advancements in Spinal Deformity Treatment

Moderator: Kota Watanabe, MD, PhD

Faculty: Dr. Naobumi Hosogane: Prevention of complications in ASD surgery, with emphasis on alignment, correction of coronal balance, and post-operative ADLs.

Dr. Ron Lehman: Utilization of Mazor and UNiD in spinal deformity treatment.

Come join us as we explore strategies for preventing complications in Adult Spinal Deformity (ASD) surgery, focusing on optimal alignment, correction of coronal balance, and improving post-operative activities of daily living (ADLs). Learn about the integration of advanced technologies such as Mazor Robotics and UNiD Adaptive Spine Intelligence in enhancing surgical outcomes for spinal deformity treatment.

13:50 - 14:20 **Argos EF**

Refreshment Break & Exhibit Viewing

14:20 - 16:50 **Argos D**

Abstract Session 3: "Best Of" Session

Moderators: Brian Hsu, MD; Dong-Gune Chang, MD, PhD & Kota Watanabe, MD, PhD

14:20 - 14:25 **About SRS**
Suken A. Shah, MD

14:25 - 14:27 **Society Intro - Australian Spine Society**
Davor Saravanja, BMed, FRACS, FAOrthoA

14:28 - 14:32 **Paper #19: Best Paper - Australian Spine Society**
Ultrasound as a Tool to Objectively Assess the Injured Spinal Cord in a Porcine Model of Thoracic Contusion Spinal Cord Injury
Madeleine Bessen, PhD; Oana Marian, Ryan O'Hare Doig, BSc (Hons), PhD; Annabel Sorby-Adams, PhD; Christine Gayen, Lola Kaukas, BHlthSci (Hons), GradCert; Anna Leonard, BHlthSci (Hons), PhD; Claire Jones, PhD

14:32 - 14:34 **Society Intro - Asia Pacific Spine Society**
Yat-Wa Wong, MBBS; FRCS(Ed); FHKCOS; FHKAM(Ortho)

14:35 - 14:39 **Paper #21: Best Paper - Asia Pacific Spine Society**
Unlocking the IVD: Unveiling Its Microbial Landscape with Shotgun Metagenomics
Ajoy Prasad Shetty, MS Orth; Karthik Ramachandran, MBBS, MS, DNB (Orth); Shanmuganathan Rajasekaran, MBBS, PhD, FRCS, MCh; Sharon Miracle Nayagam, MSc; Chitra Thangavel, BSccc

14:39 - 14:48 **Discussion**

14:48 - 14:50 **Society Intro - Association of Spine Surgeons of India (ASSI)**
Sudhir K. Srivastava, MBBS, MS

14:51 - 14:55 **Paper #22: Best Paper - Association of Spine Surgeons of India (ASSI)**
Non Fusion Anterior Scoliosis Correction in Lenke 5 AIS Patients - Surgical Outcome, AVR, AVT and Coronal Balance Correction - A Single Centre, Single Surgeon Experience
Appaji Krishnamurthy, MD; Sajan Hegde, MBBS, MS; Vigneshwara Badikkillaya, MBBS, MS: Akshya Raj, MS; *Sharan Achar T, MS, DNB Ortho*; Harith Reddy, MS

14:55 - 14:57 **Society Intro - Chinese Association of Spine CAS**
Yong Hai, MD, PhD

ASIA PACIFIC MEETING PROGRAM AGENDA

14:58 - 15:02 **Paper #23: Best Paper - Chinese Association of Spine CAS**
Etiological Classification of Major Cervicothoracic/Upper Thoracic Scoliosis
Saihu Mao, MD; Shuqi Sun, Kai Sun, Song Li, MD, PhD; Zezhang Zhu, MD, PhD; Zhen Liu, PhD; Yong Qiu, MD

15:02 - 15:04 **Society Intro - Indonesian Orthopaedic Spine Surgeon Association (IOSSA)**
Primadenny Ariesa Airlangga, MD

15:05 - 15:09 **Paper #24: Best Paper - Indonesian Orthopaedic Spine Surgeon Association (IOSSA)**
A Cost-Effective Approach to Severe Rigid Scoliosis Correction using Low-Density Pedicle Screw Constructs based on Radiographic Parameters
Greesea Dinamaria, MD*; Abdul Kadir Hadar MD*

15:09 - 15:20 **Discussion**

15:20 - 15:22 **Society Intro - Japanese Scoliosis Society (JSS)**
Jun Takahashi, MD, PhD

15:23 - 15:27 **Paper #25: Best Paper - Japanese Scoliosis Society**
Early Brace-Related Stress, Not Wear Time, Correlates with One-Year QOL Change in AIS: A Retrospective Cohort Study
Kotaro Sakashita, MD; Tomoyuki Asada, MD, PhD; Tsuyoshi Sakuma, MD, PhD; Yasushi Iijima, MD, PhD Tsutomu Akazawa, MD, PhD; Shohei Minami, MD; Seiji Ohtori, MD, PhD; Toshiaki Kotani, MD, PhD

15:27 - 15:29 **Society Intro - Korean Society of Spine Surgery**
Chang Ju Hwang, MD, PhD

15:30 - 15:34 **Paper #26: Best Paper - Korean Society of Spine Surgery**
Pelvic Inclination Angle as a Novel Sagittal Parameter: Clinical Applications in Adult Spinal Deformity Surgery
Se-Jun Park, MD, PhD; Jin-Sung Park, MD, PhD; Dong-Ho Kang, MD; Chong-Suh Lee, MD, PhD; Yunjin Nam, MD

15:34 - 15:36 **Society Intro - Korean Spinal Neurosurgery Society**
Seung-Hwan Yoon, MD, PhD

15:37 - 15:41 **Paper #27: Best Paper - Korean Spinal Neurosurgery Society**
Revision Surgery Following Primary Adult Spine Deformity Surgery
Dae Jean Jo MD, PhD; Yong Ahn MD, PhD; Sungsoo Bae MD, PhD

15:41 - 15:52 **Discussion**

15:52 - 15:54 **Society Intro - Malaysia Spine Society (MSS)**
Chee Kid Chiu, MS

15:55 - 15:59 **Paper #28: Best Paper - Malaysia Spine Society**
International Multicenter Validation of Growth Velocity and Scoliosis Progression Prediction Using the Distal Radius and Ulna (DRU) Classification: An APSS Scoliosis Focus Group Study
Hideyuki Arima, MD, PhD; Yu Yamato, MD, PhD; Chris Yin Wei Chan, MS Orth; Chee Kidd Chiu, MBBS, MSOrth; Mun Keong Kwan, MBBS, MSOrth; Shinji Takahashi, MD, PhD; Yusuke Hori, MD, PhD; Hideki Sudo, MD; Katsuhisa Yamada, MD, PhD; Shu-Hua Yang, MD, PhD; Ming-Hsiao Hu, MD; Chih-Wei Chen, MD; Jason Pui Yin Cheung, MBBS, MMedSc, MS, MD; Yat Wa Wong, MBBS, FRCS, FHKAM; Keith Dip Kei Luk, MD; Daisuke Sakai, MD; Daisuke Kudo, MD; Wataru Saito, MD, PhD; Gabriel Liu, FRCS(Orth), MSC; Leok Lim Lau, FRCS; Ajoy Shetty, MS Orth; Hideki Shigematsu, MD, PhD

15:59 - 16:01 **Society Intro - Philippine Spine Society**
Ronald Tangente, MD, MBA

16:05 - 16:09 **Paper #29: Best Paper - Philippine Spine Society**
Early Outcomes on the Combined Halo-Pelvic Traction and Kyphectomy from an All-Posterior Approach for Severe Kyphotic Deformity
Patrick Leo F. Rebato, MD FPOA; Mary Ruth A. Padua, MD FPOA FPSS; Gracia Cielo E. Balce, MD FPOA; Frederick Patrick I. Nicomedez, MD FPOA, FPSS; Samuel Arsenio M. Grozman, MD FPOA FPSS

ASIA PACIFIC MEETING PROGRAM AGENDA

16:06 - 16:08 **Society Intro - Singapore Spine Society**
Reuben CC Soh, MBBS, MMedOrth, FRCS

16:09 - 16:13 **Paper #30: Best Paper - Singapore Spine Society**
The Impact of Smoking on Anterior Cervical Discectomy and Fusion with Standalone Cages: Radiological and Functional Outcomes
Cassie Yang, MBBS; Chee Cheong Reuben Chee Cheong Soh, MBBS, MMedOrth, FRCS; Yeong Huei Ng, FRCS (Ortho); Li Tat John Li Tat Chen, MBBS (NUI), BAO, LRCSI, FRCS (Edin); Youheng Ou Yang, MBBS, MMed

16:13 - 16:24 **Discussion**

16:24 - 16:26 **Society Intro - Spine Society of Thailand (SST)**
Thanut Valleenukul, MD

16:27 - 16:31 **Paper #31: Best Paper - Spine Society of Thailand**
Prediction of Postoperative Coronal Trunk Shift in Adolescent Idiopathic Scoliosis Surgery Using Intraoperative Crossbar Measurement Technique
Tinnakorn Pluemvitayaporn, MD; Suttinont Surapuchong, MD; Mahisaun Tong-in, Charnchai Jongtaweesathapon, Piyabuth Kittithamvongs, MD, MSc; Warot Ratanakoosakul, Kitjapat Tiracharnvut, MD; Chaiwat Piyasakulkaew, MD; Sombat Kunakornsawat, MD

16:31 - 16:33 **Society Intro - Taiwan Spine Society**
Wen-Tien Wu, PhD

16:34 - 16:38 **Paper #32: Best Paper - Taiwan Spine Society**
Pang Hsuan Hsiao, MD; Chun Tseng, MD, PhD; Chien Chung Chang, MD, PhD; Hsien Te Chen, MD, PhD

16:38 - 16:47 **Discussion**

16:47 - 16:50 **Closing Remarks from Moderators**
Brian Hsu, MD; Dong-Gune Chang, MD, PhD & Kota Watanabe, MD, PhD

16:50 - 18:45 **Argos EF**

Welcome Reception

Please join your colleagues for a hosted reception featuring hors d'oeuvres, cocktails in the Exhibit Hall. Also, don't miss the opportunity to meet with the exhibitors. Available at no charge to meeting delegates.

ASIA PACIFIC MEETING PROGRAM AGENDA

Saturday, February 7, 2026

07:00 - 07:50
Industry Workshops
Each workshop is programmed by a single-supporting company and will feature presentations on topics selected by the company.

HIGHRIDGE MEDICAL — **Argos C**

Best Practices in Deformity: What Can We Learn from Each Other – An International Symposium
Faculty: Kota Watanabe, MD, Brian Hsu, MD, Ronald Lehman, MD, Rajiv Sethi, MD, Suken Shah, MD

This Highridge workshop, brings together international spine leaders for a focused, case-based discussion on adult and pediatric complex deformity. Through brief thought-leadership remarks and interactive panel discussions, faculty will share global perspectives, surgical decision-making insights, and best practices aimed at advancing deformity care worldwide.

SMILE CURVE — **Navis B**

Early Detection in Adolescents – Screening Initiatives
Chair: Prof. Jun Takahashi, MD, PhD
Faculty: Hiroshi Kuroki, MD, DMSc; Yutaka Kinoshita, MD, PhD; Kevin Lim, FRCS(Eng), FRCSEd(Orth), MBA

Adolescent idiopathic scoliosis often progresses silently during growth, making timely screening critical to enable bracing and avoid surgery. This session presents a practical, region-by-region view of modern school-based screening.
Dr. Hiroshi Kuroki traces the evolution of screening programs worldwide and in Japan—highlighting current initiatives, persistent gaps, and Japan's moiré-based efforts—and explains why device-assisted methods can improve accuracy and support earlier detection.

Dr. Yutaka Kinoshita presents Tokushima's device-enabled program, launched in 2023 and steadily expanded since then. He highlights the achievements and challenges encountered during implementation, reporting early outcomes which suggest that earlier detection may increase opportunities to connect adolescents with non-invasive treatments, such as bracing and exercise therapy.

From Singapore, Dr. Kevin Lim offers an Asia-Pacific perspective on treatment practices, screening uptake, and barriers to timely detection, as well as opportunities for shared evidence generation. Attendees will leave with actionable frameworks and collaboration ideas to implement or upgrade adolescent screening in their own settings, and to advance early detection and early treatment across Japan and the broader Asia-Pacific region.

ASIA PACIFIC MEETING PROGRAM AGENDA

07:50 - 08:00
Break & Exhibit Viewing

08:00 - 09:00 **Argos D**
Abstract Session 4: Adult Spinal Deformity
Moderators: Reuben CC Soh, MBBS, MMedOrth, FRCS & Shu-Hua Yang, MD, PhD

08:00 - 08:04	**Welcome**
08:04 - 08:08	**Paper #33: Difference in preoperative patient expectations for adult spinal deformity surgery between Japan and the United States** *Takeshi Fujii, MD, PhD;* Satoshi Suzuki, MD, PhD; Kento Yamanouchi, MD, PhD; Kazuki Takeda, MD, PhD; Philip K. Louie, MD; Aiyush Bansal, MD; Venu M. Nemani, MD, PhD; Jean-Christophe A. Leveque, MD; Rajiv K. Sethi, MD; Kota Watanabe, MD, PhD
08:08 - 08:12	**Paper #34: Assessment of maximum extension reservoir of lumbar spine using fulcrum hyperextension radiographs in severe sagittal spinal malalignment: A guide for selecting lateral lumbar interbody fusion alone versus anterior column realignment in lateral corrective surgery** *Se-Jun Park, MD, PhD;* Jin-Sung Park, MD, PhD; Dong-Ho Kang, MD; Hyun-Jun Kim, MD; Chong-Suh Lee, MD, PhD
08:12 - 08:16	**Paper #35: Sagittal Imbalance Deterioration After S2-Alar-Iliac Fixation in Adult Spinal Deformity: What Role Does Dynamic Hip Joint Coverage Play?** *Zezhang Zhu, PhD;* Dongyue Li; Zhen Liu, MD, PhD; Jie Li, MD, PhD; Yong Qiu, MD
08:16 - 08:22	**Discussion**
08:22 - 08:26	**Paper #36: Preoperative Sacral Slope Change (ΔSS) as a Risk Factor for Mechanical Complications after Adult Spinal Deformity Surgery** *Tetsuro Ohba, MD, PhD;* Hirotaka Haro, MD, PhD
08:26 - 08:30	**Paper #37: Adjacent segment disease on hip joint as a complication of lumbopelvic fixation surgery: a five-year follow-up study** *Takuhei Kozaki, MD;* Takahiro Kozaki, MD; Hiroshi Hashizume, MD; Shunji Tsutsui, MD; Masanari Takami, MD; Keiji Nagata, MD; Yuyu Ishimoto, MD; Masatoshi Teraguchi, MD; Ryuichiro Nakanishi, MD; Hiroshi Iwasaki, MD; Hiroshi Yamada, MD
08:30 - 08:34	**Paper #38: Ten-Year Longitudinal Quality of Life Decline and Spinopelvic Alignment Changes: Findings from the Toei Community Cohort** *Hideyuki Arima, MD, PhD;* Yu Yamato, MD, PhD; Koichiro Ide, MD; Tomohiko Hasegawa, MD, PhD; Go Yoshida, MD, PhD; Tomohiro Banno, MD, PhD; Shin Oe, MD; Tomohiro Yamada, MD; Yusuke Murakami, MD, PhD; Yukihiro Matsuyama, MD, PhD
08:34 - 08:40	**Discussion**
08:40 - 08:44	**Paper #39: Surgical Outcomes of Adult Idiopathic Scoliosis: A Comparative Study Between Younger and Middle-Aged Patients** *Yasushi Iijima, MD, PhD;* Toshiaki Kotani, MD, PhD; Tsuyoshi Sakuma, MD, PhD; Tsutomu Akazawa, MD, PhD; Shohei Minami, MD, PhD; Seiji Ohtori, MD
08:44 - 08:48	**Paper #40: Strategic Adjustment of ULL and LLL to Maintain Ideal L1PA** *Myung-Hoon Shin, MD, PhD*
08:48 - 08:52	**Paper #41: Updating the coronal balance classification for adult spinal deformity: a relook into the Type A subtype** Yanjie Xu, MD; *Zhen Liu, MD, PhD;* Hui Xu, MD; Xiaodong Qin, PhD; Benlong Shi, PhD; Jie Li, MD, PhD; Zezhang Zhu, PhD; Yong Qiu, MD
08:52 - 08:58	**Discussion**
08:58 - 09:00	**Closing Remarks from Moderators** *Reuben CC Soh, MBBS, MMedOrth, FRCS & Shu-Hua Yang, MD, PhD*

ASIA PACIFIC MEETING PROGRAM AGENDA

09:00 - 09:30
Refreshment Break & Exhibit Viewing — **Argos EF**

09:30 - 10:25
Abstract Session 5: Adult & Cervical Deformity, and Kyphosis — **Argos D**
Moderators: Gabriel KP Liu, FRCS(Orth), MSC and Akira Matsumura, MD PhD

09:30 - 09:34 **Paper #42: Age-specific sagittal alignment goals using GAP Scoring to reduce risk of proximal junctional kyphosis in Adult Spinal Deformity: A Single-centre Cohort study in Indian population**
Vivek Kumar, MBBS, MS; *Imtiaz Ghani, MBBS, MS*

09:34 - 09:38 **Paper #43: Sagittal spinal alignment deviation in the general elderly population: A Japanese cohort survey**
Masashi Uehara, MD, PhD; Jun Takahashi, MD, PhD

09:38 - 09:42 **Paper #44: How Much Is Too Much? FSPA-Based Analysis for PJK Prevention**
Jung-Hee Lee, MD, PhD; Ki Young Lee, MD, PhD; *Hong-Sik Park, MD*; Woo-Jae Jang, MD

09:42 - 09:48 **Discussion**

09:48 - 09:52 **Paper #45: Optimizing Craniovertebral Junction Tuberculosis Treatment: Development and Validation of a Radiological Scoring System**
Chitranshu Shrivastava, MS

09:52 - 09:56 **Paper #46: Are Elderly Patients at Elevated Risk for Complications? A Retrospective Analysis of 141 Cervicothoracic Deformity Correction Cases by a Single Surgical Team**
Ping-Yeh Chiu, MD; Winward Choy, MD; David Mazur-Hart, MD

09:56 - 10:00 **Paper #47: Beyond Flexion and Extension - The Hidden Postural Mechanics of Natural Sitting & Axial Head Loading in Cervical Myelopathy. – Results of a Novel Dynamic Sitting MRI Study**
J. Naresh Babu

10:00 - 10:06 **Discussion**

10:06 - 10:10 **Paper #48: Effect of C3 Laminectomy on the Progression of Ossification of Posterior Longitudinal Ligament in Cervical Laminoplasty: A Propensity Score-Matched Comparison of Clinical outcomes and Sagittal alignment between C3 Laminectomy with C4–6 Laminoplasty and C3–6 Laminoplasty**
Giwuk Jang, MD; Kyung Hyun Kim MD, PhD

10:10 - 10:14 **Paper #49: Evaluating the Efficacy and Safety of Halo-Femoral Traction and Halo-Gravity Traction Techniques in Severe Kyphoscoliosis with Spinal Cord Risk Classification (SCRC) Type 3 Over the Apex**
Erh-Ti Ernest Lin, MD; Yuan-Shun Lo, MD, PhD

10:14 - 10:18 **Paper #50: Outcomes of Vertebral Column Resection (VCR) in Patients with Rigid, Healed Post-Tubercular Dorsal Kyphosis with Myelopathy - Do the Benefits Match the Risks and Complications?**
Vikas Hanasoge, MBBS, MS; Saumyajit Basu; Dhruv Patel, MS

10:18 - 10:24 **Discussion**

10:24 - 10:25 **Closing Remarks from Moderators**
Gabriel KP Liu, MBBS, FRCS & Akira Matsumura, MD, PhD

10:25 - 10:40
Break & Exhibit Viewing

ASIA PACIFIC MEETING PROGRAM AGENDA

10:40 - 12:35 **Argos D**

Education Session 2: Adult Spinal Deformity: Optimizing Surgical Strategies and Long-Term Outcomes

Moderators: Brian Hsu, MD & Ronald Lehman, Jr., MD

This session is supported, in part, by an educational grant by ATEC Spine

10:40 - 10:48	**Understanding Adult Spinal Deformity (ASD): Epidemiology, Progression, and Key Risk Factors** *Monchai Ruangchainikom, MD*
10:48 - 10:56	**Spinal Sagittal and Coronal Balance: Principles, Realignment Goals, and the Spine-Pelvic-Lower Extremity Connection** *Ronald Lehman, Jr., MD*
10:56 - 11:04	**Defining Fusion Level and Surgical Goals: How Far Should We Go?** *Yong Qiu, MD*
11:04 - 11:12	**Proximal Junctional Kyphosis (PJK) and Proximal Junctional Failure (PJF): Prevention and Treatment Strategies** *Brian Hsu, MD*
11:12 - 11:24	**Discussion**
11:24 - 11:32	**Minimally Invasive Surgery (MIS) for ASD: Techniques to Achieve Optimal Outcomes** *Dong-Gune Chang, MD*
11:32 - 11:40	**When Are Osteotomies Required? Indications, Techniques, and Risk Mitigation** *Kota Watanabe, MD, PhD*
11:40 - 11:48	**Achieving a Fusion and Long-Term Success Regional Options in Biologics** *Yudha Mathan Sakti, MD*
11:48 - 11:58	**Discussion**
11:58 - 12:06	**Integrating Gait Analysis and AI: Predicting Functional Outcomes and Complications in ASD Surgery** *Hyoungmin Kim, MD, PhD*
12:06 - 12:14	**Long-Term Outcomes in ASD: Quality of Life, Functional Decline, and Secondary Health Effects** *Yu-Cheng Yao, MD*
12:14 - 12:22	**Use of Enabling Technology in Surgery: Regional Use and Challenges** *Tokumi Kanemura, MD, PhD*
12:22 - 12:32	**Discussion**
12:32 - 12:35	**Closing Comments** *Ronald Lehman, Jr., MD & Brian Hsu, MD*

12:35 - 12:50 **Argos EF**

Lunch Pick-Up

ASIA PACIFIC MEETING PROGRAM AGENDA

12:50 - 13:50 **Argos EF**

Industry Workshops

Each workshop is programmed by a single-supporting company and will feature presentations on topics selected by the company.

ATEC SPINE **Argos C**

Driving Predictability with Procedure-Specific Solutions & Data

Faculty: Anand Segar, MD

ATEC is committed to revolutionizing the approach to spine surgery. In practice, this means creating procedure-specific retractor systems, patient-specific rods, patient positioners and intra-operative neuromonitoring - all informed by EOS. In this session, Dr. Anand Segar will discuss his experience using EOSedge and EOS Insight across pediatric and adult deformity care, highlighting how pre-operative planning and tailored procedural solutions support precise execution of the surgical strategy.

13:50 - 14:20 **Argos EF**

Refreshment Break & Exhibit Viewing

14:20 - 15:35

Abstract Session 6: Basic Science, Cervical Deformity, Neuromuscular/Syndromic Deformity & Early Onset Scoliosis **Argos D**

Moderators: Michael B. Johnson, MD, PhD & Mun Keong Kwan, MBBS, MS Orth

14:20 - 14:24 **Paper #51: An End-to-End Deep-Learning Pipeline for Automated Cobb-Angle Measurement and Last-Touched Vertebra Identification in Adolescent Idiopathic Scoliosis**
Wei-Chen Lin, MD; Shu-Hua Yang, MD; Chih-Wei Chen, MD; Yun-Liang Chang, MD

14:24 - 14:28 **Paper #52: A comparative analysis of 4-, 12-, and 24-hour intervals of drain-clamping reduces postoperative blood loss following posterior spinal surgery in adolescent idiopathic scoliosis: a prospective randomized controlled trial**
Tinnakorn Pluemvitayaporn, MD

14:28 - 14:32 **Paper #53: Association between genetic predisposition and morphological characteristics in adolescent idiopathic scoliosis**
Kazuki Takeda, MD, PhD; Satoshi Suzuki, MD, PhD; Takuro Iwami, MD; Nao Otomo, MD, PhD; Takahito Iga, MD, PhD; Toshiki Okubo, MD, PhD; Masahiro Ozaki, MD, PhD; Narihito Nagoshi, MD, PhD; Morio Matsumoto, MD, PhD; Masaya Nakamura, MD, PhD; Kota Watanabe, MD, PhD

14:32 - 14:38 **Discussion**

14:38 - 14:42 **Paper #54: Effectiveness of the Modified Customised Boston-Style Rigid TLSO Versus the Rigo-Cheneau Style Rigid TLSO for Adolescent Idiopathic Scoliosis**
Jess S. Ooi, DIPPMS; Chang Liue; Tansy Koh; *Nicole Lee, PhD;* Kevin B. Lim, MD

14:42 - 14:46 **Paper #55: Effectiveness of Dual Rod Translation in Thoracic Kyphosis Restoration for AIS: A Comparison with the Conventional Technique**
Yusuke Hori, MD, PhD; Takashi Namikawa, MD, PhD; Masaki Kawamura, MD; Brando Guarrera, MD; Akira Matsumura, MD, PhD

14:46 - 14:50 **Paper #56: Which Radiological Measurements Correlate Best with Patient Perceived Post-Operative Shoulder Imbalance Following Posterior Spinal Fusion for AIS?**
Anand Kumar Ramalingam; Nicole Lee, PhD; Neeraj Mishra; Lavinia Somanesan; Jess Shi Yang. Ooi; Stacy Ng, FRCS; Kevin Boon Leong. Lim, MD

14:50 - 14:56 **Discussion**

ASIA PACIFIC MEETING PROGRAM AGENDA

14:56 - 15:00 **Paper #57: Lowest Instrumented Vertebra (LIV) Index as a Supplemental Indicator to Lastly Touched Vertebra for Selection of The Fusion Level in Main Thoracic Adolescent Idiopathic Scoliosis**
I-Hsin Chen, MD; *Chih-Wei Chen, MD;* Jui-Yo Hsu, MD; Po-Yao Wang, MD; Yu-Cheng Yeh, MD; Po-Liang Lai, MD; Ming-Hsiao Hu, MD; Shu-Hua Yang, MD

15:00 - 15:04 **Paper #58: Three-Column Osteotomy versus Halo-Gravity Traction Combined with Posterior Column Osteotomy in the treatment of Dystrophic Neurofibromatosis Type 1 Kyphoscoliosis: A Retrospective Comparative Cohort Study.**
Yuan-Shun Lo, MD, PhD; Erh-Ti Ernest Lin, MD; Yi-Hsun Huang, MD; Hung-Lun Hsieh, MD; Hsien-Te Chen, MD, PhD

15:04 - 15:08 **Paper #59: Vertebrae and Morphometric Anomaly of Neuromuscular Scoliosis with Myelomeningocele Patients: Magnetic Ressonance Imaging Study**
Farid Yudoyono, MD; Yosafat Kurniawan, MD

15:08 - 15:14 **Discussion**

15:14 - 15:18 **Paper #60: Progression of Segmental Thoracic Kyphosis Following Thoracolumbar Hemivertebra Resection in Patients with Congenital Scoliosis**
Jae Hyuk Yang, MD, PhD; Hong Jin Kim, MD, PhD; Hyung Rae Lee, MD; Jun Hyun Kim, MD; Seoung Woo Suh, MD, PhD

15:18 - 15:22 **Paper #61: The Utility of Cervical Vertebral Maturation Method for Staging Skeletal Growth and Curve Progression in Patients with Adolescent Idiopathic Scoliosis**
Samuel Tin Yan Cheung, MBBS; Garvin Chi Chun Cheung; Jason Pui Yin Cheung, MD, MBBS, MS, FRCS; Prudence Wing Hang Cheung, PhD, BDSc (Hons)

15:22 - 15:26 **Paper #62: Efficacy of Suspension Bending Cast for Early Onset Scoliosis**
Keisuke Masuda MD, PhD; Vidyadhar Upasani MD; Michael Kelly MD; Peter Newton MD

15:26 - 15:33 **Discussion**

15:33 - 15:35 **Closing Remarks from Moderators**
Michael B. Johnson, MD, PhD & Mun Keong Kwan, MBBS, MS Orth

15:35 - 15:50
Break & Exhibit Viewing

15:50 - 17:05
Abstract Session 7: Miscellaneous **Argos D**
Moderators: Yat-Wa Wong MBBS, FRCS & Yoon Ha, MD, PhD

15:50 - 15:54 **Paper #63: A Comprehensive Analysis of Potential Complications after Oblique Lumbar Interbody Fusion: A Review of Postoperative Magnetic Resonance Scans in Over 400 Cases**
Su Hun Lee, MD, PhD; Dongwuk Son, MD, PhD

15:54 - 15:58 **Paper #64: Dry Spinal Tuberculosis: An Atypical Face of Spinal Koch's**
Tushar Narayan. Rathod, MS; Deepika Jain, MS; Yash Ved, MS

15:58 - 16:02 **Paper #65: The Leverage of Technique: High-Grade Spondylolisthesis Treated with Archimedes Manoeuvre – Insights from a Single Centre**
Bhavuk Garg, MS; *Akashdeep Singh. Bali, MBBS, MS;* Anirudh Divye Krishna, MBBS

16:02 - 16:08 **Discussion**

16:08 - 16:12 **Paper #66: Efficacy Comparison of Combined Nanocrystalline Eggshell Hydroxyapatite with Umbilical Cord Mesenchymal Stem Cell (UC-MSC) Secretome and Commercial RhBMP-2 for Lumbar Interbody Fusion: Randomized Controlled Trial Study**
Yudha Mathan Sakti MD; Zikrina Lanodiyu, MD; Deas Emiri, MD; Wilhelmina Wijaya, MD

ASIA PACIFIC MEETING PROGRAM AGENDA

16:12 - 16:16 **Paper #67: Optimal Placement of Supplemental Accessory Rods to Prevent Rod Fracture at the Lumbosacral Junction in Long Spinopelvic Fixation Using Lateral Interbody Fusion: A Biomechanical Experimental Study Using a Synthetic Bone Model and a Finite Element Model**
Ryuichiro Nakanishi, MD; Shunji Tsutsui, MD; Ei Yamamoto, PhD; Takuhei Kozaki, MD; Akimasa Murata, MD; Hiroshi Yamada, MD

16:16 - 16:20 **Paper #68:The Link Between a Growth Mindset and Health-Related Quality of Life in AIS Patients on Brace Treatment**
Joelle Wang; Nicole Lee, PhD; Jess Ooi; Kevin Lim, MD

16:20 - 16:26 **Discussion**

16:26 - 16:30 **Paper #69: Delayed extubation following corrective surgery for severe kyphoscoliosis: what are the roles of pulmonary arterial hypertension and chronic respiratory failure?**
Zhen Liu, MD, PhD; Xiaokang Wang, MD; Zezhang Zhu, PhD; Yong Qiu, MD; Jie Li, MD, PhD

16:30 - 16:34 **Paper #70: The Efficacy of Dexa Vs QCT Vs MRI in the Histopathological Diagnosis of Osteoporosis and Their Correlation with Pedicle Screw Insertional Torque in Patients Undergoing Lumbar Fixation.**
Saumyajit Basu, MD; Gowtham Rangasai J, MS; Piyush Gadegoni, MS; Mainak Palit, PhD; Dhruv Patel, MS; Harsh Patel, MBBS, MS; Ayon Ghosh, MS; *Vikas Hanasoge, MBBS, MS*; Dhrumilkumar Patel, MBBS, MS; Shubham Kumar M, MS; Dipanshu Maheshwari, MBBS, MS; Ajay VM, MS

16:34 - 16:38 **Paper #71: Plantar Foot Temperature as an Adjunct to Intraoperative Neuromonitoring in Spinal Deformity Surgery: A Case Report and Prospective Case Series of 89 Patients**
Chang Hwa Ham, MD; Rizki Meizikri, MD; Seoung Woo Suh, MD, PhD

16:38 - 16:42 **Paper #72: Does Intraoperative Neuro-Monitoring(IONM) alert changes correlate with clinical outcomes in patients undergoing surgery for degenerative cervical myelopathy?**
Vikas Hanasoge, MBBS, MS; Saumyajit Basu; Aditya Vardhan. Guduru; Dhruv Patel, MS

16:42 - 16:48 **Discussion**

16:46 - 16:52 **Closing Comments from Moderators**
Yat-Wa Wong MBBS, FRCS & Yoon Ha, MD, PhD

16:52 - 16:57 **Closing Comment from Meeting Chairs & Presentation of SRS Regional Scientific Meeting Award**
Dong-Gune Chang, MD, PhD; Brian Hsu, MD & Kota Watanabe, MD, PhD

16:57 - 17:05 **Closing Comments from SRS President**
Suken A. Shah, MD

17:05
Adjournment

PODIUM PRESENTATION ABSTRACTS

1. Risk Factors associated with Degeneration of Unfused Lumbar Intervertebral Disc over Ten Years after Posterior Spinal Fusion for Thoracic Idiopathic Scoliosis

Satoshi Suzuki, MD, PhD; Kazuki Takeda, MD, PhD; Takahito Iga, MD, PhD; Toshiki Okubo, MD, PhD; Masahiro Ozaki, MD, PhD; Narihito Nagoshi, MD, PhD; Morio Matsumoto, MD, PhD; Masaya Nakamura, MD, PhD; Kota Watanabe, MD, PhD

Hypothesis
Distal adding-on after posterior spinal fusion (PSF) for thoracic adolescent idiopathic scoliosis (AIS) could be a risk factor for degeneration of unfused intervertebral lumbar disc (IVDD) over time.

Design
Prospectively collected, retrospective analyzed cohort study.

Introduction
While several studies have investigated IVDD following PSF for AIS, there are no studies that focus exclusively on thoracic main curves. This study aims to identify factors contributing to IVDD progression over a ten-year postoperative period.

Methods
A total of 92 patients with thoracic AIS (7 males, 85 females; mean age of 27.0 years) who underwent PSF and had a follow-up period of over 10 years were included in this study. Lumbar MRI and standing radiographs were obtained preoperatively and at the 10-year follow-up. IVDD was evaluated using a modified Matsumoto classification. Based on the progression of IVDD, patients were divided into two groups: the degenerated group (Group D), comprising patients with progression of disc degeneration, and the non-degenerated group (Group ND), comprising those without. Demographic characteristics, surgical variables, radiographic parameters, and SRS-22 scores were compared between the two groups using both univariate and multivariate analyses. A p-value of <0.05 was considered statistically significant.

Results
A total of 400 lumbar discs were evaluated. IVDD deterioration was observed in 38 discs (9.5%) among 31 patients in Group D. No significant differences were found between groups in Demographic characteristics and curve correction parameters. Significant differences were observed in distal adding-on (68.0% vs 20.9%, p<0.01), and L4 translation (3.8mm vs 2.1mm, p=0.03). Logistic regression analysis also identified distal adding-on (B 2.1, Odds ratio 8.13, 95%CI 2.84-23.3), and L4 translation (B 0.13, OR 1.14, 95%CI 1.001-1.30) as significant risk factors for IVDD progression. All SRS-22 domains demonstrated comparable scores between the two groups, with no significant differences.

Conclusion
Distal adding-on and increased L4 translation were significant risk factors for the progression of unfused lumbar IVDD ten years after PSF for thoracic AIS. Preventing the occurrence of distal adding-on could contribute to reducing the risk of intervertebral disc degeneration in unfused lumbar segments.

Paper #2 has been WITHDRAWN

3. Proximal Junctional Kyphosis Following Long Instrumentation for Degenerative Kyphosis: Different Failure Modes For Different Patterns of Imbalance

Yong Qiu, MD; Jie Li, MD, PhD; Zhen Liu, MD, PhD; Zezhang Zhu, PhD

Hypothesis
The incidence of different modes of proximal junctional kyphosis or failure for degenerative kyphosis(DK) patients may vary with different types of sagittal imbalance.

Design
This study aims to investigate the incidence and risk factors of different modes of proximal junctional kyphosis or failure for degenerative kyphosis(DK) patients with different types of sagittal imbalance.

Introduction
The incidence and risk factors of different modes of proximal junctional kyphosis or failure for degenerative kyphosis(DK) patients are not clear and may be associated with different types of sagittal imbalance.

Methods
A total of 190 patients with DK who underwent posterior long-segment instrumentation with S2AI screws. Patients who developed PJK within 2 years postoperatively were included. Patients with PJK were categorized into three groups: single-segment collapse group (S group), multi-segment degeneration group (M group), and proximal junctional failure group (F group). The following radiographic parameters were measured : Cobb angle, coronal balance distance (CBD), global kyphosis (GK),lumbar lordosis (LL), sagittal vertical axis (SVA), proximal junctional angle (PJA),and paravertebral muscle fat infiltration rates were analyzed among the three groups.

Results
Among all patients, 55 (28.9%) developed PJK, among which 74.5% were in the M group, 10.9% were in the S group, and 14.5% were in the F group. In the M group, 85% of patients had the kyphotic apex located in the thoracic spine (TL), whilst in S group, 67% of patients had the kyphotic apex below L2. In the S group, 50% of the upper-end fixation levels were below T10. The F group had a significantly higher incidence of global imbalance (67% of patients had preoperative SVA > 5 cm) compared to the M group. Compared to the S and M groups, the F group exhibited significantly increased VBQ scores and higher rates of paravertebral muscle fat infiltration (VBQ score: F group 3.4 vs. M group 3.0 vs. S group 2.75; paravertebral muscle fat infiltration rate: F group 40% vs. M group 36% vs. S group 29%).

Conclusion
Postoperative PJK in degenerative kyphosis patients is predominantly characterized by multi-segment symmetrical degeneration. Patients with preoperative imbalance and significant bone and paravertebral muscle degeneration have a higher risk of proximal junctional failure.

4. Constructing a Visualizable Model to Predict Mechanical Complications After Spinal Deformity Surgery for Adult Spine Deformity Based on Machine Learning Algorithms

Jie Li, MD, PhD; Zhen Liu, MD, PhD; Zezhang Zhu, PhD; Yong Qiu, MD

Hypothesis
The risk factors of mechanical complications (MC) following spinal deformity surgery for adult spine deformity (ASD) could be predicted precisely by machine learning models

Design
To predict mechanical complications (MC) following spinal deformity surgery for adult spine deformity (ASD) using machine learning models, analyze the risk factors, and develop a visualizable model for risk assessment.

Introduction
Mechanical complications (MC) is common in adult spine deformity (ASD) and the may be predicted precisely by machine learning models

Methods
Clinical and radiological data from 525 patients with spinal deformities who underwent surgical treatment for ASD in our hospital. Demographic data, comorbidities, local and systemic radiological parameters and so on, were trained and tested on the datasets. The best machine learning model was selected based on ROC (Receiver Operating Characteristic curve) and PRC (Precision-Recall Curve) in the test set. SHAP (Shapley Additive explanations) analysis was used to rank the contribution degree of risk factors. LIME (local interpretable model-agnostic explanations) analysis was constructed for visualizing MC risk in individual cases.

Results
135 (25.7%) experienced mechanical complications (MC) postoperatively.In the validation cohort, the Random Forest (RF) model achieved the highest Area Under the Curve (AUC) value of 0.80, followed by GNB (AUC = 0.77), XGB (AUC = 0.76), LR (AUC = 0.74), Light GBM (AUC = 0.73), and SVA (AUC = 0.66). The GNB, Light GBM, and LR models exhibited the highest accuracy, all at 0.78. The Light GBM model showed the highest specificity of 0.93. SHAP analysis identified preoperative higher preoperative vertebral bone quality (VBQ) scores, larger preoperative T1 pelvic angle (T1PA), and higher paraspinal muscle fat infiltration rate (FI%) as the main risk factors for MC.

Conclusion
The RF model exhibited the best overall performance in predicting MC. The main risk factors for MC, including higher paraspinal muscle fat infiltration, larger preoperative T1 pelvic angle (T1PA), and higher VBQ scores, were identified through the RF model. Machine learning-based prediction model for MC holds potential to provide significant guidance for surgical decision-making in ASD patients.

5. Modified Global Alignment and Proportion Scoring with Body Mass Index and Bone Mineral Density and Paraspinal Muscle (GAPBM) for Improving Predictions of Mechanical Complications after Adult Spinal Deformity Surgery

Sung Hyun Noh, MD, PhD

Hypothesis
This study aims to identify the factors associated with mechanical complications by analyzing muscle mass, metabolic indicators, and skeletal parameters.

Design
Retrospective study

Introduction
Mechanical complications following adult spinal deformity surgery remains a critical concern, with multiple factors potentially contributing to the need for reoperation. While previous studies have explored the impact of bone mineral density (BMD) and skeletal alignment, the role of muscle composition and metabolic factors remains unclear.

Methods
A retrospective analysis was conducted on 293 patients who underwent spinal surgery. Patients were categorized based on whether they had mechanical complications. Independent variables included muscle mass parameters (Multifidus, Psoas, Quadratus, fat), BMD, weight, body mass index (BMI), and GAP score. Paraspinal structures were measured by MRI, using artificial intelligence. The ability of the Scoliosis Research Society (SRS)-Schwab classification, age-adjusted alignment goals, GAP score, modified global alignment and proportion scoring with BMI and BMD (GAPB), GAPB with paraspinal muscle volume (GAPBM) to predict mechanical failure was compared by calculating the area under the receiver operating characteristic curve (AUC).

Results
Larger multifidus and quadratus muscle mass were associated with a lower incidence of mechanical complications, while increased BMI and fat composition showed a positive correlation with mechanical complications. AUCs of the SRS-Schwab classification, GAP score, age-adjusted alignment goals, GAPB, and GAPBM were 0.579 (95% confidence interval [CI], 0.463-0.602), 0.808 (95% CI, 0.720-0.877), 0.588 (95% CI, 0.495-0.641), 0.875 (95% CI 0.828-0.941), and 0.903 (95% CI 0.858-0.951) respectively.

Conclusion
The GAPBM system, which includes paraspinal muscle and fat, showed improved predictability for predicting mechanical complications compared to the GAPB. Given these results, surgeons should keep in mind the importance of paraspinal muscle and fat as well as bone quality, BMI, and proportional alignment. Further research with larger sample sizes and additional biomechanical factors is warranted to better understand their clinical implications.

6. The Impact of Postoperative Gait Patterns on Patient-Reported Outcomes in Adult Spinal Deformity

Jung-Hee Lee, MD, PhD; Ki Young Lee, MD, PhD; *Woo-Jae Jang, MD*; Hong-Sik Park, MD

Hypothesis
The persistence of midfoot strike gait (MFS) in patients following deformity correction in adult spinal deformity (ASD) leads to suboptimal clinical outcomes, despite favorable radiographic outcomes.

Design
A retrospective study.

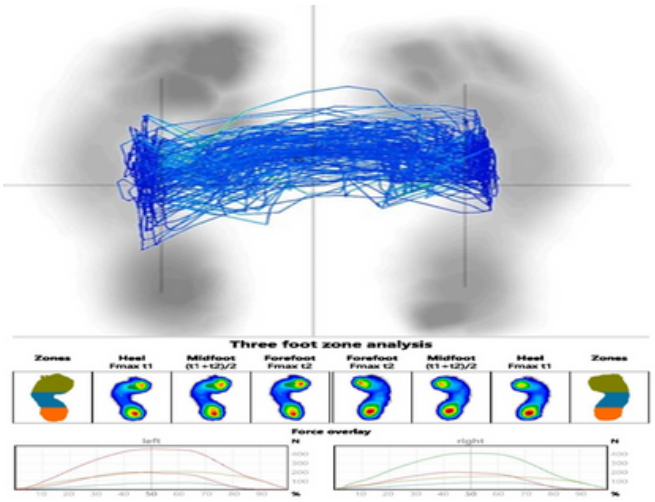
Introduction
MFS is a distinct preoperative gait pattern observed in ASD patients, wherein the process of load transfer from heel to the midfoot following heel strike is dramatically shortened. Despite ideal deformity correction, MFS appears to persist in certain patients. Accordingly, this study aimed to analyze the gait patterns of ASD patients and assess the clinical significance of persistent MFS after surgery.

Methods
176 patients (mean age 70.1 years) who achieved optimal sagittal balance following deformity correction were analyzed. Treadmill-based gait analyses, including center-of-pressure trajectory and three-foot-zone analysis, were conducted preoperatively and postoperatively. Based on postoperative gait pattern, patients were classified into MFS-negative (MN) (n=115) and MFS-positive (MP) groups (n=61), and comparative analyses were performed. Gait patterns of both groups were also compared to those of the normal control group (n=72).

Results
All gait parameters, excluding step time, stride time, and cadence, showed less difference between MN group and the control group, than between MP group and the control group ($p<0.05$). MN group showed a similar time change in heel-to-forefoot (%) to that of the control group after surgery ($p=0.013$), and the maximum pressure difference between heel and midfoot was significantly larger in the MN group than in the MP group ($p=0.001$). There was a significantly higher likelihood of patients with persistent MFS to direct their gaze at the floor while walking (odds ratio 10.95). At the last follow-up, MN group showed a significant improvement in clinical outcomes, including VAS score for back pain, ODI, and SF-36 scale ($p<0.05$).

Conclusion
Despite achieving optimal sagittal balance in ASD, persistent MFS may lead to suboptimal clinical outcomes, which could result in ongoing pain and restrictions in daily activities. In the setting of ASD surgery, when radiographic outcomes are favorable but clinical results are not, examinations of gait patterns – notably the persistent MFS – as well as investigations behind a tendency for the downward gaze while walking, are warranted.

PODIUM PRESENTATION ABSTRACTS



Gait analysis of a patient with persistent midfoot strike gait.

7. Association of Circulatory Proteins with Adult Spinal Deformity Risks: A Mendelian Randomization Study

Gabriel Chun Yin Sung, BASc(GHD); Kenny Y. Kwan, MD, FRCS(C)

Hypothesis

Circulatory proteins play an etiologic role in ASD risk.

Design

We conducted a two-sample, cis-MR study with the use of genome-wide association studies (GWAS) summary statistics of populations with European ancestry.

Introduction

Adult spinal deformity (ASD) affects around 32% of adult populations aged 65 and over. With global ageing population, rapid identification of putative targets for ASD from the human proteome is urgently needed.

Methods

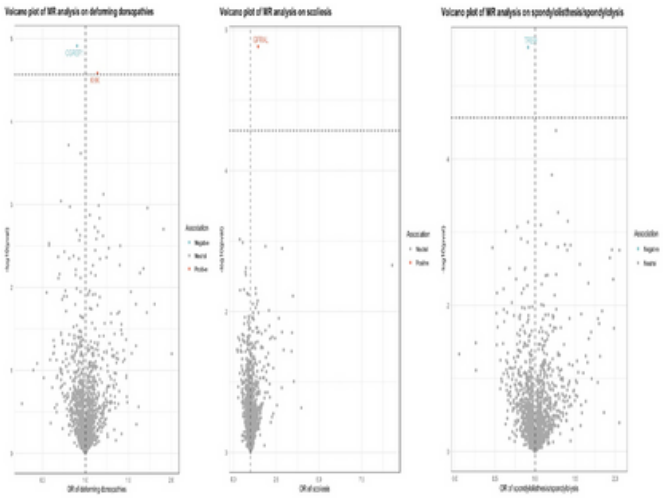
We examined the causal role of 1,632 circulating proteins, measured by antibody-based Olink platform from the UK Biobank Pharma Proteomics Project (N=54,219) with general ASD risk and 9 of its subtypes including scoliosis, kyphosis, lordosis, spinal osteochondrosis, spondylolisthesis, torticollis, atlantoaxial subluxation, other fusion of spine from the FinnGen study (max. N=366,756), using Wald ratio approach. Bonferroni correction was applied to correct for multiple testing ($p < 3.06 \times 10^{-5}$) for associations between genetically predicted proteins and ASD risks. Genetic colocalization was conducted to test for linkage disequilibrium by correlated variants.

Results

All instruments for 1,632 circulatory proteins had r2 > 0.001 and F statistics > 10, indicating low risks of linkage disequilibrium and weak instrument bias respectively. Four proteins were associated with three ASD phenotypes, with potential to strong evidence of colocalization. Genetically predicted trehalase (TREH) was associated with lower spondylolisthesis risk (OR = 0.91 per SD, 95% CI: 1.08–1.20), and GDNF family receptor alpha like (GFRAL) with higher scoliosis risk (OR = 1.14 per SD, 95% CI: 0.87–0.95) with strong evidence for genetic colocalization (PP.H4 = 0.88 to 0.98). Elevated levels of ketohexokinase (KHK) was associated with higher risk of ASD defined by deforming dorsopathies (OR = 1.14 per SD, 95% CI: 1.08–1.20), while lower levels of cell growth regulator with EF-hand domain 1 (CGREF1) was associated with protective effect on ASD (OR = 0.90 per SD, 95% CI: 0.86–0.95), with potential evidence for genetic colocalization (PP.H4 = 0.63 to 0.78).

Conclusion

Four novel genetic associations between circulatory proteins with risks of three ASD phenotypes were identified in our study. While these findings can aid drug target discovery and development, further investigations are needed to determine whether these proteins can be diagnostic or therapeutic targets of ASD.



Volcano plots from MR

Paper #8 has been WITHDRAWN

PODIUM PRESENTATION ABSTRACTS

9. Development and Internal Validation of the Avoid Surgery Predictive Score (ASPS) as a Predictive Tool to Assess Surgical Risk in Spinal Metastasis Patients Undergoing Surgery

Warunyu Limmaneevichitr, MD; Siravich Suvithayasiri, MD; Nath Adulkasem, MD; Sirichai Wilartratsami, MD; Borriwat Santipas, MD; Pinprapha Boonhyad, MD; *Panya Luksanapruksa, MD*

Hypothesis

A simple scoring system using routine clinical data can predict perioperative mortality and serious morbidity in spinal metastasis surgery, aiding decision-making.

Design

Retrospective cohort; predictive-tool development.

Introduction

Surgical treatment of spinal metastases carries substantial perioperative risks, particularly in patients with systemic disease and poor physiological reserves. Existing tools are often complex or lack validation. We aimed to derive and internally validate a simple, bedside risk score—the Avoid Surgery Predictive Score (ASPS)—to predict perioperative mortality and serious morbidity, thereby supporting treatment decisions in line with the NOMS framework.

Methods

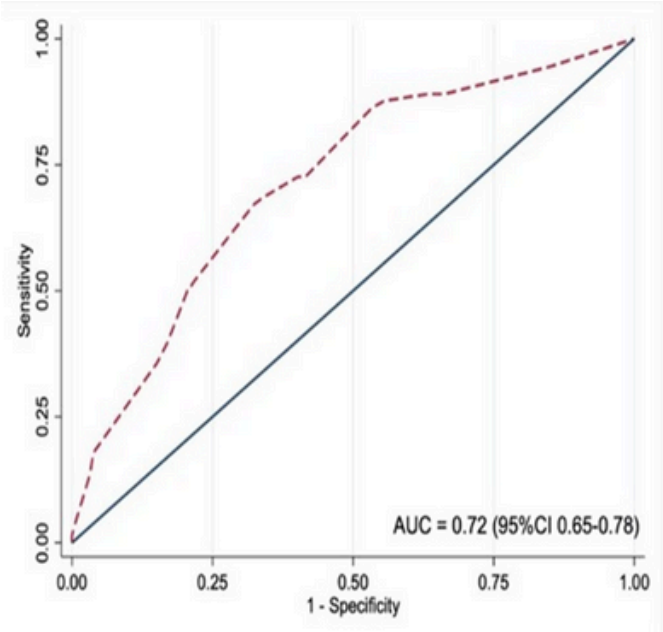
We retrospectively analyzed 467 consecutive adult patients who underwent surgery for spinal metastasis at a single tertiary center between 2008 and 2023 (mean age 58 ± 12 years, 52.7% male). Demographic, clinical, and laboratory variables were collected. Missing data were imputed using predictive mean matching. Dichotomized predictors were entered into a multivariable logistic regression model with backward elimination. Final regression coefficients were converted into integer weights to develop a predictive score. The model's performance was assessed using the area under the receiver operating characteristic curve (AuROC) with internal validation via bootstrapping.

Results

Five independent predictors—hypoalbuminemia (< 3.5 g/dL, +5), anemia (Hb < 12 g/dL men, < 13 g/dL women, +1), ASIA grade < C (+2), ASA class ≥ 3 (+2), and stage-5 ESRD (+7)—formed a scoring system. Risk strata were defined as safe (0–3), potential intolerance (4–7), and surgery not recommended (≥ 8); the high-risk threshold showed 83 % specificity. In-hospital mortality was 3.4 %, rising fivefold in the ≥ 8 group. The optimism-adjusted AuROC was 0.72 (95 % CI 0.65–0.78).

Conclusion

Considering five main independent variables, ASPS delivers accurate and well-calibrated forecasts of short-term mortality and major complications after spinal metastasis surgery. Its simplicity enables real-time calculation, supports the "systemic disease" arm of the NOMS framework, and guides multidisciplinary teams toward operative, minimally invasive, or nonoperative strategies. Prospective multi center validation is warranted before broad implementation.



The area under the receiver operating characteristic curve of the weighted predictive score demonstrated excellent predictive performance for Preoperative Predictor Unsafe surgery for Spinal metatasis Score (PPUSs)

10. Will Coronal Imbalance Impact Surgery Strategy in Lenke 5C AIS Patients with Poor Thoracic Compensatory Ability?

Zongshan Hu, PhD; Chunxiao Chen, MD

Hypothesis

Lenke 5C patients with preoperative coronal Type C and poor thoracic compensatory ability may benefit more from non-selective fusion compared with selective fusion.

Design

Retrospective study.

Introduction

To investigate the effect of preoperative coronal patterns on the clinical outcome of Lenke 5C patients with poor thoracic curve compensation ability following different fusion strategies.

PODIUM PRESENTATION ABSTRACTS

Methods
Poor thoracic curve compensation was defined as a thoracic cobb angle between 15° and 25° on supine bending films. Coronal patterns were classified as Type A (CBD<20mm), Type B (CBD>20 mm and C7PL shifted to concave side of main curve), and Type C (CBD>20 mm and C7PL shifted to convex side of main curve) based on coronal balance distance and C7 plumbline relative to main curve position. Patients were subgrouped into selective fusion (SF) and non-selective fusion (NSF) groups. The study aimed to compare the clinical efficacy of selective fusion surgery among different preoperative coronal patterns and different fusion surgeries in patients with preoperative coronal pattern Type C. Quality of life in preoperative Type C patients following different fusion strategies was assessed using the SRS-22 scale.

Results
Patients with preoperative Type C coronal pattern had a higher risk of thoracic curve progression post-selective fusion surgery compared to Type A patients (48.7% vs. 20.9%, P=.007). In the Type A group, 4.65% had thoracic curve progression exceeding 10°, while in the Type C group, it was 21.95%. At final follow-up, 93.1% of Type A patients maintained good coronal balance, while 17.1% of Type C patients had imbalance. Type C patients who had non-selective fusion showed improved thoracic curvature from 34.86±4.64° to 11.14±4.30°, maintained during follow-up. At final follow-up, only 5.7% of Type C patients retained the Type C coronal pattern. In Lenke 5C AIS patients with preoperative Type C, the NSF group had higher pain (4.33±.51 vs. 3.87±.55, P=.003) and self-image scores (4.88±.10 vs. 4.55±.50, P=.020) compared to the SF group according to the SRS-22 questionnaire.

Conclusion
Lenke 5C scoliosis patients with poor thoracic compensatory ability and preoperative Type C coronal imbalance showed higher risks of proximal thoracic curve progression and inferior coronal balance restoration with selective fusion. Caution is advised when considering selective fusion strategies in this subgroup.

11. Utility of Preoperative Fulcrum-Side Bending Assessment for Predicting Distal Adding-On in Adolescent Idiopathic Scoliosis Lenke Types 1 and 2

Masashi Miyazaki, MD, PhD; Noriaki Sako, MD

Hypothesis
Preoperative fulcrum-side bending (FSB) assessment can predict the risk of distal adding-on (DAO) following posterior corrective fixation in Lenke type 1 and 2 adolescent idiopathic scoliosis (AIS).

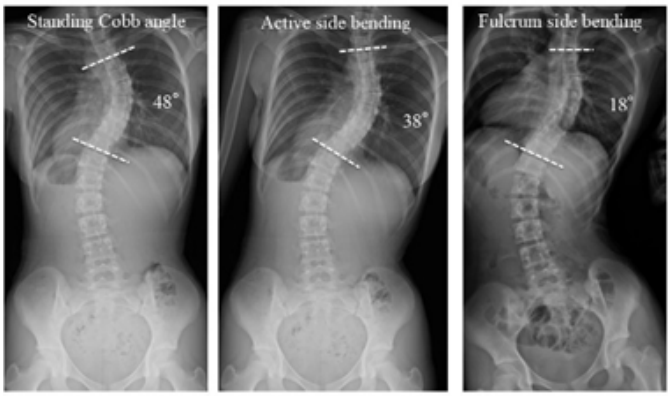
Design
Retrospective cohort study.

Introduction
DAO is a known complication following AIS surgery, associated with patient dissatisfaction and potential reoperation. Although factors like curve type and skeletal maturity have been linked to DAO, the prognostic value of preoperative curve flexibility remains underexplored.

Methods
Thirty-two AIS patients with Lenke type 1 or 2 curves undergoing posterior correction using an all-pedicle screw technique were evaluated. Preoperative curve flexibility was assessed using fulcrum-side bending (FSB) and active side bending (ASB) radiographs. Patients were grouped based on the presence or absence of DAO at two years postoperatively. Radiographic parameters including ΔFSB, ΔASB, and correction rates were compared. Logistic regression identified factors associated with DAO.

Results
DAO occurred in 12 of 32 patients (37.5%). The DAO group showed significantly greater ΔFSB of the main thoracic (MT) curve (43.9° vs. 35.8°, p = 0.03) and higher MT correction rates (81.2% vs. 73.6%, p = 0.01). ΔFSB (MT) and MT correction rate were identified as independent risk factors for DAO (odds ratio 1.23 and 1.17, respectively). ASB parameters were not significantly associated with DAO.

Conclusion
Greater preoperative flexibility of the MT curve, as assessed by FSB, is a significant risk factor for postoperative DAO. Surgeons should carefully evaluate FSB results when determining the lowest instrumented vertebra to mitigate the risk of DAO in highly flexible cases.



PODIUM PRESENTATION ABSTRACTS

12. Development and Validation of Transformer-Based Deep Learning Models to Predict Curve Progression in Idiopathic Scoliosis

Shinji Takahashi, MD, PhD; Kei Watanabe, MD, PhD; Haruki Ueda, MD, PhD; Hideyuki Arima, MD, PhD; Takumi Takeuchi, MD, PhD; Yu Yamato, MD, PhD; Naobumi Hosogane, MD; Hiroki Oba, MD, PhD; Shoji Seki, MD, PhD

Hypothesis
To develop and validate a deep learning–based AI system capable of predicting scoliosis curve progression from frontal radiographs using state-of-the-art convolutional and transformer architectures across a multicenter dataset.

Design
Multicenter, observational cohort study with retrospective and prospective enrollment.

Introduction
Curve progression in idiopathic scoliosis remains clinically unpredictable despite established risk factors such as Cobb angle and skeletal maturity. There is a growing need for reliable, interpretable tools to aid early identification of high-risk patients.

Methods
Baseline and 2-year follow-up frontal whole-spine radiographs were collected and processed using standardized image augmentation and contrast-limited adaptive histogram equalization. Six deep learning models were fine-tuned on the dataset using stratified 10-fold cross-validation. Grad-CAM was applied to visualize attention regions. Two regions of interest (ROI1: full radiograph; ROI2: C7 to iliac crest) were used to evaluate robustness.A total of 547 patients with idiopathic scoliosis were included from six academic institutions in Japan. Inclusion criteria were: (1) age ≥6 years, (2) confirmed diagnosis of idiopathic scoliosis based on clinical and radiographic assessment, (3) availability of standing frontal whole-spine radiographs at baseline and after two years. After excluding 52 borderline progression cases, 298 were categorized as progression (≥10° Cobb angle increase) and 197 as non-progression (≤5°).

Results
After excluding 52 borderline progression cases, 298 were categorized as progression and 197 as non-progression. ViT and ConvNeXtV2 models achieved the highest individual AUCs (0.755 and 0.751, respectively). Ensemble models outperformed individual ones, with average ensemble achieving an AUC of 0.769. Grad-CAM revealed that CNNs focused on local curve apex, while transformer models demonstrated global attention across spine, ribs, and pelvis. ROI2 performed comparably to ROI1, supporting image standardization without loss of accuracy.

Conclusion
Transformer-based AI models reliably predict scoliosis curve progression using frontal radiographs. Their ability to incorporate global anatomical features offers an advantage over CNNs in assessing complex spinal deformity. These findings support clinical implementation of AI tools for early risk stratification and treatment planning.

13. Classification of Adolescent Idiopathic Scoliosis Using Contrastive Clustering: An Unsupervised Machine Learning Approach

Sehan Park, MD; Dong-Ho Lee, MD, PhD; Chang Ju Hwang, MD, PhD; Jae Hwan Cho, MD, PhD

Hypothesis
We hypothesized that contrastive clustering, an unsupervised machine learning method, could classify AIS curves into distinct and clinically meaningful patterns beyond existing systems.

Design
Retrospective image analysis study.

Introduction
Conventional AIS classifications such as King and Lenke do not fully capture the diversity of curve morphology, particularly in C-shaped curves or thoracic curves extending into the lumbar spine. Unsupervised learning may provide new, data-driven classifications to inform surgical decisions.

Methods
We analyzed 1,156 AIS patients who underwent corrective surgery. Using standard standing posteroanterior radiographs, spinal columns were segmented with U-net and processed into sequential spinal centerlines. Contrastive clustering was applied to group curve morphologies. Cluster quality was assessed via silhouette scores and t-SNE visualization. Two deformity surgeons defined clusters based on shared morphological features. Interobserver reliability was assessed with kappa coefficients.

PODIUM PRESENTATION ABSTRACTS

Results

Six clusters were identified: lumbar single curves (cluster-1), lumbar-dominant double curves (cluster-2), long C-shaped thoracic curves extending to the lumbar spine (cluster-3), short C-shaped thoracic curves within the thoracic spine (cluster-4), and two types of thoracic-lumbar double curves differentiated by lumbar apex level and curve magnitude (cluster-5 and 6). The silhouette score was 0.308, and interobserver reliability was moderate (κ = 0.701–0.731). This classification identified curve subtypes not clearly defined in Lenke classification, such as thoracic curves with differing distal extents.

Conclusion

Contrastive clustering successfully identified six distinct AIS curve patterns, capturing clinically relevant morphological variations overlooked by traditional classification systems. This unsupervised learning-based approach may complement existing systems and guide future research on AIS surgical planning and outcome prediction.

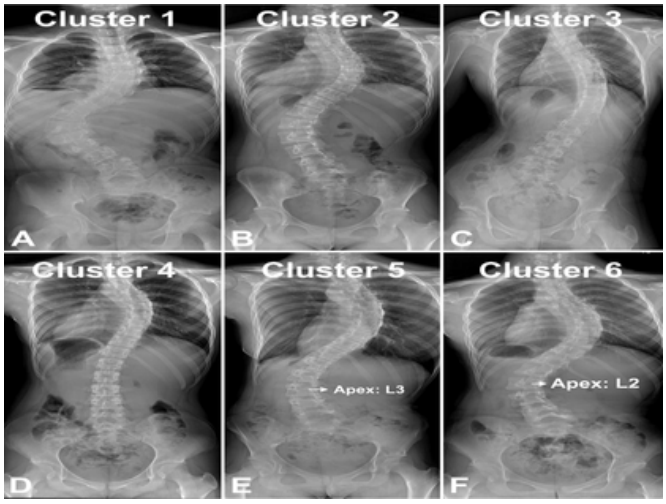


Figure. Cluster 1: single lumbar main curve. Cluster 2: lumbar-dominant double curve. Cluster 3: long thoracic single curve extending into lumbar spine. Cluster 4: short thoracic single curve confined to thoracic spine. Cluster 5: thoracic double curve with distal, smaller lumbar apex. Cluster 6: thoracic double curve with proximal, larger lumbar apex.

14. Exploring the psychosocial effects of Adolescent Idiopathic Scoliosis treatment in Hong Kong: A 24-month study

Anjaly Saseendran, MS, BS; Kenny Y. Kwan, MD, FRCS(C)

Hypothesis

Adolescent Idiopathic Scoliosis (AIS) and treatment groups significantly influence the psychosocial well-being of affected children over a 24-month period.

Design

A prospective longitudinal cohort study was conducted.

Introduction

This prospective longitudinal study investigated the psychosocial outcomes of Adolescent Idiopathic Scoliosis (AIS) in Hong Kong over 24 months, examining how treatment methods like conservative management, bracing, or surgical intervention influence patient-reported outcomes, including health-related quality of life (HrQoL), self-esteem, depression, anxiety, body image, and disease knowledge.

Methods

A cohort of 130 AIS patients (32 males, 98 females, age 11-18) was enrolled, and patient-reported outcome measures (PROMs) were administered at the initial clinical visit and after 24 months. PROMs included validated tools like the Scoliosis Research Society-22r (SRS-22r), Short Form-12 (SF-12), and EQ-5D-5L, alongside assessments of self-esteem, depression, anxiety, body image, and scoliosis misconceptions. PROMs data were assessed for normality using the Shapiro-Wilk test, compared between baseline and 24 months with the Wilcoxon signed-rank test, and analyzed for treatment group influence using the Kolmogorov-Smirnov test.

Results

Most patients underwent bracing treatment (16.1%). Subjects also reported a significant decline in HrQoL (SRS-22r: $Z=-4.414$, $p<0.001$) and increased pain (SRS-22r pain: $Z=-5.606$, $p<0.001$) over 2 years. However, significant improvements were observed in mental health, physical functioning, self-image, general physical health (SF-12), and disease understanding. Analysis showed no significant differences in psychosocial outcomes across treatment types.

Conclusion

This study indicates that AIS does not broadly impair physical or mental health over 24 months, with patients showing resilience in several psychosocial areas despite increased pain and reduced HrQoL. Treatment type had no significant impact on patients' wellbeing, suggesting comparable effects across management strategies. Further research is needed to enhance treatment compliance and address pain and HrQoL to improve long-term outcomes for AIS patients.

PODIUM PRESENTATION ABSTRACTS

15. Utilizing Stable Vertebra on Push-Prone Traction Radiographs for the Determination of the Lowest Instrumented Vertebra: A Novel Approach for AIS Patients with Lenke Type 3C and 6C

Tinnakorn Pluemvitayaporn, MD

Hypothesis
Using stable vertebra in push-prone traction radiographs as the LIV for Lenke type 3C and 6C could preserve more lumbar motion segments while achieving satisfactory postoperative outcomes

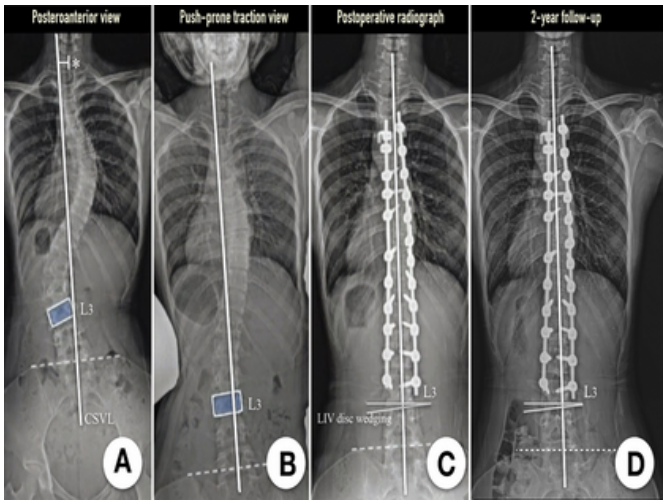
Design
Retrospective cohort study.

Introduction
The determination of the lowest instrumented vertebra (LIV) in AIS surgery is a contentious issue, particularly concerning Lenke classifications types 3C and 6C. This debate largely stems from concerns about the risks of distal adding-on and spinal imbalance. Several studies suggest that extending fusion levels and positioning the LIV below L3 may lead to greater functional impairment after surgery. Recent studies indicated that push-prone traction radiographs are a reliable method for predicting postoperative correction outcomes.

Methods
A study was conducted on AIS patients with Lenke type 3C and 6C curves who underwent posterior spinal surgery at a single institution from 2021 to 2024. The research included a thorough preoperative evaluation that featured advanced radiographic assessments, notably push-prone traction radiographs, to determine the location of the LIV by identifying the stable vertebra (SV). Comprehensive demographic data, radiographic metrics, surgical details, and postoperative outcomes were meticulously collected and analyzed.

Results
Thirty-six AIS patients (33 female and 3 male) with a mean age of 13.9 ± 2.2 years were included in this study, with a mean follow-up period of 28.4 months. Preoperatively, the cohort presented with Lenke type 3C (24 out of 36) and Lenke type 6C (12 out of 36). The preoperative thoracic curve was corrected to an average of 5.7°, demonstrating an average correction rate of 89%. Similarly, the preoperative lumbar curve was corrected to an average of 5° with a correction rate of 90%.

Conclusion
Using the stable vertebra in push-prone traction radiographs may offer an alternative method for determining the optimal LIV for Lenke types 3C and 6C. This approach could preserve more lumbar motion segments and improve surgical outcomes.



The full-length 36-inch standing whole spine plain radiographs show differences in the stable vertebra (SV) levels. The SV is at the L4 level in the PA view (A), at the L3 level in PPT view (B), and the immediate postoperative plain radiograph (C). No significant change in curve correction at the final follow-up (D).

16. Dynamic Bone Metabolism Evaluated by Bone Histomorphometry in Patients with Primary Thoracic Adolescent Idiopathic Scoliosis

Masayuki Sato, MD; Masayuki Ohashi, MD, PhD; Yohei Shibuya, MD; Hideki Tashi, MD; Toru Hirano, MD, PhD; Kei Watanabe, MD, PhD

Hypothesis
High bone turnover may contribute to vertebral wedging and curve progression.

Design
Retrospective study

Introduction
Adolescent idiopathic scoliosis (AIS) is a three-dimensional deformity involving both the spine and vertebral bodies. Although its etiology remains unclear, several studies have reported that systemic high bone turnover and osteopenia are associated with AIS progression. However, few studies have directly and dynamically assessed the spinal bone microarchitecture. This study aimed to characterize spinal bone microarchitecture and metabolism using bone histomorphometry in patients with primary thoracic AIS who underwent posterior spinal fusion. It also sought to analyze the associations among histomorphometric parameters, curve severity, and vertebral deformity.

Methods
We included female patients with primary thoracic AIS (Lenke types 1–4) who were skeletally mature (Risser grade 4 or 5) and underwent posterior spinal fusion at age 20 or younger between 2016 and 2020. All patients received double tetracycline labeling preoperatively, and a biopsy of the vertebral spinous process was performed during surgery. Histomorphometric analyses were conducted on undecalcified, thin-sectioned specimens. Correlations among parameters were assessed using Spearman's rank correlation coefficient (rs).

Results
A total of 51 patients were included, with a mean age at surgery of 16.1 years (range: 13–24 years). According to the Lenke classification, 38 patients were type 1, 12 were type 2, and 1 was type 3. The mean Cobb angle of the main thoracic (MT) curve was 53° (range: 39°–92°). The MT Cobb angle showed significant positive correlations with mineralizing surface (MS) (rs=0.298), bone formation rate (BFR) (rs=0.309), and activation frequency (Ac.f) (rs=0.310) ($p<0.05$).MS and BFR were positively correlated with serum total P1NP (MS/BFR, rs=0.343/0.436) and TRACP-5b (rs=0.423/0.470) ($p<0.05$). The coronal wedging angle of the apical vertebra was significantly correlated with the MT Cobb angle (rs=0.379, $p<0.05$), but not with histomorphometric parameters or serum bone metabolic markers.

Conclusion
Higher spinal bone turnover was associated with increased MT curve magnitude, and greater apical vertebral wedging was also linked to greater curve severity. These findings suggest that elevated bone turnover in the scoliotic spine may contribute to curve progression.

17. The Risk of Coronal Imbalance at 2 Years Follow-up in Lenke 6C Idiopathic Scoliosis with Distal Fusion to L3： Does Preop Coronal Pattern Matter?

Abdukahar Y. Kiram, PhD; Yinyu Fang, MS; Jie Li, MD, PhD; Zhen Liu, MD, PhD; *Zezhang Zhu, PhD*; Yong Qiu, MD

Hypothesis
The changes of coronal imbalance in Lenke 6C primarily depends on the compensation by distal disc wedging of the lowest instrumented vertebrae (LIVs) and residual distal lumbar segment, which remains unclear at the LIV of L3 at present. Therefore, our study aims to explore the prognosis of different pre-operative coronal pattern in Lenke 6 curve and whether the pre-operative coronal pattern can affect the distal fusion to L3.

Design
To explore the prognosis of different pre-operative coronal pattern in Lenke 6C curve at 2 years follow-up and whether the pre-operative coronal pattern can affect the distal fusion to L3.

Introduction
Non-selective fusion strategy is usually adopted to maintain coronal balance while correcting the double structural curves, among which whether to stop distal fusion to L3 has always been an issue for its benefits of preserving mobile segments.

Methods
Forty nine patients were categorized according to the pre-operative coronal pattern (type A, coronal balance distance (CBD) < 20 mm; type C, CBD ≥ 20 mm and C7PL shifted to the convex side of the curve). FU-coronal imbalance group (CIB+) was defined as having a CBD≥20mm at the 2-year follow-up.

Results
Of the 49 patients, type C was observed preoperatively in 30 patients (61%), immediately after surgery in 18 patients (37%) and 2 years after surgery in 14 patients (29%). Among the 30 patients with preoperative type C, 14 (47%) had immediate postoperative coronal imbalance, whereas among the 19 patients with preoperative type A, 4 (21%) had immediate postoperative coronal imbalance. Among the 18 patients with immediate postoperative coronal imbalance, 10 showed spontaneous correction and the remaining 8 showed coronal imbalance 2 years after surgery. 6 of the 31 patients who did not have immediate postoperative coronal imbalance developed imbalance at the 2-year follow-up. Multivariate logistic regression analysis revealed that type C was an independent risk factor for CIB at the 2-year follow-up (OR 9.581, 95% CI 1.055-85.851, $p = 0.045$).

Conclusion
Patients with type C CIB in Lenke 6C AIS may be at the greatest risk of developing CIB following PSF with 43% of them exhibiting CIB at the final follow-up. The incidence of postoperative CIB may not vary with the preoperative CBD becoming large. When preoperative pattern is type C, the selection of LIV at L3 should be reconsidered cautiously.

18. Posterior Spinal Corrective Surgery for Lenke 1 AIS with Anatomically Designed Pre-Bent Rods: A Comparative Study with the Conventional Simultaneous Double-Rod Rotation Technique

Katsuhisa Yamada, MD, PhD; Akira Fukushima, MD; Hiroyuki Tachi, MD; Terufumi Kokabu, MD; Manabu Ito, MD, PhD; Kuniyoshi Abumi, MD, PhD; Hideki Sudo, MD, PhD

PODIUM PRESENTATION ABSTRACTS

Hypothesis
Patients with Lenke1 adolescent idiopathic scoliosis (AIS) who underwent correction surgery using anatomically designed pre-bent rods would have a higher thoracic kyphosis (TK) and more anatomical correction than with simultaneous double-rod rotation technique (SDRRT) which provides a sagittal correction of the main thoracic (MT) spine curve.

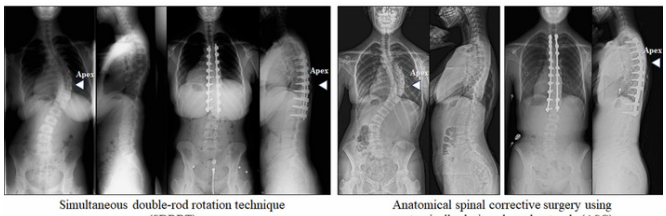
Design
Retrospective analysis of a prospectively collected, consecutive, nonrandomized series of patients.

Introduction
The goal of MT AIS surgery is to correct the spinal deformity in 3D, including correction of TK as well as scoliosis. Although SDRRT for Lenke1 AIS was reported to provide sagittal correction of the MT curve (Sudo et al. Spine2014), this technique had the limitations of insufficient and non-anatomical TK formation. Rod curvature and multilevel facetectomy have been reported to greatly influence sagittal curve correction, and we reported that anatomical spinal corrective surgery using anatomical pre-bent rods (ASC) could provide anatomical sagittal correction with the formation of a favorable TK (Sudo et al. Sci Rep2021). This study aimed to compare the surgical outcomes with conventional SDRRT and ASC.

Methods
Data from two consecutive series of patients who underwent posterior correction surgery for Lenke1 AIS were evaluated. 32 cases (mean age 15.0y) performed SDRRT from 2008 to 2011 and 37 cases (mean age 14.8y) performed ASC from 2015 to 2021 were included. All patients were followed up (f/u) for a minimum of 2 years (mean 3.6y/2.3y). Outcome measures included patient demographics and radiographic measurements.

Results
The mean preoperative (pre-op) MT Cobb angle was 55.6° in ACS group and 63.4° in SDRRT group (P<0.01). The average MT Cobb angle correction rate at the final f/u was 78.7 ° in ACS and 67.8% in SDRRT (P<0.01). Although the pre-op TK (T5-T12) was equivalent in two groups (12.8°, 11.9°), ACS had significantly higher TK than SDRRT at the final f/u (28.5°, 20.5°, P<0.01). The rates of patients with T6-T8 TK apex at the final f/u was 94.6% in ACS and 72.7% in SDRRT.

Conclusion
Patients who underwent corrective surgery using anatomically designed, pre-bent rods had a significantly higher TK than patients who underwent conventional SDRRT, suggesting the potential benefits of SDRRT with multilevel facetectomy using anatomical rods.



Simultaneous double-rod rotation technique (SDRRT)

Anatomical spinal corrective surgery using anatomically designed pre-bent rods (ASC)

Pre-op and final f/u radiographs

19. Best Paper - Australian Spine Society: Ultrasound as a Tool to Objectively Assess the Injured Spinal Cord in a Porcine Model of Thoracic Contusion Spinal Cord Injury

Madeleine Bessen, PhD; Oana Marian, MD; Ryan O'Hare Doig, PhD, BSc (Hons); Annabel Sorby-Adams, PhD; Christine Gayen; Lola Kaukas, BHlthSci (Hons), GradCert; Anna Leonard, PhD, BHlthSci (Hons); Claire Jones, PhD

Hypothesis
Quantitative ultrasound (US) measures can detect and track changes to the spinal cord over time following traumatic spinal cord injury (SCI).

Design
Experimental large animal study.

Introduction
Tools for monitoring traumatic spinal cord injury (SCI) severity and progression are limited. Ultrasound (US) imaging may be suitable but requires improved understanding of tissue changes observed with the modality post-injury. Using serial US images, this study: (1) determined temporal changes to the spinal cord and subarachnoid space over 24-hours post-SCI; and, (2) quantitatively compared US to magnetic resonance imaging (MRI) and histology at 24-hours post-SCI, in a porcine model.

Methods
Thoracic contusion SCI was induced in anaesthetised female pigs (N=10 across three injury groups). Midsagittal B-mode US images were obtained hourly from baseline to 24-hours post-SCI. At 24-hours, T2-weighted MRI and histology specimens were obtained. Injury-site spinal cord and dura sagittal diameters were measured on US images. Greyscale distribution measures (median, interquartile range [IQR]) of parenchymal signal were assessed on US and MRI. Tissue loss and intraparenchymal haemorrhage (IPH) were quantified on histological sections. Association of US parenchymal changes with MRI and histology outcomes were assessed by Pearson's correlation.

Results
Spinal cord swelling caused apparent subarachnoid occlusion by 13-hours; maximum spinal cord diameter occurred at 20-hours, accompanied by dura distension ≤10%. US parenchymal greyscale median and IQR increased rapidly from baseline to 2-hours (median: 37.4–197.4%; IQR: 37.5–132.9%) and slowly and/or inconsistently from 2- to 24-hours (median: -37.9–80.04%; IQR: -46.3–32.33%) post-SCI. At 24-hours, increased US median greyscale was moderately-to-strongly associated with IPH (r=0.69; p=0.035) and tissue loss (r=0.74; p=0.015), and increased IQR was strongly associated with tissue loss (r=0.70; p=0.024); but greyscale median and IQR from US and MRI were not associated.

Conclusion
US can objectively assess spinal cord swelling and dura distension, and parenchymal echogenicity appears related to IPH and tissue loss, in a porcine SCI model. This study supports continued investigation of US as a tool to assess injury progression and therapeutic outcomes.

21. Best Paper - Asia Pacific Spine Society: Unlocking the IVD: Unveiling Its Microbial Landscape with Shotgun Metagenomics

Ajoy Prasad Shetty Tonse, MS Orth; Karthik Ramachandran, MBBS, MS, DNB(Orth); Shanmuganathan Rajasekaran, MBBS, PhD, FRCSA, MCh; Sharon M. Nayagam, MSc; Chitra Thangavel, BSc

Hypothesis
The main objective of the study is to explore the bacterial diversity in patients with IVDD using shotgun metagenome sequencing.

Design
Prospective Cohort Study.

Introduction
The intervertebral disc disease (IVDD) leading to degeneration is multifactorial, and one such factor is subclinical infection. As evidenced earlier, the disc harbours a unique microbiome, and this study proposes to explore the abundance of the entire microbial community using shotgun metagenomics.

Methods
Shotgun metagenomics was used to identify the diverse microbial species in IVD. The IVD control tissue samples were collected from brain-dead organ donors (n=20), while diseased tissue from patients undergoing microdiscectomy with both modic changes (MC) (n=18) and non-modic (NMC) (n=22). DNA was extracted, and shotgun sequencing was performed using the Illumina Novaseq platform. Alpha and beta diversity analyses were conducted with statistical tests, including the Mann-Whitney U test and PERMANOVA (permutational multivariate analysis of variance).

Results
With a median relative abundance of over 1%, a total of 202 species was identified in the control IVD tissue, whereas 116 and 146 species were found in the diseased MC and NMC tissue samples, respectively. The alpha diversity revealed a rich species diversity, with a significant difference between the control and NMC samples (p=0.03). The beta diversity analysis using PCoA showed a significant difference (p=0.002) between the control and diseased (MC & NMC) populations. Across all samples (Control, MC & NMC), the most abundant bacterial species were Klebsiella pneumoniae, Pseudomonas aeruginosa, Corynebacterium amycolatum, and Acidovorax sp. BLS4. The bacterial diversity in diseased samples (MC & NMC) was lower. The presence of Pseudomonas aeruginosa phages supports P. aeruginosa as a natural inhabitant of IVD.

Conclusion
The study strengthened our hypothesis that IVDD is caused by infection, as evidenced by the abundance of P. aeruginosa. As it facilitates co-bacterial species to polymicrobial infection, which may influence the disease progression by modulating the host immunity and the IVD microbiome. Further richness of Pseudomonas phages in the disease group strongly supports the presence of P. aeruginosa in IVD and its possible role in IVDD.

22. Best Paper - Association of Spine Surgeons of India: Non Fusion Anterior Scoliosis Correction in Lenke 5 AIS patients-surgical outcomes, AVR, AVT & coronal balance correction- a single centre, single surgeon experience

Sajan K. Hegde, MBBS, MS; Dr K Appaji Krishnan, DO, DNB; Dr Vigneshwara Badikkillaya, MBBS, MS, Ortho,FASSI; *Sharan T. Achar, MS*; Harith B. Reddy, MS; A Akshyaraj, MD

Hypothesis
To analyse the efficacy of NFASC for Lenke 5 AIS patients in terms of cobbs, rotation & translation correction with a look into complications at 2year follow up (FU).

Design
Prospective Cohort Study.

Introduction
Non Fusion Anterior Scoliosis Correction (NFASC) as Vertebral Body Tethering (VBT) was introduced as a growth modulating scoliosis surgery. With advancing recent innovations, it has now been used as a motion preserving corrective procedure in Adolescent Idiopathic Scoliosis (AIS). But there has been varied results and complications among the centres world-wide especially in the lumbar Lenke 5 curves, which account for 12-20% of AIS.

PODIUM PRESENTATION ABSTRACTS

Methods

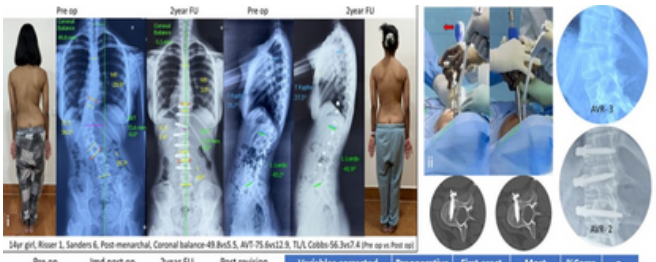
42 patients of Lenke 5 curve with coronal cobbs angle of 40-80o showing >50% flexibility on awake traction radiographs who underwent NFASC between 2019-2023 were included. 36 girls & 6 boys were assessed clinically & radiologically with skeletal-maturity parameters, curve type, Cobb angle, Apical vertebral rotation (AVR), Apical vertebral translation (AVT), Coronal balance (C7P-CSVL), intra-operative details and Scoliosis Research Society-22 revised (SRS-22r) questionnaire.

Results

The mean FU was 28.1months (24-60months) with mean age 14+3.43yrs, risser stage of 4.12+0.56 and sanders stage of 6.91+0.54.The instrumented levels were from T10-L4 (T9-9.7%, T10- 41.9%, T11- 32.3%, T12- 12.9%, L3- 54.8%, L4- 45.1%). 72.6% curve correction post-surgery was maintained at 66.13% correction at 2year FU (loss of correction of 6.35+4.05o in 60% of patients) (p=0.001). The coronal balance improved significantly (C7P-CSVL from pre op 34.9+12.4 to 6.8+2.1mm at 2yr FU- 80% correction) (P=0.001) along with maintenance of the sagittal profile. The AVR improved by grade 1.2+0.43 and AVT by 36.4+15.5mm (p<0.01). The median SRS 22r sub-score was 4.3 (3.5-4.8). Tether breakage was encountered in 8 patients (19.04%) but with no significant clinical (minor increase in flank crease) and radiological (loss of correction was 12.87+5.8o) decompensation except in 1 where revision was mandated. No other approach related/ post-operative complications were noted unlike those reported in literature.

Conclusion

NFASC achieves and maintains successful good cobbs correction (66% at 2yr FU) with significant AVT, coronal balance correction, though there was 19% tether breaks without significant decompensation.



Variables corrected iv	Preoperative (°)	First erect (°)	Most recent (°)	%Correction	p-value
Mean TL/L cobbs	58.41±13.05	16.01±5.11	20.25±8.1	66.13	<0.01*
Mean thoracic kyphosis	22°± 10°	23°± 9°	25°± 9°	14	>0.05
Lumbar lordosis	45°± 8°	43°± 10°	48°± 10°	5	>0.05
Apical Vertebral Rotation (AVR)	3.27 ± 1.09	1.54 ± 0.76	2.1 ± 0.35	Grade 1	0.05
Apical Vertebral Translation (AVT)	56.7 ± 26.3	16.5 ± 8.7	20.3 ±10.8	64.2	<0.01*
Coronal balance (C7P-CSVL)	34.9 ± 12.4	10.5 ± 5.3	6.8 ± 2.1	80.5	<0.01*

23. Best Paper - Chinese Association of Spine CAS: Etiological classification of major cervicothoracic/upper thoracic scoliosis

Saihu Mao, PhD; Shuqi Sun; Kai Sun, No; Song Li, MD, PhD; Zezhang Zhu, MD, PhD; Zhren Lui, PhD; Yong Qiu, MD

Hypothesis

A clinical etiological classification system for cervicothoracic scoliosis, established based on retrospective summary of clinical data, can effectively distinguish different etiological subtypes of cervicothoracic scoliosis, and is expected to guide individualized clinical management and prognosis evaluation.

Design

Retrospective Cohort Study.

Introduction

At present, the clinical etiology of cervicothoracic scoliosis remains unclear, and the disease characteristics and therapeutic challenges associated with different etiologies require further investigation. This study aims to analyze, categorize, and summarize the clinical etiologies of cervicothoracic scoliosis.

Methods

We retrospectively reviewed patients with cervicothoracic scoliosis treated surgically or with bracing at our institution from January 2017 to September 2025. Inclusion criteria were a primary curve in the C6–T4 region with a Cobb angle >10°. Patient demographics, clinical etiology, and curve direction were recorded, and disease characteristics were compared among etiological subtypes.

Results

A total of 184 patients (79 males, 105 females) with a mean age of 12.3 ± 5.1 years (range, 3–34) were included. Congenital scoliosis was most common (52.1%), comprising failures of formation (14.7%), failures of segmentation (6.0%), and mixed-type (31.5%). Other etiologies included idiopathic (26.6%), neurofibromatosis-associated (17.4%), Chiari malformation-related (2.2%), myogenic (1.1%), and tumor-related (0.5%). Among patients younger than 12 years, congenital scoliosis accounted for 71.4%. In idiopathic cases, 63.2% were female and all primary curves were left-sided, whereas no clear sex or curve-direction pattern was observed in other etiological subtypes.

Conclusion

Among patients with cervicothoracic scoliosis and a Cobb angle >10°, congenital scoliosis was the most common etiology, particularly in younger children, followed by idiopathic, neurofibromatosis-associated, and other neuromuscular causes. The findings of this study provide reference data to aid in the clinical diagnosis and differential assessment of cervicothoracic scoliosis.

PODIUM PRESENTATION ABSTRACTS

24. Best Paper - Indonesian Orthopaedic Spine Surgeon Association (IOSSA): A Cost-Effective Approach to Severe Rigid Scoliosis Correction using Low-Density Pedicle Screw Constructs based on Radiographic Parameters

Greesea Dinamaria, MD; *Abdul Kadir Hadar, MD*

Hypothesis
What is the efficacy of low density pedicle screw constructs in the surgical correction of severe rigid scoliosis by radiographic parameters?

Design
Retrospective Study.

Introduction
Severe rigid scoliosis presents significant surgical challenges due to its marked curvature and limited flexibility. Traditional high-density pedicle screw constructs provide strong biomechanical stability but are associated with increased operative time, blood loss, cost and risk of screw related complication. Low-density pedicle screw constructs, employing selective screw placement as critical vertebrae levels have emerged as a promising alternative. This approach aims to maintain adequate correction and stability while reducing surgical morbidity and resource utilization.

Methods
A prospective cohort of patient diagnosed with severe rigid scoliosis underwent posterior spinal fusion utilizing a low-density pedicle screw technique. Surgery performed by single orthopaedic surgeon involved selective screw placement at key vertebral levels to optimize correction forces while minimizing hardware density. Data collected included preoperative and post operative radiographic parameters (Cobb angle, sagittal and coronal balance), operative time, intraoperative blood loss and perioperative complications.

Results
Low-density pedicle screw constructs achieved significant correction of coronal and sagittal deformities, with postoperative Cobb angle reductions. Operative time and intraoperative blood loss were significantly reduced, contributing to decreased surgical morbidity. The incidence of screw malposition and neurovascular complications was minimized, reflecting the benefits of fewer fixation points.

Conclusion
Low-density pedicle screws provide efficient, safe scoliosis correction with fewer implants— success hinges on meticulous planning, appropriate patient selection, and continual clinical validation.

25. Best Paper - Japanese Scoliosis Society: Early Brace-Related Stress, Not Wear Time, Correlates with One-Year QOL Change in AIS: A Retrospective Cohort Study

Kotaro Sakashita, MD; Tomoyuki Asada, MD, PhD; Tsuyoshi Sakuma, MD, PhD; Yasushi Iijima, MD, PhD; Shohei Minami, PhD; Tsutomu Akazawa, MD, PhD; Seiji Ohtori, MD; Toshiaki Kotani, MD, PhD

Hypothesis
Early brace-related stress at 1 month, assessed by the JBSSQ-brace, is independently associated with 1-year change in SRS-22r health-related quality of life, whereas objectively measured brace wear time is not.

Design
Retrospective Cohort Study.

Introduction
Brace treatment for adolescent idiopathic scoliosis (AIS) can prevent curve progression, but may adversely affect quality of life (QOL). Few studies have evaluated QOL using objectively measured brace wear time, and it remains unclear whether brace-related stress or prolonged wear time has the greater impact on QOL. We evaluated factors related to 1-year change in QOL during brace treatment.

Methods
In this retrospective cohort, 133 AIS patients treated with Boston braces (7 males; mean age 12.4 years) were analyzed. The primary outcome was change in SRS-22r total score from baseline to 1 year. Braces were prescribed for ≥20 h/day. Independent variables included the major Cobb angle, Risser sign, baseline SRS-22r, JBSSQ-brace at 1 month (evaluating brace-related stress; lower scores indicated higher stress), and objectively measured wear time (using a temperature logger). Missing data were handled using multiple imputation. Multiple linear regression was used to identify associated factors.

Results
Model fit was acceptable (adjusted $R^2 = 0.38$; all VIF < 2). Higher JBSSQ-brace scores (i.e., lower stress) were independently associated with greater improvement in SRS-22r total score ($\beta = 0.014$; 95% CI, 0.002 to 0.026; $p = 0.027$). Baseline SRS-22r was inversely associated with improvement ($\beta = -0.632$; 95% CI, −0.812 to −0.452; $p < 0.01$). Objectively measured wear time was not associated with QOL change ($\beta = -0.003$; 95% CI, −0.013 to 0.008; $p = 0.63$), nor was major Cobb angle ($\beta = 0.009$; 95% CI, −0.004 to 0.022; $p = 0.18$).

Conclusion

Brace-related stress at 1 month, captured by JBSSQ-brace, was a key correlate of 1-year QOL change, whereas objective wear time and curve magnitude were not. Because lower JBSSQ-brace scores indicate higher stress, greater early stress was associated with worse QOL trajectories. Stratifying patients by 1-month JBSSQ-brace and introducing early psychological support may be a pragmatic strategy to mitigate QOL decline during brace treatment.

26. Best Paper - Korean Society of Spine Surgery: Pelvic Inclination Angle as a Novel Sagittal Parameter: Clinical Applications in Adult Spinal Deformity Surgery

Se-Jun Park, MD, PhD; Jin-Sung Park, MD, PhD; Dong-Ho Kang, MD; Chong-Suh Lee, MD, PhD; Yunjin Nam, MD

Hypothesis

We hypothesized that pelvic inclination angle (PIA) would better correlate with clinical outcomes than pelvic tilt (PT) in patients undergoing adult spinal deformity (ASD) surgery.

Design

Retrospective Study.

Introduction

Restoring PT to "normal range" is an essential goal in ASD surgery; however, normal PT values vary among individuals due to differences in pelvic incidence (PI). Recently, PIA was introduced as a novel sagittal parameter to evaluate pelvic compensation. This study aim to evaluate the clinical utility of PIA in assessing postsurgical outcomes after ASD surgery.

Methods

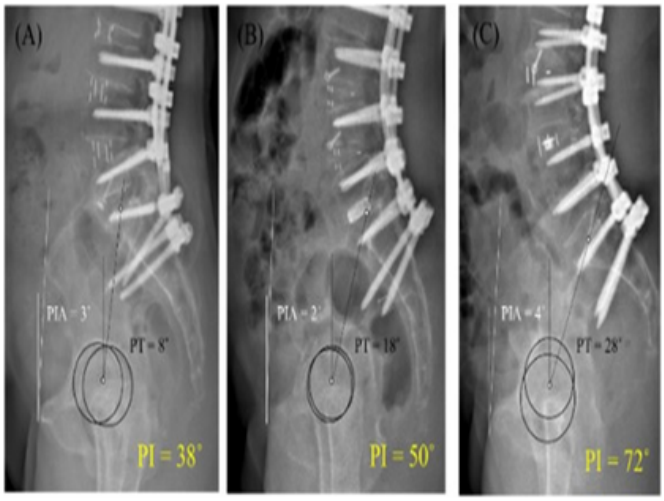
We retrospectively analyzed consecutive patients who underwent ≥ 6-level fusion, including the sacrum/pelvic for ASD. Sagittal parameters—including PIA, PI−lumbar lordosis (LL), PT, T1 pelvic angle (T1PA), and sagittal vertical axis (SVA)—and clinical outcomes [Oswestry disability index (ODI) and Scoliosis Research Society-22r (SRS-22r) scores], were evaluated preoperatively and at 2 years postoperatively. Pearson's correlation analysis was performed to examine the relationship among sagittal parameters and between sagittal parameters and ODI. Linear regression analysis was used to define the relationship between postoperative ODI and PIA.

Results

A total of 211 patients were included in the study (mean age, 69.6 years; female, 88.2%; and mean fusion length, 8.0 levels). PIA showed moderate-to-strong correlations with PI−LL, PT, and T1PA, both pre- and postoperatively, indicating that PIA well reflects sagittal deformity severity. Postoperative ODI correlated most strongly with PIA (r = 0.427), significantly higher than correlations with PI−LL (r = 0.218, P < 0.001) and PT (r = 0.233, P < 0.001). Additionally, ΔODI was also most strongly correlated with ΔPIA (r = 0.242) compared with ΔPI−LL (r = 0.055, P = 0.014), ΔPT (r = 0.117, P = 0.048), ΔT1PA (r = 0.075, P = 0.021), and ΔSVA (r = 0.020, P = 0.017). Linear regression analysis demonstrated the equation: PIA (°) = 4.0° + 0.2 × ODI (%). The postoperative PIA thresholds corresponding to mild (ODI = 20) and severe (ODI = 40) disability were 8.0° and 12.0°, respectively. Postoperative PIA was significantly influenced by the postoperative LL and PT, but not by PI.

Conclusion

PIA is a reliable parameter that reflects sagittal deformity severity and demonstrates stronger correlations with clinical outcomes than conventional sagittal measures. It may serve as a practical reference for evaluating pelvic compensation and guiding surgical alignment targets in ASD correction.



27. Best Paper - Korean Spinal Neurosurgery Society: Revision Surgery Following Primary Adult Spine Deformity Surgery

Dae Jean Jo, MD, PhD; Yong Ahn, MD, PhD; Sungsoo Bae, MD

Hypothesis

We hypothesized on various techniques to suggest another treatment option for deformity revisions based on experience of a single-institution, high-volume center.

Design

Retrospective Cohort Study, and Case Series Using Data from a Single Institution.

Introduction
Adult deformity surgery is technically demanding, due to patient and implant-related factors. Clinical data supports the effectiveness of surgery in huge deformities with clear sagittal malalignment, but conversely face the increasing problem of surgical revisions. Frequently reported failures are: proximal or distal failure, junctional disease, non-union with rod breakage and clinically relevant loss of correction. Posterior osteotomies, combined anterior and posterior approaches, single-level lordotic cages or multi-level interbody cages and multi-rod complexes are some of the rescue techniques that surgeons can apply to effectively perform revisions. There is a lack of consensus on which technique should be adopted in revision surgery and it still remains a case-by-case decision.

Methods
Revision surgeries via a modified extratransforaminal lumbar interbody fusion(ExTLIF) by using conventional ALIF cages were performed on patients with complications after deformity surgery.

Results
51 patients underwent ExTLIF procedure. Mean lumbar lordosis, segmental lumbar lordosis, and mean disc space increased significantly during the last follow-up. Significant correlation existed between subsidence and cage height.

Conclusion
In revision surgery, the source of the problem indicates different techniques. In proximal junction failures, decompression of the cord with extension to about 3 level higher and using hooks are necessary. In distal junction failures, L5S1 OLIF with iliac extension may be recommended. In cases of both proximal and distal complications in fixed deformities, posterior decompression with osteotomy has high correctional versatility. If there are more than 2 levels of motion segments, anterior column support is preferred, with or without anterior column realignment. Lateral lumbar interbody fusion is recommended in any type of revisions except in fixed deformities and contraindications (i.e. vascular variations, morbid obesities, prior abdominal surgeries, intraperitoneal or retroperitoneal infection or tumor). Posterior only approaches are possible with osteotomy combined with exTLIF technique.

28. Best Paper - Malaysia Spine Society: International Multicenter Validation of Growth Velocity and Scoliosis Progression Prediction Using the Distal Radius and Ulna (DRU) Classification: An APSS Scoliosis Focus Group Study

Hideyuki Arima, MD, PhD; Yu Yamato, MD, PhD; Chris Yin Wei Chan, MSOrth; Chee Kidd Chiu, MBBS, MSOrth; Mun Keong Kwan, MBBS, MS Orth; Shinji Takahashi, MD, PhD; Yusuke Hori, MD, PhD; Hideki Sudo, MD; Katsuhisa Yamada, MD, PhD; Shu-Hua Yang, MD, PhD; Ming-Hsiao Hu, MD; Chih-Wei Chen, MD; Jason Pui Yin Cheung, MD, MBBS, MS, FRCS; Yat Wa Wong, MD, MBBS, FRCS; Keith Dip Kei Luk, MD; Daisuke Sakai, MD, PhD; Daisuke Kudo, MD, PhD; Wataru Saito, MD, PhD; Gabriel KP Liu, MD; Leok-Lim Lau, FRCS; Ajoy Prasad Shetty Tonse, MS Orth; Hideki Shigematsu, MD, PhD

Hypothesis
Growth velocity and scoliosis curve progression vary according to distal radius and ulna (DRU) classification stages, and the DRU classification is a valid and reliable predictor of growth potential and scoliosis progression across different ethnic populations in patients with idiopathic scoliosis.

Design
Prospective International Multicenter Cohort Study.

Introduction
The distal radius and ulna (DRU) classification, which evaluates bone maturity using wrist radiograph, is recognized for its clinical utility. However, its validity across cross-ethnic cohorts remains unexplored. Objective: This study aims to investigate growth velocity and scoliosis progression in idiopathic scoliosis patients across DRU classifications in an international multicenter study.

Methods
Idiopathic scoliosis patients aged 9 to 18 years, enrolled in a prospective multicenter study at Asian scoliosis centers (October 2020–December 2023), were examined every 4 to 6 months for height, arm span, Cobb angle, DRU classification, and Risser stage. The rate of change in height, arm span, and scoliosis curve was calculated based on DRU classification and Risser stage at the previous visit. Data from the first registration to the start of brace or surgery were analyzed. Data collected after the initiation of brace or surgery were excluded from the analysis to minimize confounding due to these interventions.

PODIUM PRESENTATION ABSTRACTS

Results
Of 329 enrolled idiopathic scoliosis patients, 191 (mean age 13.5 ± 1.6 years, 84.8% female) (119 Japanese, 40 Malaysian, 20 Taiwanese, 12 Hong Kong) were analyzed. The baseline Cobb angle of the scoliosis curve was 22.6° ± 9.8°. Peak growth in body height occurred at radius grade (R) 5 (0.74 ± 0.31 cm/month), ulna grade (U) 4 (0.78 ± 0.29 cm/month), and Risser stage 0 (0.53 ± 0.35 cm/month). Peak change in arm span occurred at R5 (0.88 ± 0.29 cm/month), U4 (0.91 ± 0.41 cm/month), and Risser stage 0 (0.62 ± 0.50 cm/month). In contrast, progression of the maximum scoliosis curve was most pronounced at R6 (0.20 ± 0.60 degrees/month), U5 (0.33 ± 0.57 degrees/month), and Risser stage 0 (0.12 ± 0.79 degrees/month). Scoliosis curve progression was less likely to occur at or after R9 (0.04 ± 0.85 degrees/month) and U7 (0.05 ± 0.69 degrees/month).

Conclusion
The results from this Asian multicenter study demonstrate that R7 and U5 are associated with a high risk of scoliosis curve progression, which is consistent with previous reports. The DRU classification has been confirmed as a practical method for evaluating scoliosis curve progression across different ethnicities.

29. Best Paper - Philippine Spine Society: Early Outcomes on the Combined Halo-Pelvic Traction and Kyphectomy from an All-Posterior Approach for Severe Kyphotic Deformity

Leo F. Rebato, MD, DPOA; Mary Ruth A. Padua, MD, FPOA FPSS; Gracia Cielo E. Balce, MD, FPOA; Frederick Patrick I. Nicomedez, MD, FPOA, FPSS; Samuel Arsenio M. Grozman, MD, FPOA FPSS

Hypothesis
The use of halo-pelvic traction and an all-posterior approach surgical approach is a viable option in the management of severe kyphotic deformity in young children.

Design
Case report.

Introduction
Severe kyphotic deformity is one of the sequelae of tuberculosis of the spine. When left untreated, patients may develop restrictive lung and heart disease and even neurologic deficits. Surgical management of severe kyphotic deformity is complex and high risk especially in young children. Halo-pelvic traction is a technique reported to decrease complexity, blood loss, operative time and complication rate in definitive fixation, however, the technique has not been used locally in correction of severe deformities.

Methods
This is a case report on a 6-year-old with severe kyphotic deformity secondary to tuberculosis of the spine. The aim is to provide novel insights into the design and application of the halo-pelvic traction construct, combined with an all posterior surgical technique to achieve deformity correction.

Results
The halo-pelvic traction was able to achieve 26 degrees (35.13%) correction over 35 days with an average daily angular correction at 0.72 degrees per day and daily lengthening at 1.52mm per day. The patient was able to ambulate with assistance at 2 weeks and ambulate without assistance at 3 weeks on the traction construct. At 6 weeks, vertebral column resection and definitive fixation through an all-posterior approach was done with final angular correction of 49 deg (66.21%). Halo-pelvic construct was maintained as an adjunct to fixation and is to be maintained until with fusion.

Conclusion
The combined two-staged approach of halo-pelvic traction and vertebral column resection through an all-posterior approach has proven to be effective in this pediatric patient with severe kyphotic deformity.

30. Best Paper - Singapore Spine Society: The Impact of Smoking on Anterior Cervical Discectomy and Fusion with Standalone Cages: Radiological and Functional Outcomes.

Cassie Yang, MBBS; Reuben CC Soh, MBBS, FRCS, MMedOrth; Yeong Huei Ng, FRCS (Ortho); Li Tat John Li Tat Chen, MBBS (NUI), BAO, LRCSI, FRCS (Edin); Youheng Ou Yang, MBBS, MMed

Hypothesis
Smoking causes increased subsidence after anterior cervical discectomy and fusion with anchored standalone cages, leading to poorer functional outcomes.

Design
Retrospective Cohort Study.

PODIUM PRESENTATION ABSTRACTS

Introduction
Standalone cages for anterior cervical discectomy and fusion (SA-ACDF) are simpler to implant but exhibit higher subsidence rates than traditional plate and screw constructs. Smoking is a recognized risk factor for subsidence, though several studies suggest functional outcomes remain unaffected. We hypothesized that smoking exacerbates subsidence after SA-ACDF, resulting in worse functional outcomes.

Methods
A retrospective review of patients who underwent primary single (SL) and double-level (DL) SA-ACDF from 2015–2022 was performed. Patients were categorized as Non-Smokers (NS) or Current/Ex-Smokers (CES). Patients with diagnosis of cervical myelopathy, radiculopathy, or myeloradiculopathy, age range 40–90 years were included. Patients with prior cervical spine surgery, tumor, or infection diagnosis were excluded. Data collected included patient biodata (age, gender, number of operated levels), radiological outcomes (1-year postoperative subsidence rates, 1-year Δtotal intervertebral height (TIH), 1-year Δlordotic angle), and functional outcomes (Japanese Orthopedic Association Score (JOAS), Neck Disability Index (NDI), Visual Analogue Scores for Neck Pain (VASNP) and Upper Limb Pain (VASLP) preoperatively, at 6 months, and at 2 years).

Results
23 CES and 48 NS were identified. Between the groups, there were no significant differences in age or levels operated ($p>0.05$). A higher proportion of the CES group were males ($p=0.001$).Radiological Outcomes of CES vs NS: Subsidence rate at 1 year was 60.9% (n=14) vs 35.4% (n=17) ($p=0.043$). The ΔTIH was 2.4mm vs -1.7mm ($p=0.038$), ΔLordotic Angle was -4.1° vs -3.8° ($p=0.78$) and fusion rate was 91.3% (n=21) Vs 89.5% (n=43) ($p=0.82$). Functional Outcomes of CES vs NS: Preoperative JOAS was 11.4 vs 11.8, NDI 45.9 vs 35.4, VASNP 6.1 vs 4.1, and VASLP: 4.3 vs 2.3. At two years postoperatively, JOAS was 15.0 vs 14.8, NDI 19.8 vs 9.6, VASNP 2.4 vs 1.0 and VASLP was 2.1 vs 0.5.Improvement in all functional scores were found after surgery ($p<0.05$). The rate of functional improvements were similar ($p>0.05$). CES demonstrated persistently worse NDI, VASNP and VASLP scores ($p<0.05$) at all time periods. Smoking did not affect JOA scores.

Conclusion
In SA-ACDF, smoking is linked to significantly worse radiological and functional outcomes. Subsidence rates are almost twice as high in smokers. NDI, VASNP, and VASLP scores improve post-surgery but remain about twice as elevated in smokers at 2 years postoperatively.

31. Best Paper - Spine Society of Thailand:Prediction of Postoperative Coronal Trunk Shift in Adolescent Idiopathic Scoliosis Surgery Using Intraoperative Crossbar Measurement Technique

Tinnakorn Pluemvitayaporn, MD; Suttinont Surapuchong, MD; Mahisaun Tongin; Charnchai Jongtaweesathapon; Piyabuth Kittithamvongs, MD, MSc; Warot Ratanakoosakul; Kitjapat Tiracharnvut, MD; Chaiwat Piyasakulkaew, MD; Sombat Kunakornsawat, MD

Hypothesis
To use the intraoperative crossbar measurement technique to assess and predict the postoperative coronal trunk shift following corrective spinal deformity through posterior fusion and instrumentation in adolescent idiopathic scoliosis.

Design
Prospective Cohort Study.

Introduction
Adolescent idiopathic scoliosis (AIS) surgery aims to achieve spinal balance while minimizing complications. Numerous studies focus on the selection of instrumented levels, the prevention of shoulder imbalance, and the avoidance of the adding-on phenomenon. However, there exists a paucity of studies addressing postoperative coronal trunk shift and its intraoperative detection.

Methods
The study enrolled all individuals diagnosed with adolescent idiopathic scoliosis (AIS) and indicated for surgery between 2023 and 2025, based on the Lenke classification system. The fusion levels were chosen following Lenke's recommendations. Radiographic parameters assessed included C7-CSVL distance, major Cobb angle, T1 tilt angle, UIV tilt angle, and LIV tilt angle, both pre- and postoperatively. The postoperative coronal trunk shift was predicted utilizing the distance proportion derived from the intraoperative crossbar measurement technique

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Results
The study included 50 AIS patients (45 females and 5 males) with an average age of 16.4 ± 4.5 years. The preoperative proximal thoracic curve averaged 57.7 degrees, reducing to 28.6 degrees postoperatively (50.4% correction). The main thoracic curve decreased from 48.9 degrees to 15.2 degrees (68.9% correction), and the thoracolumbar/lumbar curve dropped from 46.8 degrees to 11.3 degrees (75.9% correction). Intraoperative C7-CSVL distance after the deformity correction was 0.27 times the C7 vertebral body width, with postoperative distance at 0.55 times.

Conclusion
The intraoperative measurement of C7-CSVL using the crossbar technique accurately predicts 0.5 times the postoperative C7-CSVL distance. Our study shows that this technique effectively predicts postoperative trunk shift in adolescent idiopathic scoliosis (AIS) patients undergoing surgery. It is straightforward, reliable, accurate, and easily accessible.

32. Best Paper - Taiwan Spine Society: An Innovative 3D-360° Scanning Camera Radiation-Free Device for Assessing the trend of Adolescent Idiopathic Scoliosis curve

Pang Hsuan Hsiao, MD; Chun Tseng, MD, PhD; Chien Chung Chang, MD, PhD; Hsien Te Chen, MD, PhD

Hypothesis
We hypothesize that a radiation-free 3D-360° scanning device can assess scoliosis curves and monitor curve progression in AIS patients.

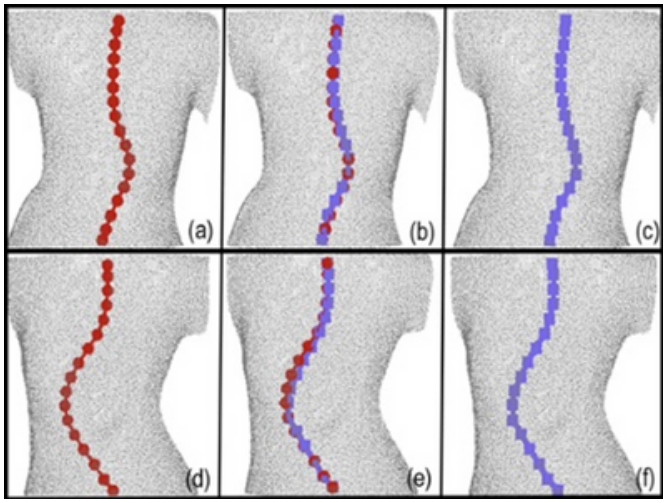
Design
Prospective Validation Study.

Introduction
Adolescent idiopathic scoliosis (AIS) requires regular whole spine X-ray follow-up before reaching the indication for surgical intervention. However, prolonged monitoring with spinal X-rays results in cumulative radiation exposure, which may increase the risk of cancer in adolescent. Therefore, tracking the progression of scoliosis while reducing radiation exposure has always been a challenging task. This study will introduce a new radiation-free device for evaluation the curve trend and comparing with traditional X-rays in AIS patients.

Methods
From August 2023 to September 2024, we collected data from a total of 55 patients diagnosed with adolescent idiopathic scoliosis, ranging in age from 14 to 30 years. All patients underwent whole segment spine X-ray anterior-posterior and sagittal view imaging and scanning with the new device. The results were analyzed using deep learning, comparing point cloud data generated by the device with the corresponding conventional X-ray findings. The two sets of extracted data are appropriately scaled and analyzed using Jaccard Index and Mean Square Error (MSE) to calculate the degree of alignment.

Results
The average Jaccard Index across the 55 patients is 0.91. The MSE has an average value of 1.96×10^{-5}. The red curve represents the trend of the X-ray. The blue curve indicates the trend predicted by the machine. Figure (a), (b) and (c) is the same subject. Figure (d), (e) and (f) is another subject. The overlap between the two is figure (b) and (e).

Conclusion
This new device can be considered as an alternative to traditional X-rays for adolescent idiopathic scoliosis patients who have not reached the surgical indication.



33. Difference in Preoperative Patient Expectations for Adult Spinal Deformity Surgery Between Japan and The United States

Takeshi Fujii, MD, PhD; Satoshi Suzuki, MD, PhD; Kento Yamanouchi, MD, PhD; Kazuki Takeda, MD, PhD; Philip K. Louie, MD; Aiyush Bansal, MD; Venu M. Nemani, MD, PhD; Jean-Christophe A. Leveque, MD; Rajiv K. Sethi, MD; Kota Watanabe, MD, PhD

Hypothesis
Postoperative clinical outcomes and patient satisfaction following adult spinal deformity (ASD) surgery is shaped by pre-operative patient expectations and is influenced by ethnic and cultural factors.

Design
A prospective study.

Introduction
Patient expectations may potentially influence a patient's perception of their clinical outcomes and differ depending on ethnicity, as activities of daily living can vary widely in different cultures. This study aims to clarify the preoperative patient expectations for ASD surgery and also further delineate these expectations between Japanese and American patients.

Methods
Patients aged > 50 years old undergoing correction surgery with more than 5 level fusions for ASD was prospectively recruited at both institutions in Japan and the United States (US). To quantify patient expectations, we used a modified Hospital for Special Surgery Lumbar Spine Surgery Expectations Survey (HSS survey; Mancuso et al. 2013). Lumbar Stiffness Disability Index (LSDI) was used to assess disabilities of daily living due to spinal stiffness.

Results
A total of 59 patients (67 ± 9 years old) were included, with 35 patients from Japan (JP) and 24 from the US. There was no significant difference in the number of fused levels between the groups (JP, 10.5 ± 2.0; US, 12.0 ± 3.4, p=0.10). Overall expectations, as measured by the HSS score, were similar between the groups (JP: 65±18, US: 68±18, p=0.44). However, Japanese patients had significantly higher expectations for improvements in appearance ($p < 0.01$), ability to stand up ($p = 0.02$), sit down on the floor ($p < 0.01$), stand up from the floor ($p < 0.01$), emotional stress ($p < 0.01$), and prevention of condition progression ($p < 0.01$). In contrast, expectations for improvement in driving ability were significantly lower in JP compared to the US ($p<0.01$). The overall LSDI score was significantly lower in JP (20±20) than in the US (34±20, p=0.01), indicating less disability, particularly with forward bending, among Japanese patients.

Conclusion
Preoperative patient expectations for ASD surgery varied between Japan and the US, likely reflecting differences in lifestyle. Japanese patients may demonstrate greater tolerance for forward bending movements associated with spinal deformity symptoms. Differences in expectations based on the lifestyle and ethnicity should be considered when determining surgical indications for ASD.

34. Assessment of Maximum Extension Reservoir of Lumbar Spine Using Fulcrum Hyperextension Radiographs in Severe Sagittal Spinal Malalignment: A Guide For Selecting Lateral Lumbar Interbody Fusion Alone Versus Anterior Column Realignment in Lateral Corrective Surgery

Se-Jun Park, MD, PhD; Jin-Sung Park, MD, PhD; Dong-Ho Kang, MD; HyunJun Kim, MD; Chong-Suh Lee, MD, PhD

Hypothesis
Fulcrum hyperextension radiograph effectively represent the maximum extension reservoir (MER) in lumbar spine and can be utilized to determine the need for anterior column realignment (ACR) in lateral-approach surgery for severe sagittal malalignment (SSM).

Design
Prospective study.

Introduction
Proper restoration of lumbar lordosis (LL) is crucial in the surgical treatment for SSM. Lateral lumbar inerbody fusion (LLIF) has been popularly used to treat SSM. ACR, a modified technique of LLIF, can offer a greater degree of lordosis correction by releasing anterior longitudinal ligament. No clear guidelines exist regarding the indication of ACR in lateral approach for SSM. We report on the usefulness of fulcrum hyperextension radiographs for assessing the MER of patients with severe SSM.

Methods
We included patients with SSM (defined as preoperative PI-LL > 20°) undergoing ≥ 5-level fusion including the sacrum. The patients were divided into two groups according to performance of ACR: LLIF group (LLIF alone) and ACR group. Preoperative LL was compared according to patient's positions; standing, active extension, supine, and fulcrum hyperextension. The offsets between postoperative and preoperative fulcrum hyperextension LL were calculated and compared between the groups.

Results
Altogether, 161 patients were included in the study (mean age, 70.2 years; total levels fused, 7.3). Preoperative LL was significantly greatest in fulcrum hyperextension, followed by supine, active extension, and standing positions (37.2°, 26.5°, 23.8°, and 11.7°, respectively, $P < 0.001$). The offsets between postoperative and preoperative fulcrum LL were significantly different between the LLIF and ACR groups (-0.7° vs. 17.8°, $P < 0.001$). Subgroup analysis using patients with an LL offset > 0° revealed that the mean LL offsets were 7.6° and 19.4° in the LLIF and ACR groups, respectively.

Conclusion
Fulcrum hyperextension radiographs best represented the MER. Therefore, it can be used to predict the maximum LL by LLIF alone, which can be estimated as fulcrum hyperextension LL + 7.6°. This threshold can guide the selection between LLIF alone versus ACR in deformity correction using the lateral approach.

Picture of taking fulcrum hyperextension radiograph using a hard bolster.

35. Sagittal Imbalance Deterioration After S2-Alar-Iliac Fixation in Adult Spinal Deformity: What Role Does Dynamic Hip Joint Coverage Play?

Zezhang Zhu, PhD; Dongyue Li; Zhen Liu, MD, PhD; Jie Li, MD, PhD; Yong Qiu, MD

Hypothesis
This study aimed to determine the role of hip joint coverage after long fusion to pelvis with S2-alar-iliac screw (S2AI fixation).

Design
Retrospective.

Introduction
Although alterations in hip joint coverage following S2-alar-iliac (S2AI) fixation in patients with adult spinal deformity (ASD) have been widely reported, the impact of such secondary changes on the hip-spine alignment and maintenance of postoperative sagittal balance remain unexplored.

Methods
ASD patients who underwent S2AI fixation at our institution between January 2016 and January 2023 were retrospectively reviewed (n=157). Patients were stratified into two groups based on pre-to-post changes in femoral head coverage (FHC): the coverage change group (Group C, n=39) and the non-coverage change group (Group NC, n=40). Group C was further subdivided according to FHC recovery during follow-up into rebound (Group C-R, n = 10) and non-rebound (Group C-NR, n = 29) groups. Clinical outcomes and radiographic parameters of hip and spinopelvic alignment were assessed preoperatively, at the initial postoperative standing, and at the 2-year follow-up.

Results
Compared to Group C, patients in Group NC demonstrated a higher incidence of sagittal imbalance-related mechanical complications at 2-year follow-up, with a greater tendency for sagittal imbalance progression (p=0.013), a larger post-to-follow-up ΔSVA (p=0.029), and a higher incidence of PJK (p=0.031). Although there was no significant difference in PJK incidence between Group C-NR and Group C-R (p=0.845), Group C-NR showed a greater tendency for postoperative sagittal imbalance aggravation (p=0.025), with a significantly larger ΔSVA during follow-up (p=0.002). The optimal cut-off values for predicting postoperative sagittal imbalance aggravation were 3.5% for pre-to-post ΔFHC (AUC=0.694) and 1.8% for post-to-follow-up ΔFHC (AUC=0.713).

Conclusion
Dynamic postoperative changes in hip joint coverage, characterized by the FHC, are associated with postoperative sagittal balance maintenance. Patients with limited pre-to-post and post-to-follow-up changes in the FHC demonstrate compromised hip joint compensatory capacity, thereby increasing the risk of postoperative sagittal imbalance-related mechanical complications.

36. Preoperative Sacral Slope Change (ΔSS) as a Risk Factor for Mechanical Complications after Adult Spinal Deformity Surgery

Tetsuro Ohba, MD, PhD; Hirotaka Haro, MD, PhD

Hypothesis
To investigate whether the preoperative change in sacral slope (ΔSS) from sitting to standing is associated with mechanical complications, including proximal junctional kyphosis (PJK) and rod fracture (Rod Fx), after adult spinal deformity (ASD) surgery.

Design
Retrospective observational study.

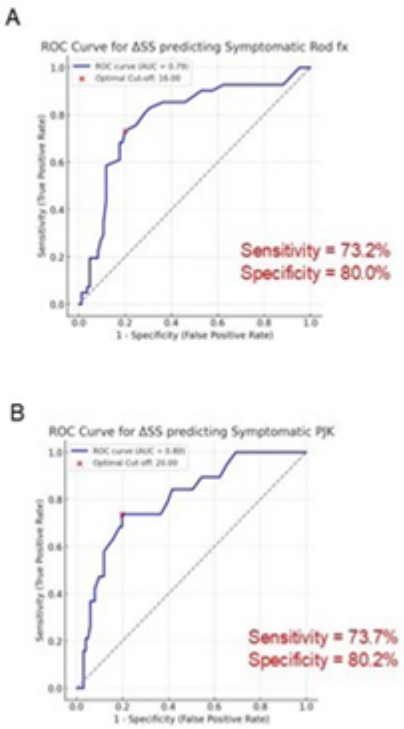
Introduction
Despite efforts to optimize alignment and construct stability, mechanical complications remain prevalent after ASD surgery. Dynamic spinopelvic parameters such as ΔSS have recently gained attention as potential markers of spinal flexibility and postoperative risk.

Methods
We analyzed 181 women who underwent ASD surgery. ΔSS was calculated from preoperative standing and seated lateral radiographs. Multivariate logistic regression was conducted to assess ΔSS as an independent risk factor for PJK and Rod Fx. Receiver operating characteristic (ROC) analysis was also performed.

Results
Mechanical complications were observed in 47.0% (PJK) and 49.7% (Rod Fx). A higher ΔSS was independently associated with increased risk of both PJK and Rod Fx. Specifically, each 1° increase in ΔSS was associated with a 10% increase in the risk of symptomatic Rod Fx (adjusted OR: 1.10, 95% CI: 1.05–1.15, $p < 0.001$). ROC analysis showed optimal ΔSS cutoffs of 20° for PJK and 16° for Rod Fx, with AUCs of 0.80 and 0.79, respectively.

Conclusion
ΔSS is an independent risk factor for mechanical complications following ASD surgery. Preoperative dynamic spinopelvic assessment may improve surgical planning and outcomes.

Fig. 1



Receiver operating characteristic (ROC) curve analysis for ΔSS as a predictor of postoperative mechanical complications in patients with PJK. (A) ROC curve of ΔSS for predicting symptomatic rod fracture (Rod Fx). (B) ROC curve of sacral slope change (ΔSS) for predicting proximal junctional kyphosis (PJK).

37. Adjacent Segment Disease on Hip Joint as a Complication of Lumbopelvic Fixation Surgery: A Five-Year Follow-Up Study

Takuhei Kozaki, MD; Takahiro Kozaki, MD; Hiroshi Hashizume, MD; Shunji Tsutsui, MD; Masanari Takami, MD; Keiji Nagata, MD; Yuyu Ishimoto, MD; Masatoshi Teraguchi, MD; Ryuichiro Nakanishi, MD; Hiroshi Iwasaki, MD; Hiroshi Yamada, MD

Hypothesis
A long spinopelvic fusion surgery may be a risk factor for hip OA after spinal fusion surgery.

Design
Retrospective single-center study.

Introduction
Surgeons often include pelvic fixation during thoracolumbar fusion surgery to prevent the distal junctional problem. However, the spinopelvic fixation has induced a new problem at the hip joint. Past studies revealed the relation between spinopelvic fixation and the progression of hip osteoarthritis (OA). This study aimed to investigate the prevalence of and risk factors for hip OA at 5 years after spinal fusion surgery.

Methods
A total of 290 patients (580 hips) were enrolled. This study measured the center edge (CE) angle and Kellgren-Lawrence (KL) grade on anteroposterior radiographs at 1 month postoperatively (baseline) and 5 years postoperatively. CE angle of less than 25° was defined as developmental dysplasia of the hip (DDH). The patients were matched according to calculated propensity scores in a logistic regression model adjusted for age, sex, body mass index, preoperative severity of disorders, the presence of DDH, KL grade at 1 month postoperatively, and number of fusion segments, and divided into the pelvis fixation and non-pelvis fixation groups.

Results
Progression of the KL grade was identified in 80 hips (13.8 %) in 580 hips, and newly onset in 59 hips (11.3%) limited to 523 hips with KL grade of 0 at 1-month postoperative. The multiple logistic regression analysis showed that the risk factors for progression of KL grade were being female, pelvic fixation, DDH, and progressed KL grade (1-3) at 1 month postoperatively.

Conclusion
This study showed that 13.8 % hips with spinal fusion experienced progression of hip OA, new onset was 11.3 %. The risk factors based on multiple regression analysis were female sex, pelvic fixation, DDH, and history of hip OA. The surgeons should be aware of the risk of the progression of hip OA after spinopelvic fixation surgery.

PODIUM PRESENTATION ABSTRACTS

38. Ten-Year Longitudinal Quality of Life Decline and Spinopelvic Alignment Changes: Findings from the Toei Community Cohort

Hideyuki Arima, MD, PhD; Yu Yamato, MD, PhD; Koichiro Ide, MD; Tomohiko Hasegawa, MD, PhD; Go Yoshida, MD, PhD; Tomohiro Banno, MD, PhD; Shin Oe, MD; Tomohiro Yamada, MD; Yusuke Murakami, MD, PhD; Yukihiro Matsuyama, MD, PhD

Hypothesis
Progressive changes in spinopelvic alignment over 10 years are associated with clinically meaningful declines in health-related quality of life (HRQOL), including general and disease-specific measures, in community-dwelling older adults.

Design
Retrospective analysis of a prospective community-based cohort.

Introduction
Sagittal malalignment is a known contributor to impaired HRQOL in adult spinal deformity (ASD), but longitudinal evidence in non-surgical, community-dwelling populations is limited. This study aimed to examine the long-term impact of spinopelvic alignment changes on HRQOL using EQ-5D and Oswestry Disability Index (ODI) over 10 years.

Methods
We retrospectively analyzed data from the Toei Study, a prospective musculoskeletal health program in Toei Town, Japan. Residents aged ≥50 who participated in both 2014 and 2024 were included. Of these, 103 individuals had complete radiographic and QOL data (EQ-5D, ODI). QOL decline was defined as ΔEQ-5D ≤ −0.08. Multivariate regression was used to examine associations between changes in alignment (ΔSVA, ΔPI–LL, ΔPT), physical function, lifestyle, and comorbidities with QOL decline.

Results
Of the 103 participants (mean age in 2014: 68.4 ± 6.8 years), 29 (28.2%) showed clinically meaningful deterioration in EQ-5D over 10 years. Multivariate logistic regression revealed that older age (OR = 1.16, 95% CI: 1.04–1.30, p = 0.009) and higher baseline Locomo-25 scores (OR = 0.75, 95% CI: 0.61–0.93, p = 0.007) were independently associated with EQ-5D dcline. Increased pelvic tilt (ΔPT) showed a trend toward significance (OR = 1.09, p = 0.115). In the multivariate linear regression analysis for ΔODI, higher baseline Locomo-25 scores (coefficient = −0.195, p < 0.001), poorer functional reach test performance (coefficient = −0.434, p = 0.013), and greater increases in ΔPT (coefficient = 0.385, p = 0.047) were significantly associated with worsening disability. A modest positive correlation was also observed between ΔSVA and ΔEQ-5D (r = 0.21).

Conclusion
This 10-year longitudinal study in a community-dwelling older population demonstrated that deterioration in spinopelvic alignment —particularly increased pelvic tilt—is associated with long-term HRQOL decline. Physical frailty indicators, including balance and Locomo-25 scores, also predicted greater functional impairment. These findings underscore the importance of integrating spinal alignment and physical function surveillance into preventative strategies for aging populations.

39. Surgical Outcomes of Adult Idiopathic Scoliosis: A Comparative Study Between Younger and Middle-Aged Patients

Yasushi Iijima, MD, PhD; Toshiaki Kotani, MD, PhD; Tsuyoshi Sakuma, MD, PhD; Tsutomu Akazawa, MD, PhD; Shohei Minami, MD, PhD; Seiji Ohtori, MD

Hypothesis
We hypothesized that middle-aged patients with adult idiopathic scoliosis would exhibit more advanced spinal deformity and require more extensive surgery, including pelvic fixation, compared to younger patients. We also expected clinical outcomes to be less favorable in the middle-aged group due to age-related degenerative changes.

Design
Retrospective cohort study.

Introduction
Adolescent idiopathic scoliosis (AIS) is typically treated during adolescence. Some patients delay surgery or show curve progression, requiring adult treatment. In our prior study, older age —particularly over 37 years—was identified as a risk factor for lumbar lateral listhesis in patients with adult idiopathic scoliosis (Kotani et al., SSRR 2022). This study compares outcomes between younger (20–39) and middle-aged (40–59) AIS patients.

Methods
We retrospectively reviewed 85 AIS patients diagnosed before age 20 who underwent spinal surgery between ages 20 and 59. The mean age was 34.1 ± 12.5 years, and 69 patients were female. Patients were divided into a younger group (n=63) and a middle-aged group (n=22). We compared number of fused vertebrae, incidence of pelvic fixation, global spinal alignment parameters (Cobb angle, pelvic incidence-lumbar lordosis [PI-LL] mismatch, sagittal vertical axis [SVA], and pelvic tilt [PT]), main curve flexibility (side bending correction rate), and SRS-22 scores before and 2 years after surgery.

Results
Middle-aged patients had fewer isolated thoracic curves (3/22 vs. 26/63 patients), needed longer fusion (11.0 vs. 8.6 levels), and more pelvic fixation (15/22 vs. 0/63 patients). They showed more severe preoperative parameters: higher main curve Cobb angles (61.9° vs. 51.3°), PI-LL mismatch (26.9° vs. -3.0°), greater SVA (35.9 mm vs. -14.7 mm), and PT (27.7° vs. 10.7°). Main curve flexibility was lower in the middle-aged group (37.3% vs. 47.3%). At 2 years, both groups had good alignment, but middle-aged patients had larger residual main curves (25.9° vs. 18.5°) and lower SRS-22 scores in function, pain, mental health, self-image, and postoperative function. All differences were significant ($P < 0.05$).

Conclusion
Younger AIS patients can be treated using strategies similar to adolescents. Middle-aged patients more often present with degenerative changes and sagittal imbalance, requiring pelvic fixation. Early surgical intervention may reduce fusion extent and improve outcomes.

40. Strategic Adjustment of ULL and LLL to Maintain Ideal L1PA

Myung-Hoon Shin, MD, PhD

Hypothesis
Strategic modulation of upper lumbar lordosis (ULL) and lower lumbar lordosis (LLL) can effectively maintain postoperative L1 pelvic angle (L1PA) within its proposed ideal range, thereby significantly reducing the incidence of proximal junctional failure (PJF) following long-level fusion surgery.

Design
Retrospective cohort study.

Introduction
While ideal L1PA deviation has been proposed as PI * 0.5 - 19° (±2°), the optimal surgical approach to maintain L1PA within this range remains unclear. Upper lumbar lordosis (ULL) and lower lumbar lordosis (LLL) have been identified as key modifiable factors influencing L1PA; however, a standardized surgical strategy for their adjustment is lacking. This study investigates the relationship between L1PA and PJF and proposes a novel surgical approach focusing on ULL and LLL modulation to optimize postoperative alignment and reduce PJF risk.

Methods
A retrospective analysis was performed on patients who underwent long-level fusion surgery (T4-sacrum) at our institution between 2015 and 2023. Inclusion criteria consisted of patients with complete preoperative and postoperative imaging and a minimum of two years of follow-up. L1PA was measured preoperatively and postoperatively, and its deviation from the ideal range was recorded. The cohort was stratified based on PJF occurrence. The primary outcome measure was the incidence of PJF in relation to L1PA deviation. Secondary analyses included the effects of ULL and LLL adjustments on achieving optimal L1PA. Statistical analyses were performed using regression models to determine the impact of ULL and LLL on L1PA and its correlation with PJF.

Results
mong 150 patients included in the study, 38 (25.3%) developed PJF within two years postoperatively. In the PJF group, postoperative L1PA was significantly higher than the ideal range (mean deviation: +6.2° ± 1.8°, $p < 0.001$). Regression analysis revealed a strong positive correlation between L1PA deviation and PJF occurrence ($R^2 = 0.685$). Furthermore, subgroup analysis demonstrated that patients with L1PA within the ideal range had a significantly lower incidence of PJF (7.5%) compared to those with excessive deviation (41.2%, $p < 0.01$). When analyzing ULL and LLL adjustments, an optimal ratio of ULL:LLL = 30:70 was associated with maintaining L1PA within the target range in PI mid-range patients. In contrast, in patients with PI > 60°, a higher ULL proportion (>40%) was required to prevent excessive L1PA increase.

Conclusion
L1PA is a critical determinant of sagittal balance, and its deviation correlates strongly with PJF risk. Our study highlights the necessity of precise ULL and LLL adjustments to maintain L1PA within an ideal range. By tailoring lordosis distribution based on PI, surgeons can achieve optimal postoperative alignment and significantly reduce PJF incidence. This novel approach offers a refined surgical strategy that may enhance long-term outcomes in long-level fusion surgery. Further prospective studies are warranted to validate these findings and develop intraoperative alignment protocols.

41. Updating the Coronal Balance Classification for Adult Spinal Deformity: A Relook into the Type A Subtype

Yanjie Xu, MD; *Zhen Liu, MD*, PhD; Hui Xu, MD; Xiaodong Qin, PhD; Benlong Shi, PhD; Jie Li, MD, PhD; Zezhang Zhu, PhD; Yong Qiu, MD

Hypothesis
Propose a refined coronal classification with subgroup analysis of degenerative scoliosis (DS) patients with Type A coronal pattern and to ascertain its implications on postoperative coronal imbalance (CIB).

PODIUM PRESENTATION ABSTRACTS

Design
A retrospective study.

Introduction
Classifying the coronal curve pattern is crucial for optimizing surgical decision-making. Whilst our previous Nanjing coronal classification provides insight into the risk stratification of DS, certain aspects of the classification still fall short of satisfaction. Despite the Type A pattern was originally defined as a balanced coronal type by Bao et al., recent studies have reported that up to one-third of patients with this pattern still develop postoperative CIB. These findings suggested that the original classification system may underestimate the risk of postoperative CIB in patients with a Type A coronal pattern. Therefore, a refinement of the prior classification is warranted to address the inherent deficiencies.

Methods
A total of 239 DS patients who underwent spinal correction surgery were recruited in this study. Patients were divided into Type A, B, and C based on the Nanjing coronal imbalance classification system. Patients with Type A coronal imbalance were further divided into three subtypes according to the CBD and the tendency of trunk inclination: Type Aa, CBD ≤1 cm; Type Ab, CBD > 1 cm, and C7 Plumb Line (C7PL) shifted to the concave side of the curve; Type Ac, CBD > 1 cm and C7PL shifted to the convex side.

Results
The incidence of postoperative CIB is 23% (32/139) in the Type A group, 18% (11/60) in the Type B group, and 58% (23/40) in the Type C group ($p<0.001$). Among patients with Type A coronal alignment, 54 patients were Type Aa, 46 patients were Type Ab, and 39 patients were Type Ac. After surgery, 32 patients had a postoperative coronal imbalance, with 5 patients in Type Aa (9%), 5 patients in Type Ab (11%), and 22 patients in Type Ac (56%). Postoperative coronal malalignment was found to be more prevalent in Type Ac patients ($P < 0.001$).

Conclusion
Patients with Type Ac coronal imbalance are at greater risk of postoperative CIB following surgery compared with patients with Type Aa and Type Ab alignment. The modified coronal imbalance classification highlights the high risk of CIB in Type Ac, similar to the Type C coronal imbalance pattern.

42. Age-Specific Sagittal Alignment Goals Using GAP Scoring to Reduce Risk of Proximal Junctional Kyphosis in Adult Spinal Deformity: A Single-Centre Cohort Study in Indian Population

Vivek Kumar, MBBS, MS; *Imtiaz Ghani, MBBS, MS*

Hypothesis
Incorporating age-specific alignment targets into GAP scoring during surgical planning helps in reducing the risk of PJK.

Design
Retrospective Analysis - Single centre Cohort study in Indian population

Introduction
Proximal junctional kyphosis (PJK) is a common complication after adult spinal deformity (ASD) surgery, often associated with overcorrection of sagittal alignment relative to a patient's age. The Global Alignment and Proportion (GAP) score is a validated tool for assessing spinopelvic alignment, yet it does not account for age-related normative values.

Methods
Eighty-three patients (mean age 68.2 ± 7.9 years; 72% female) who underwent long-segment thoracolumbar fusion for ASD by a single surgeon between 2016 and 2022 were retrospectively reviewed. Patients were divided into two groups: Standard GAP group (n=41): Preoperative planning based on conventional GAP criteria.Age-adjusted GAP group (n=42): Planning incorporated age-specific targets for PI–LL mismatch, pelvic tilt, and sagittal vertical axis. The primary outcome was the incidence of PJK, defined as kyphosis ≥10° between the UIV and UIV+2 with ≥10° increase from baseline at final follow-up (minimum 2 years). Secondary outcomes included revision surgery rates and GAP proportionality scores.

Results
PJK occurred in 12 patients (29.3%) in the standard GAP group compared to 3 patients (7.1%) in the age-adjusted GAP group ($p = 0.01$). The mean final GAP proportionality score was significantly better in the age-adjusted group (4.1 ± 1.4 vs. 6.0 ± 1.9; $p = 0.008$). Revision surgery due to junctional complications was required in 4 patients in the standard group, versus none in the age-adjusted group. Patient-reported outcomes (ODI, SRS-22) trended better in the age-specific group, though differences were not statistically significant.

Conclusion
Incorporating age-specific alignment targets into GAP-based preoperative planning significantly reduces the incidence of proximal junctional kyphosis in adult spinal deformity surgery. This personalized approach improves sagittal proportionality and may help minimize revision risk due to junctional failure.

PODIUM PRESENTATION ABSTRACTS

43. Sagittal Spinal Alignment Deviation in the General Elderly Population: A Japanese Cohort Survey

Masashi Uehara, MD, PhD; Jun Takahashi, MD, PhD

Hypothesis
Spinal sagittal position and degree of deviation differed between genders.

Design
Japanese resident cohort study based on a municipal registry.

Introduction
It is widely recognized that sagittal spinal alignment changes with age. However, there are presently no clear benchmarks for such values or those for the whole spine in the general population. Quality epidemiological studies are needed to establish standards for spinal alignment deviation. In this study of an aged Japanese population, we employed random sampling from the basic resident registry of a rural town for subject selection to determine reference values of sagittal spinal alignment.

Methods
Registered citizens of 50 to 89 years old were targeted for this survey. We established 8 groups based on age and gender after random sampling from the resident registry. A total of 413 people were enrolled. Radiographic parameters of sagittal spinal alignment of the cohort were measured and analyzed. For the purposes of examining to what extent deviation would occur and from which age, comparisons between age groups on the basis of 50's age group reference values were performed using multiple comparisons based on the Dunnett test.

Results
80's females was a mean of 66 mm forward of that of 50's females. Forward movement of the cervical spine was especially prominent in men. Cervical protrusion was markedly greater in 60's males onwards. C2-7 SVA was large at all ages in males, and T1 slope increased from their 60's. In women, lumbar lordosis and posterior pelvic inclination were noticeable from a younger age than in men. The amount of pelvic tilt misalignment in female subjects was approximately 10 years earlier than their male counterparts.

Conclusion
This first resident cohort of Japanese individuals determined average spinal alignment parameters by age and gender. Spinal balance generally shifts forward as age increases. A forward shift in the upper cervical spine occurs first in men, while lumbopelvic alignment shift occurs first in women.

44. How Much Is Too Much? FSPA-Based Analysis for PJK Prevention

Jung-Hee Lee, MD, PhD; Ki Young Lee, MD, PhD; *Hong-Sik Park, MD*; Woo-Jae Jang, MD

Hypothesis
In the surgical treatment of adult spinal deformity (ASD), determining the threshold of overcorrection is essential to achieve favorable outcomes and to reduce various potential complications.

Design
A retrospective study.

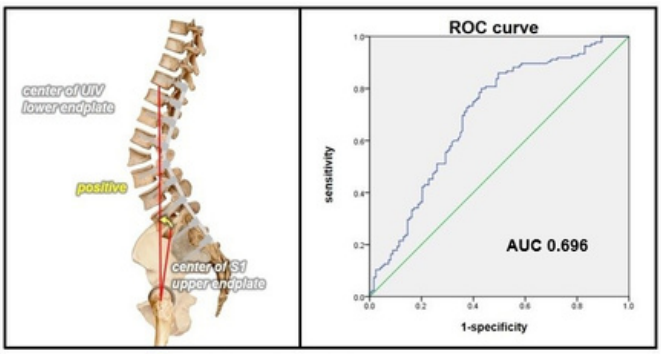
Introduction
Proximal junctional kyphosis (PJK) is a common complication that can occur after surgical treatment for ASD. However, there is still no consensus on how the degree of correction of lumbar lordosis (LL) affects PJK. Recently, a novel and fixed parameter known as the fused spinopelvic angle (FSPA) has been introduced as a method for preventing PJK. In this study, our goal is to determine the threshold of overcorrection using FSPA and validate its effectiveness.

Methods
We retrospectively selected 258 consecutive patients (mean age 71.4 years) with a minimum 2-year follow-up who underwent long segment fixation with sacropelvic fixation. A comparative analysis was performed by dividing the patients into two groups: the non-PJK group (n=135) and the PJK group (n=123). Pearson's correlation coefficient was used to analyze the relationship between parameters, while linear regression analysis and a multivariate logistic regression model were conducted to identify the risk factors for PJK and assess the upper limit of overcorrection.

Results
The PJK group exhibited significantly more negative postoperative FSPA (4.9° vs. -0.3°, $p<0.05$). Logistic regression analysis identified the FSPA as a crucial risk factor for PJK ($p<0.05$). In ROC curve analysis aimed at preventing PJK, the target value for FSPA was determined to be 2.38°. The FSPA has a strong positive correlation with the postoperative pelvic incidence (PI)-LL ($r=0.516$, $p<0.001$). A linear regression model revealed a threshold for the postoperative PI-LL, with FSPA exceeding 2.38°, to be -17.6 ($r=0.61$).

Conclusion
We found that in order to prevent PJK after surgical treatment of ASD, it is important to correct FSPA 2.38° or more. Furthermore, achieving an overcorrection where the PI-LL does not exceed -17.6 can result in clinical and radiological improvements after surgery.

PODIUM PRESENTATION ABSTRACTS



cut-off value of FSPA = +2.38

Post PI-LL = -19.546 + 0.826 x FSPA = -17.6

Fused spinopelvic angle (FSPA) and its predictive value for proximal junctional kyphosis (PJK). An FSPA cut-off of +2.38° was identified (AUC = 0.696), corresponding to a PI–LL threshold of –17.6.

45. Optimizing Craniovertebral Junction Tuberculosis Treatment: Development and Validation of a Radiological Scoring System

Chitranshu Shrivastava, MS

Hypothesis

A radiological scoring system can reliably stratify disease severity in craniovertebral junction tuberculosis and guide appropriate management decisions, resulting in improved functional and radiological outcomes.

Design

Prospective observational study.

Introduction

Craniovertebral junction (CVJ) tuberculosis is a rare but serious manifestation of spinal tuberculosis, representing less than 1% of cases. It presents with diverse clinical and radiological features, ranging from mild neck pain to severe neurological deficits due to cervical cord compression. Treatment decisions, especially in cases with instability but no neurological compromise, remain challenging. This study introduces a structured radiological scoring system to guide management decisions.

Methods

This prospective study enrolled 30 patients with CVJ tuberculosis over 18 months. Clinical and radiological evaluations—including X-rays, CT, and MRI—were performed at baseline and at 3, 6, and 9 months. Neurological status was assessed using the ASIA scale. A novel 12-point radiological scoring system was developed, assessing bony destruction, instability, cord compression, and neurological deficits.

Results

According to the novel radiological score, patients with a score <8 (17 cases) were managed conservatively, while those with scores >8 (13 cases) required surgical intervention. Statistical analysis revealed a strong correlation between radiological score and management strategy ($p<0.001$). The four-item Radiological Scale was assessed for reliability and validity. Cronbach's alpha (0.776) indicated good internal consistency. Construct validity was supported by a Kaiser-Meyer-Olkin value of 0.811 and Bartlett's test ($p < 0.001$). Principal Component Analysis identified a single factor (eigenvalue = 2.721) explaining 68.033% of variance, with strong factor loadings (≥ 0.763). These results confirm the scale as a reliable and valid assessment tool.

Conclusion

The proposed radiological scoring system is a reliable and valid tool for assessing CVJ tuberculosis severity and guiding treatment decisions. It supports personalized management and warrants further validation in larger cohorts.

Radiological score

• Destruction of	Characteristics	score
1. occipital condyle	Involved	0.5
	Destroyed	1
2. C1 lateral mass	Involved	0.5
	Destroyed	1
3. C2 lateral mass	Involved	0.5
	Destroyed	1
4. Odontoid process	Involved	0.5
	Destroyed	1
• Instability		
Vertical instability (basilar invagination) or horizontal instability or rotatory instability		2
• Cord compression or cord involvement in MRI		1
• Neurology		
No neurological deficit		0
Complete neurological deficit		1
Incomplete neurological deficit		2
Total Score		12

Figure showing novel radiological score

PODIUM PRESENTATION ABSTRACTS

46. Are Elderly Patients at Elevated Risk for Complications? A Retrospective Analysis of 141 Cervicothoracic Deformity Correction Cases by a Single Surgical Team

Ping-Yeh Chiu, MD; Winward Choy, MD; David Mazur-Hart, MD

Hypothesis
Elderly patients undergoing cervicothoracic deformity correction may have higher complication rates and less favorable outcomes than younger patients.

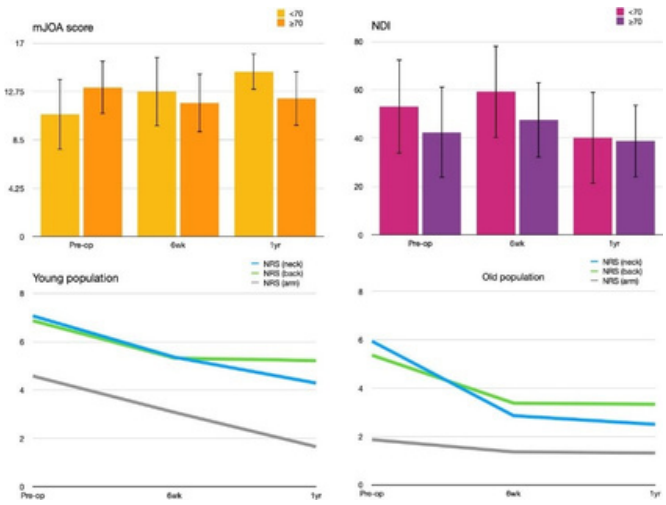
Design
A retrospective cohort study of 141 patients who underwent cervicothoracic deformity correction by a single surgical team between 2011 and 2023.

Introduction
Cervicothoracic deformity correction is complex and often considered higher risk in elderly patients. This study aimed to compare outcomes between patients aged <70 and ≥70 years.

Methods
Patients were divided into two age groups: <70 (n=97) and ≥70 (n=44). Clinical and surgical data, radiographic parameters, complications, and health-related quality of life (HRQoL) scores (ODI, NRS, SRS-22r) were collected preoperatively, and at 6 weeks and 1 year postoperatively.

Results
Except for age and Charlson Comorbidity Index, baseline characteristics were similar. Use of 3-column osteotomy (70.1% vs. 68.2%), hospital/ICU stay, and complication rates (overall, medical, surgical, neurologic) showed no significant differences. Infection, junctional failure, implant failure, and reoperation were also comparable. HRQoL outcomes: mJOA improved in younger patients but not significantly in older ones. ODI improved at 1 year in younger patients, with a similar trend in the elderly. SRS-22r scores improved significantly in both groups, with earlier benefit in younger patients. NRS scores for neck/back pain improved in both groups; arm pain improved mainly in the younger group. Radiographic correction was similar at 1 year: SVA (2.93 vs. 4.25 cm), C2–7 SVA (4.09 vs. 3.64 cm), cervical lordosis (−20.9° vs. −18.1°), T1 slope (31.5° vs. 34.7°), and T1 slope minus lordosis (17.3° vs. 20.5°).

Conclusion
Elderly patients did not have higher complication rates. Though functional improvement was greater in younger patients, radiographic correction was similar. Age alone should not preclude surgical consideration.



47. Beyond Flexion and Extension - The Hidden Postural Mechanics of Natural Sitting & Axial Head Loading in Cervical Myelopathy - Results of a Novel Dynamic Sitting MRI Study

J Naresh Babu, MD

Hypothesis
Natural sitting posture, through axial head loading, alters cervical vertebral alignment and induces ligamentum flavum buckling, contributing to dynamic spinal cord compression and progression of cervical myelopathy. These changes that are under recognised in conventional supine MRI might might drive the disease progression and management in Degenerative Cervical Myelopathy.

Design
Prospective observational comparative imaging study.

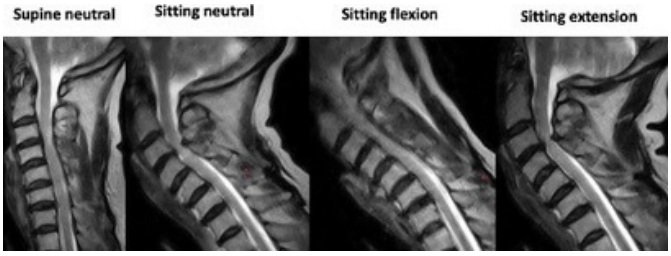
Introduction
Recent studies have suggested that upright posture and associated axial head loading may exacerbate neurological compression through dynamic buckling of the ligamentum flavum in degenerative cervical myelopathy (DCM). But there is paucity in the literature due to unavailability of methods to obtain sitting MRI. Present study by utelising upright dynamic MRI aims to investigate the effects sitting on ligamentum flavum dynamics and its implications for disease progression in DCM.

Methods
This study included 50 patients diagnosed with DCM and 50 age-matched controls presenting with axial neck pain. All participants underwent a comprehensive radiographic evaluation and dynamic MRI in both supine and sitting postures. Radiological measurements were compared and Statistical analysis was performed using independent samples t-tests and ANOVA.

PODIUM PRESENTATION ABSTRACTS

Results
The DCM group demonstrated significant increases in disc bulge (38.13% vs. 8.07%), ligamentum Flavum thickness (25.98% vs. 12.99%), and reductions in sagittal spinal cord diameter (14.05% vs. 3.08%) and cross-sectional area (14.45% vs. 3.44%) compared to controls. Notably, the greatest severity of cervical stenosis was observed at the C3-C4 level in extension positions, indicating heightened susceptibility to dynamic ligamentum flavum buckling. Furthermore, increased cervical lordosis (11.1° vs. 6.5°) and C3-C4 angulation (5.3° vs. 0.2°) were noted in DCM patients.

Conclusion
For the first time, our findings suggest that just sitting in upright posture can result in increased neurological compression by provoking dynamic disco-ligamentous instability in Degenerative Cervical Myelopathy. The implications of these findings are pivotal for clinical decision-making and surgical planning as the management decisions are traditionally made on the basis of information obtained in supine MRI.



MRI depicting supine and sitting Postural Effects.

48. Effect of C3 Laminectomy on the Progression of Ossification of Posterior Longitudinal Ligament in Cervical Laminoplasty: A Propensity Score-Matched Comparison of Clinical outcomes and Sagittal alignment between C3 Laminectomy with C4–6 Laminoplasty and C3–6 Laminoplasty

Giwuk Jang, MD; Kyung Hyun Kim, MD, PhD

Hypothesis
When laminoplasty C3456 was performed, the range of motion(ROM) increased in the group that underwent C3 laminectomy, but we wondered whether there would be progression of Ossification of the posterior longitudinal ligament (OPLL) depending on instability.

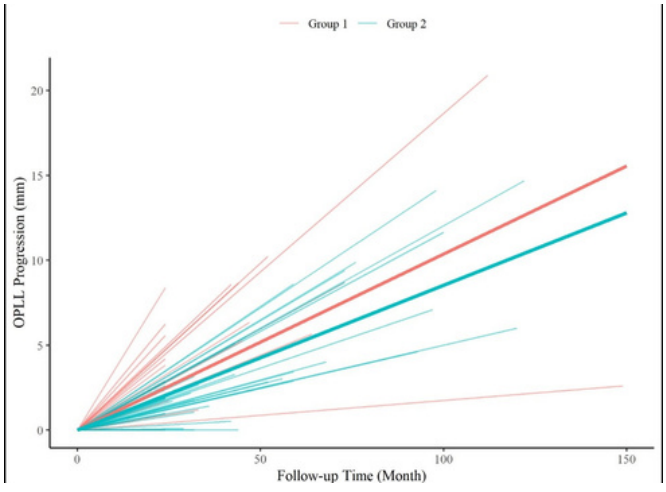
Design
This study included patients who underwent laminoplasty at our institution since 2010, with ≥2 years of follow-up and postoperative CT. Only patients with cervical spondylotic myelopathy due to continuous or mixed-type OPLL were included, as focal and segmental types rarely progress.

Introduction
Conventional laminoplasty may reduce lordosis, cause axial pain, and limit ROM, leading to modified approaches. C3 laminectomy preserves semispinalis cervicis at C2, improving ROM and reducing axial pain. This study aimed to clarify its effect on postoperative OPLL progression.

Methods
Preoperative, immediate postoperative, one-year postoperative, and two-year postoperative X-ray and CT images were obtained to measure OPLL length, ROM, and other sagittal parameters. Demographic data, visual analogue scale for neck and arm pain, Neck Disability Index, Japanese Orthopaedic Association score, and other complications were also reviewed.

Results
The propensity score match (PSM) was performed for the two groups, and 22 patients in the C3 laminectomy, C4-6 laminoplasty group (LN group) and 44 patients in the C3-6 laminoplasty group (LP group) were matched 1:2. ROM exhibited no significant difference between the two groups before surgery, but after 1 year of follow-up, it showed a substantial difference of 36.12 ± 3.69 in the LN group and 33.66 ± 3.62 in the LP group ($p = 0.024$). Multivariable linear regression analysis was performed on the OPLL progression, and the LN group increased by 0.1034 mm per month and the LP group increased by 0.0853 mm per month ($P < 0.001$).

Conclusion
In terms of lordosis and ROM, C3 laminectomy seems to be favorable, but in terms of OPLL progression, C3 laminectomy seems to be favorable. Therefore, we think that laminoplasty rather than C3 laminectomy is a good way to prevent OPLL progression in patients with mixed and continuous type of cervical OPLL.



Group 1 (LN) showed a significantly higher gradient of OPLL progression over time than group 2 (LP) ($P < 0.0001$).

PODIUM PRESENTATION ABSTRACTS

49. Evaluating the Efficacy and Safety of Halo-Femoral Traction and Halo-Gravity Traction Techniques in Severe Kyphoscoliosis with Spinal Cord Risk Classification (SCRC) Type 3 Over the Apex

Erh-Ti Ernest Lin, MD; Yuan-Shun Lo, MD, PhD

Hypothesis
In patients with severe spinal kyphoscoliosis and spinal cord risk classification (SCRC) type 3 at the curve apex, both preoperative halo-gravity traction (HGT) and halo-femoral traction (HFT) following spinal release can achieve effective and safe deformity correction, with substantial contributions from traction alone and without increasing the risk of postoperative neurological deficits.

Design
A retrospective case series.

Introduction
Patients with severe kyphoscoliosis and SCRC type 3 are at high risk for neurological injury during corrective surgery. Preoperative halo-gravity traction (HGT) and halo-femoral traction (HFT) following spinal release are used to improve safety and correction, but comparative data remain limited.

Methods
A total of 73 patients (24 males, 49 females, mean age 22.4 ± 6.4 years) and 56 patients (15 males, 41 females, mean age 22.9 ± 10.4 years) were included in the HFT and HGT group, respectively. Radiographic parameters were measured at the initial assessment, post-traction, post-final surgery, and during each follow-up. Neurologic function was assessed using the Frankel score system. IONM alerts and all complications were documented. Quality-of-life was evaluated using the SF-36 questionnaire.

Results
In the HFT vs HGT group, the total correction rates were 39.9 ± 7.2% v.s. 41.3 ± 6.8% for the major Cobb and 36.6 ± 9.3% v.s. 44.4 ± 9.2% for global kyphosis (GK) after final surgery, respectively. The traction contributions were 57.6 ± 11.1% v.s. 52.3 ± 9.3% for major Cobb and 70.1 ± 10.5% v.s. 63.9 ± 11.1% for global kyphosis (GK), respectively. More than half of the total correction can be achieved gradually and safely through preoperative traction with patients in an awake state.

Conclusion
Significant outcomes can be expected in patients with severe kyphoscoliosis, even with spinal cord risk classification (SCRC) type 3 at the apex undergoing HFT and HGT.

A patient undergoing HFT is presented. An 18-year-old female was diagnosed with severe adolescent idiopathic scoliosis.

50. Outcomes of Vertebral Column Resection (VCR) in Patients with Rigid, Healed Post-Tubercular Dorsal Kyphosis with Myelopathy - Do the Benefits Match the Risks and Complications?

Vikas Hanasoge, MBBS, MS; Saumyajit Basu, MS(Orth), DNB(Orth), FRCSEd; Dhruv Patel, MS

Hypothesis
VCR in Post Tubercular severe rigid kyphosis with myelopathy has more benefits than risks.

Design
Retrospective, single-center series.

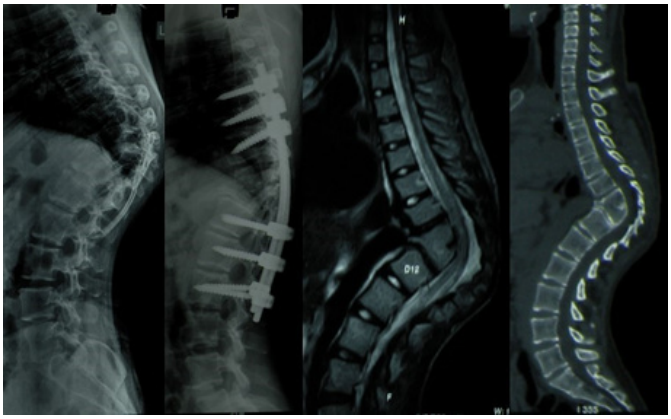
Introduction
A dreaded sequel of healed dorsal spine tuberculosis is severe, rigid kyphosis with myelopathy. The aim of surgery in these patients is to correct spinal deformity to restore cord function.

Methods
A total of 30 patients diagnosed with severe, rigid post-tubercular kyphosis underwent deformity correction by VCR in our center during the period 2007 to 2018 – they were retrospectively analyzed – including demographics, pre and 2 years postoperative neurological status (based on ASIA scores), sphincter dysfunction (mJOA scores), radiological correction, functional outcome (SRS-22r), and we recorded all the complications.

PODIUM PRESENTATION ABSTRACTS

Results
The mean age of the study group was 22.9 years (2-68). The mean follow-up period was 3.2 years (2.2 – 11). The mean time of presentation from the onset of deficits is 7.13 months (1-24). The mean thoracic kyphosis significantly improved from pre-op Cobb's angle of 66.48 degrees (40-120) to post-op Cobb's angle of 21.9 degrees (8-45). All patients underwent VCR with pedicle fixation cranial and caudal to the osteotomy site. Preoperatively patients with ASIA D (30.1%) had complete recovery, ASIA C (53.3%) had either complete or improvement in one grade of neurology as of ASIA B (6.6 %) but ASIA A patients (10%) had no neurological recovery at the end of follow up. The mean sphincter dysfunction score improved from 1.5 to 2.0. The overall complication rate was 30% including 2 neurological (intra-op drop in Neuromonitoring signals) and 7 non-neurological (PJK, Implant failure/prominence). The functional score measured with SRS-22r questionnaire improved post-correction (preoperative: 2.2 ± 0.3 and at last follow-up: 4 ± 0.3).

Conclusion
Post-tubercular dorsal kyphosis corrections are safe and effective offering good clinic-radiological and functional outcomes. Neurological recovery can be expected of at least one grade from ASIA C, ASIA D and in some cases of ASIA B but no neurological recovery occurred in patients of ASIA A. Preoperative neurological status and duration of myelopathy is of value in predicting the postoperative recovery. Complications are anticipated in these cases due to the severity of the deformity.



VCR in Post TB Kyphosis of ASIA C Neurology case

51. An End-to-End Deep-Learning Pipeline for Automated Cobb-Angle Measurement and Last-Touched Vertebra Identification in Adolescent Idiopathic Scoliosis

Wei-Chen Lin, MD; Shu-Hua Yang, MD; Chih-Wei Chen, MD; Yun-Liang Chang, MD

Hypothesis
Integrating vertebral-segmentation cues with landmark detection in a stacked-hourglass network will reduce spatial and angular error and accurately locate the last-touched vertebra (LTV) on standing whole-spine radiographs, outperforming landmark-only or segmentation-only approaches.

Design
Retrospective, single-centre model-development and validation study using de-identified anteroposterior full-length spine films acquired between 2018 and 2024.

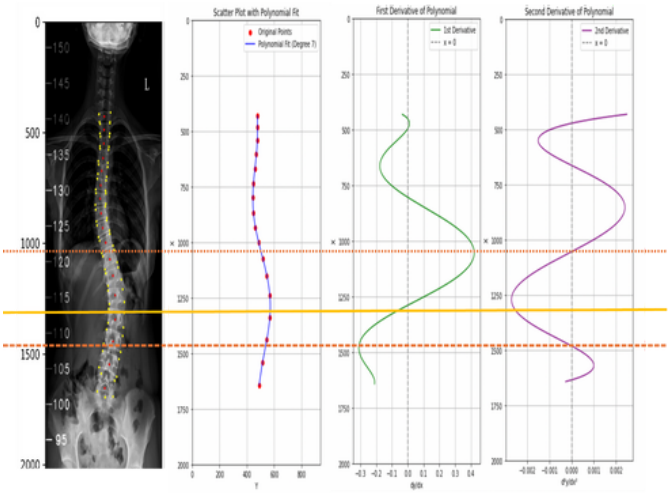
Introduction
Manual Cobb-angle measurement and LTV selection remain the cornerstone of surgical planning in adolescent idiopathic scoliosis (AIS) but are time-consuming and observer-dependent. Prior AI studies treat landmark detection and segmentation separately and ignore LTV prediction, limiting clinical utility. We propose a unified framework that couples both tasks and yields real-time, reproducible outputs.

Methods
After exclusions, 442 radiographs were split 397/45 for training and validation. A two-stack hourglass network was jointly supervised to output corner-landmark heat-maps, centroid heat-maps, and vertebral masks. Centroid predictions were fitted with adaptive-order polynomials; derivatives defined end-vertebra slopes (Cobb angle) and intersection with the sacral vertical line (LTV). Primary metrics were mean Euclidean landmark error, absolute Cobb-angle error, and LTV accuracy.

Results
Adding segmentation supervision lowered landmark error from 3.09 mm to 2.60 mm ($p < 0.001$). Mean absolute Cobb-angle error across 109 curves was 2.68°, consistent across mild, moderate, large, and severe subgroups (<3° each). Compared with published landmark-only or segmentation-only models, spatial precision improved ≈40 % and angular precision ≈25 %. In severe curves (>45°), the model identified the correct LTV in 90 % of cases.

Conclusion
The proposed pipeline delivers sub-3 mm spatial accuracy, sub-3° angular accuracy, and reliable LTV localization at real-time speed. It offers a one-click alternative to manual assessment and, pending multi-centre prospective validation, could standardize curvature surveillance and streamline fusion-level planning in AIS clinics worldwide.

PODIUM PRESENTATION ABSTRACTS



Seventeen centroids are fitted with a 10th-degree polynomial (blue curve); first-derivative zeros mark the apex (L2), and second-derivative zeros define the upper (T11) and lower (L3) end vertebrae used to calculate the Cobb angle

52. A Comparative Analysis f 4-, 1o2-, and 24-Hour Intervals of Drain-Clamping Reduces Postoperative Blood Loss Following Posterior Spinal Surgery in Adolescent Idiopathic Scoliosis: A Prospective Randomized Controlled Trial

Tinnakorn Pluemvitayaporn, MD

Hypothesis

To analyze and compare the amount of postoperative blood loss in the 4-, 12-, and 24-hour intervals of drain-clamping in adolescent idiopathic scoliosis patients who underwent posterior spinal surgery.

Design

Prospective randomized controlled trial.

Introduction

Adolescent idiopathic scoliosis surgery represents a significant spinal procedure with the potential for considerable blood loss, often necessitating blood transfusion. To mitigate postoperative blood loss, drain-clamping emerges as a viable technique; however, the optimal time intervals for implementing postoperative drain-clamping remain controversial.

Methods

Ninety patients diagnosed with adolescent idiopathic scoliosis who underwent posterior spinal surgery between 2021 and 2024 were evaluated. The patients were randomly divided into three groups: thirty patients underwent postoperative drain clamping at 4-hour intervals, thirty at 12-hour intervals, and thirty at 24-hour intervals. Various demographic and clinical data were collected, including sex, age at surgery, Lenke's curve type, number of instrumented levels, pre- and postoperative major Cobb angles, preoperative hemoglobin and hematocrit levels, intraoperative blood loss volume, total blood loss per fusion segment, and intraoperative blood transfusion requirements. A thorough analysis was conducted to compare the data across the three groups.

Results

The 4-hour intervals of the drain-clamping group demonstrated no significant differences when compared to the 12- and 24-hour intervals, both in terms of total blood loss prior to drain removal and total blood loss per fusion segment. Furthermore, there was no notable variance in the necessity for postoperative blood transfusions across any groups. No serious intra- or postoperative complications were reported in any of the groups analyzed.

Conclusion

4-, 12-, and 24-hour intervals for drain clamping during posterior spinal surgery in adolescent idiopathic scoliosis patients indicate no statistically significant difference in the reduction of postoperative blood loss per level or the necessity for postoperative blood transfusions. Therefore, a 4-hour interval for drain-clamping is suggested to be sufficient for this procedure.

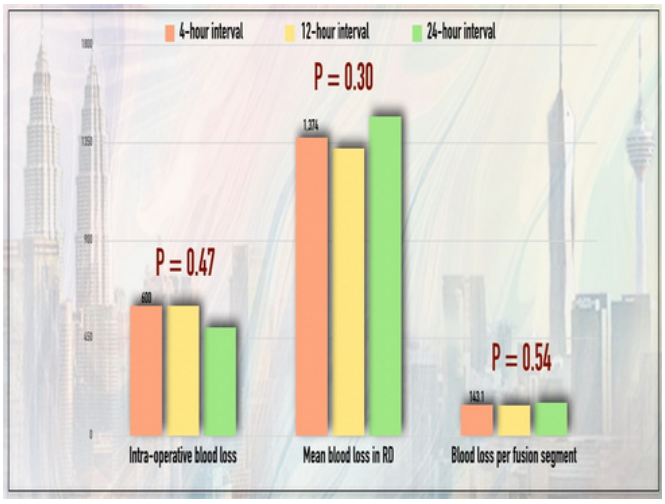


Figure 1 show no statistically significant difference among 3 groups

53. Association Between Genetic Predisposition and Morphological Characteristics in Adolescent Idiopathic Scoliosis

Kazuki Takeda, MD, PhD; Satoshi Suzuki, MD, PhD; Takuro Iwami, MD; Nao Otomo, MD, PhD; Takahito Iga, MD, PhD; Toshiki Okubo, MD, PhD; Masahiro Ozaki, MD, PhD; Narihito Nagoshi, MD, PhD; Morio Matsumoto, MD, PhD; Masaya Nakamura, MD, PhD; Kota Watanabe, MD, PhD

Hypothesis
The strength of genetic factors based on the polygenic risk score (PRS) influences the spinal morphology.

Design
Multi-center cohort study.

Introduction
We previously developed a polygenic risk score (PRS) to predict the risk for the development and progression AIS utilizing the world's largest genome-wide association study (GWAS) dataset. However, no studies have investigated the relationship between PRS and the spinal morphology of AIS. This study aims to elucidate how PRS influences the morphological characteristics of AIS.

Methods
A total of 106 female AIS patients who underwent GWAS were included. The AIS susceptibility PRS was calculated using a previously conducted GWAS cohort (Case/Control = 3,028/28,971). The correlation analyses were conducted between PRS and various parameters including body mass index (BMI), bone mineral density (BMD), Cobb angles (proximal thoracic (PT_Cobb), main thoracic (MT_Cobb), thoracolumbar (TL_Cobb)), main curve flexibility, sagittal spinal alignment (TK, SS, PT, PI, LL, PI-LL mismatch), apical vertebral rotation, vertebral wedging, and pedicle length and diameters on computed tomography (CT).

Results
No significant correlation was observed between PRS and BMI or BMD. While PRS showed no significant correlation with PT_Cobb or TL_Cobb angles, a significant positive correlation with MT_Cobb angle was found ($r = 0.34$, $p = 0.003$), and a significant negative correlation was observed with main curve flexibility ($r = -0.21$, $p = 0.03$). Stratified analysis by curve type revealed that a significant positive correlation between PRS and MT_Cobb angle ($r = 0.34$, $p = 0.003$), and a significant negative correlation between PRS and vertebral wedging ($r = -0.24$, $p = 0.047$) in the thoracic curve group, whereas no correlation was observed in the lumbar curve group. Partial correlation analysis adjusted for MT_Cobb revealed no significant association between PRS and vertebral wedging.

Conclusion
This study demonstrated that higher PRS was associated with increased Cobb angle in the main thoracic curve and reduced flexibility in AIS. However, no significant associations were found between PRS and spinal morphology on CT imaging. These findings suggest that genetic predisposition may contribute to curve progression through mechanisms beyond bone stracture, such as cartilage, nerves, and muscles. Understanding these genetic influences provides new insights into AIS pathogenesis.

54. Effectiveness of the Modified Customised Boston-Style Rigid TLSO Versus the Rigo-Cheneau Style Rigid TLSO for Adolescent Idiopathic Scoliosis

Jess S. Ooi, DIPPMS; Chang Liue; Tansy Koh; *Nicole Lee, PhD*; Kevin B. Lim, MD

Hypothesis
The Rigo-Cheneau style brace produces better brace compliance and treatment outcomes than the modified Boston-style brace.

Design
Retrospective Cohort.

Introduction
This study aims to compare the outcomes of the Rigo-Cheneau brace (RCS) and modified Boston-style brace (MBB) in AIS patients at least 1 year after bracing.

Methods
The records of patients with >= 1-year follow-up X-rays from brace initiation since October 2022, including patients ≥10 years, Risser 0-II, major curve 15-40°, and had no prior bracing. 56 patients prescribed the RCB met the inclusion criteria, and 56 patients prescribed the MBB were randomly selected. The Rigo-Cheneau classification was used. Patients were instructed to brace full-time. Outcomes tracked included: in-brace correction(%), brace compliance, major curve non-progression of ≥6° (treatment success), stability and magnitudes of major curves, progression to surgery, and major curve ≥45°. Independent samples t-test and chi-squared test were used to compare the differences between the two brace cohorts.

Results
67 of 112 patients (60%) were followed up till 1.5-year (±1month) and 50% reached Risser 4-5 at latest visit. Baseline characteristics of the two bracing groups were similar, except for curve pattern, as there were 22% more patients with type B curves in the MBB group, and 21% more patients with type E curves in the Rigo-Cheneau group (p=0.027). However, major curve locations (p=0.891) and magnitude (29.66±5.88° for RCB vs. 28.95±4.76, p=0.481) were similar between the two groups. In-brace correction were similar except for lumbar curves, where correction was greater with the MBB group (64.95%±19.84% vs. 43.21%±24.88%, p=0.001). Brace compliance was similar (12.30±4.75 for Boston-style vs. 11.83±4.74, p=0.602). At latest follow-up, the major curve magnitude (26.82±6.51° for MBB vs. 28.42±7.74°, p=0.481) were similar between the two groups. Treatment success rate was 91% for the MBB group and 84% for the RCB group. 2 patients (4%) in the MBB group and 4 (7%) in the RCB group progressed to surgery or had curve ≥45°.

PODIUM PRESENTATION ABSTRACTS

Conclusion

Treatment success was 84-91% for about 12 hours/day, higher than average for rigid full time bracing of 73.2% (95%; CI 61-86%) according to Costa et al (2021). There was no significant difference in brace compliance and treatment outcomes between MBB and RCB groups.

Table: Bracing treatment and outcomes

Parameter	All patients n=112	Rigo-Cheneau n=56	Modified customised Boston-style n=56	p-value
Initial in-brace correction (°)				
Major	16.65±6.07	15.70±6.30	17.61±5.73	0.096
Thoracic	17.77±8.76	13.39±6.67	23.44±7.92	**<0.001**
Thoracolumbar	17.67±5.16	16.65.98	18.59±5.27	0.228
Lumbar	13.36±6.18	11.36±6.61	15.60±4.87	**0.011**
Percent initial in-brace correction (%)				
Major	58.61±21.28	55.18±21.62	62.03±20.56	0.089
Thoracic	51.12±21.45	49.44±22.27	53.22±20.50	0.440
Thoracolumbar	63.21±18.14	61.03±18.83	65.20±17.69	0.464
Lumbar	53.46±24.96	43.21±24.88	64.95±19.84	**0.001**
S-curve percent correction (%)	53.15±20.41	49.41±21.43	58.32±18.03	0.122
Single percent correction (%)	60.33±19.78	55.02±17.60	63.88±20.63	0.090
Brace wear time per day (hrs)	12.06±4.73	11.83±4.74	12.30±4.75	0.602
Final major curve at last two visits	(n=112)	(n=56)	(n=56)	
>30	32 (29%)	19 (34%)	13 (23%)	0.296
>50	1 (1%)	0 (0%)	1 (2%)	1.000
≥45°	2 (2%)	1 (2%)	1 (2%)	1.000
Progression to surgery	4 (4%)	3 (5%)	1 (2%)	0.618
Progression to surgery or ≥45°	6 (5%)	4 (7%)	2 (4%)	0.679
Progression ≥6°	10 (9%)	6 (11%)	4 (7%)	0.742
Decrease ≥6°	25 (22%)	11 (20%)	14 (25%)	0.651
Unchanged (±5°)	73 (65%)	36 (64%)	37 (66%)	1.000

Bracing Treatment & Outcomes

55. Effectiveness of Dual Rod Translation in Thoracic Kyphosis Restoration for AIS: A Comparison with the Conventional Technique

Yusuke Hori, MD, PhD; Takashi Namikawa, MD, PhD; Masaki Kawamura, MD; Brando Guarrera, MD; Akira Matsumura, MD, PhD

Hypothesis

We hypothesized that the Dual Rod Translation (DRT) technique provides superior thoracic kyphosis (TK) restoration compared to the conventional rod rotation (RR) method, without compromising coronal curve correction, in thoracic AIS patients.

Design

Retrospective cohort study.

Introduction

Thoracic AIS is frequently associated with hypokyphosis, and inadequate TK restoration has been reported with conventional RR techniques. The DRT technique corrects scoliosis by applying translational forces after bilateral rod placement, theoretically enhancing TK restoration. This study aimed to compare radiological and clinical outcomes between DRT and RR techniques.

Methods

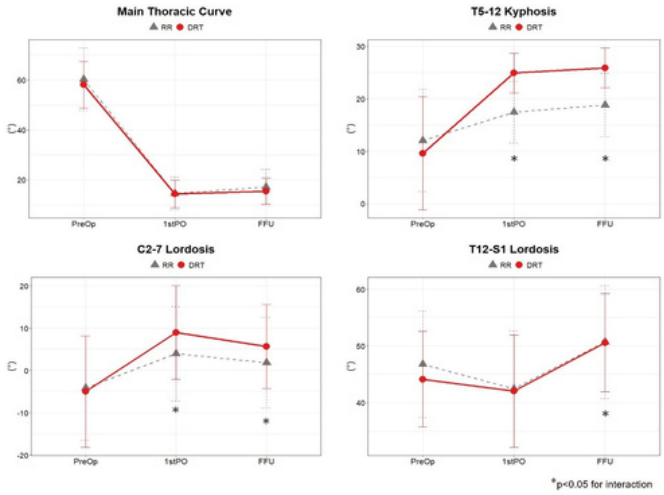
A total of 229 AIS patients with Lenke type 1-3 curves (199 females, mean age 16 ± 4 years) who underwent posterior spinal fusion with at least 1-year follow-up were retrospectively analyzed. Patients were divided into the DRT group (n=74) and RR group (n=155). Radiological parameters, including coronal curve, TK, cervical lordosis (CL), and lumbar lordosis (LL), were assessed preoperatively, at 1 week postoperatively, and at final follow-up. Changes over time were evaluated using mixed-effects models. SRS-22 scores were also compared.

Results

A total of 74 patients were included in the DRT group and 155 in the RR group. The main thoracic curve significantly improved in both groups (DRT: 58° pre-op to 14° at post-op and 15° at final follow-up; RR: 60° to 15° and 17°, respectively), with no significant difference between groups ($p = 0.467$). TK increased significantly more in the DRT group (DRT: 10°to 24°and 25°; RR: 12° to 17° and 19°, respectively; $p < 0.01$). Similarly, CL improved significantly more in the DRT group (DRT: -5° to 9°and 6°; RR: -4° to 4° and 2°, respectively; $p < 0.01$). LL also showed greater improvement in the DRT group (DRT: 44°to 42°and 51°; RR: 47° to 42° and 51°, respectively; $p = 0.03$). Improvements in SRS-22 scores were comparable between groups.

Conclusion

The DRT technique achieved equivalent coronal curve correction while providing superior TK restoration and favorable reciprocal alignment changes compared to the RR technique, supporting its efficacy for sagittal balance restoration in thoracic AIS.



Changes in main thoracic curve, TK, CL, and LL are shown. DRT provided greater thoracic kyphosis, cervical lordosis, and lumbar lordosis restoration. *$p < 0.05$ for group-by-time interaction.

PODIUM PRESENTATION ABSTRACTS

56. Which Radiological Measurements Correlate Best with Patient Perceived Post-Operative Shoulder Imbalance Following Posterior Spinal Fusion for AIS?

Anand K. Ramalingam, MS(Ortho); Nicole Lee, PhD; Neeraj Mishra, MRCS(Ed); Lavinia Somanesan, BSc; Jess S. Ooi, DIPPMS; Stacy Ng, FRCS; Kevin B. Lim, MD

Hypothesis
The commonly used radiological measurements all correlate with patient perception of shoulder imbalance after PSIF for AIS.

Design
Retrospective cohort.

Introduction
Shoulder imbalance following posterior spinal instrumentation and fusion (PSIF) for adolescent idiopathic scoliosis (AIS) can affect a patient's self-esteem and confidence. The study aims to correlate patient-perceived shoulder imbalance with radiological measurements and assess its impact on health-related quality of life (HRQoL) post-operatively.

Methods
AIS patients who underwent PSIF with a follow-up of ≥6 months were included. Patients self-assessed shoulder imbalance using the frontal view of the Trunk Appearance Perception Scale (TAPS) and completed the Scoliosis Research Society-22r (SRS-22r) questionnaire. Two independent orthopaedic surgeons measured the clavicular angle, clavicle-rib intersection difference, T1-tilt angle, and first rib angle from post-operative X-rays.

Results
From June 2023 to January 2024, 64 patients (51 females, 13 males), with a mean age of 16.51±2.60 years and a mean follow-up of 20.51±13.33 months post-PSIF, qualified for the study. Pearson's correlation demonstrated that TAPS showed moderate negative correlation with the clavicle-rib intersection difference (r=-0.3, p=0.042), T1-tilt angle (r=-0.3, p=0.041), and first rib angle (r=-0.3, p=0.013). However, there was no correlation between patients' perception and the clavicular angle (r=-0.2, p=0.073). Furthermore, TAPS showed a moderate positive correlation with Self-Image (r=0.5, p<0.001), and weak positive correlation with Management Satisfaction (r=0.2, p=0.047) and Total SRS-22r scores (r=0.3, p=0.017). After adjusting for confounding factors, multivariate linear regression analysis showed that TAPS were positively associated with the Self-Image and Total scores of the SRS-22r.

Conclusion
Clavicle-rib-intersection difference, T1-tilt and first rib angle have a moderate correlation with patient-perceived post-operative shoulder balance also correlated with improvements in self-image and management satisfaction, and ultimately patients' HRQoL.

57. Lowest Instrumented Vertebra (LIV) Index as a Supplemental Indicator to Lastly Touched Vertebra for Selection of The Fusion Level in Main Thoracic Adolescent Idiopathic Scoliosis

IHsin Chen, MD; *Chih-Wei Chen, MD*; Jui-Yo Hsu, MD; Po-Yao Wang, MD; Yu-Cheng Yeh, MD; Po-Liang Lai, MD; Ming-Hsiao Hu, MD; Shu-Hua Yang, MD

Hypothesis
LIV-index, defined as the summation of the proximity of lowest instrumented vertebra (LIV) relative to neutral vertebra (NV) and stable vertebrae (SV), expressed as (LIV-NV)+(LIV-SV), effectively predicts postoperative distal adding-on (DA).

Design
A retrospective cohort study.

Introduction
Selecting the last substantially touched vertebra (LSTV) or the lastly touched vertebra (LTV) as the LIV has been shown to prevent DA in Lenke 1A and 2A curves or Lenke 1B and 1C curves, respectively. However, DA was still observed in our cohort even when fusing at or distal to LSTV or LTV when undergoing thoracic curve fusion (TCF). The purposes of this study are to demonstrate the effectiveness of LIV-index, defined as the summation of the proximity of LIV relative to NV and SV as (LIV-NV)+(LIV-SV), in predicting postoperative DA.

Methods
A multicenter observational analysis was conducted on AIS patients who underwent TCF for major thoracic curves (Lenke 1&2 curves) with LIV at or distal to LTV. Subgroup analysis was performed between the DA and non-DA groups.

Results
112 patients were included in the study with 10 patients presenting with DA during follow up. Subgroup analysis revealed that patients with DA had higher LIV compared to NV and higher LIV compared to SV. All patients in the DA group had an LIV-index < 0, indicating LIV-index < 0 is a significant risk factor for DA (sensitivity=100%, specificity=92%, PPV=55.5%, NPV=100%, p<.0001). Additionally, the sub-subgroup analysis for patients under 15 years old at the time of surgery also demonstrate strong discrimination of LIV-index for DA (sensitivity=100%, specificity=94%, PPV=77%, NPV=100%, p<.0001).

Conclusion

When fusing at or distal to LTV/LSTV for Lenke type 1 and 2 curves, the LIV-index—defined as the sum of coronal balance (LIV-SV) and vertebral column rotation (LIV-NV)—can be used to guide LIV selection and help prevent DA, particularly in younger patients.

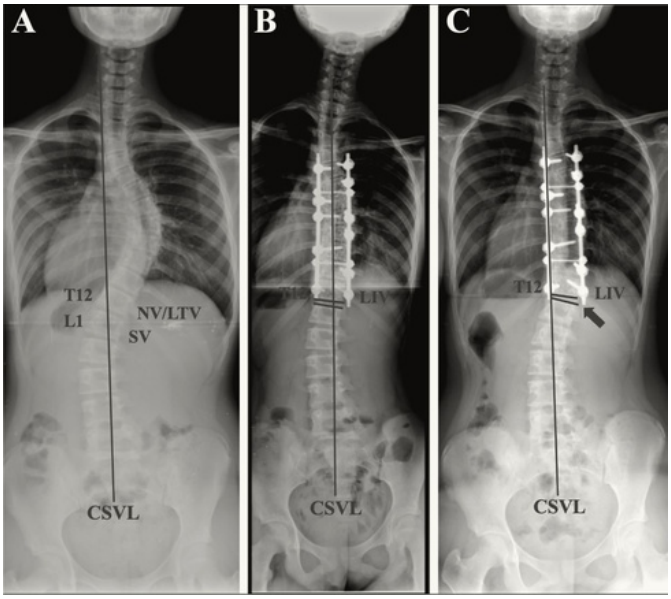


Fig. 1. (A) Preoperative and (B) immediately postoperative erect standing whole-spine radiographs of a 13-year-old girl with Lenke 1BN curve. The levels of LIV, LTV, LSTV, NV, and SV corresponded to T12, T12, T12, T12, L1, respectively. The LIV-index for this patient was calculated as (LIV-NV) + (LIV-SV) = 0 + (-1) = -1. (C) Distal adding-on phenomenon was observed 2 years after surgery, as indicated by the arrow.

58. Three-Column Osteotomy versus Halo-Gravity Traction Combined with Posterior Column Osteotomy in the treatment of Dystrophic Neurofibromatosis Type 1 Kyphoscoliosis: A Retrospective Comparative Cohort Study.

Yuan-Shun Lo, MD, PhD; Erh-Ti Ernest Lin, MD; Yi-Hsun Huang, MD; Hung-Lun Hsieh, MD; Hsien-Te Chen, MD, PhD

Hypothesis

Although PCO and HGT have been extensively studied in patients with dystrophic NF1, the literature on the application of 3CO in this population remains scarce, with its clinical and radiographic outcomes being a subject of debate.

Design

Retrospective Comparative Cohort Study.

Introduction

dystrophic neurofibromatosis type I (NF1) kyphoscoliosis presents unique challenges for corrective spinal surgery due to anatomical abnormalities. To compare the radiographic and clinical outcomes of NF1 kyphoscoliosis patients undergoing 3CO, HGT, or PCO and to evaluate their efficacy and safety in this cohort, different treatment strategies and their associated complication rates warrant further comprehensive investigation.

Methods

dystrophic NF1 kyphoscoliosis were divided into 3CO, HGT, and PCO groups based on the surgical strategy. Radiographic parameters were measured preoperatively, postoperatively, and at each follow-up. Intraoperative and postoperative complications were recorded for each patient, and patient-reported outcomes were assessed using the Scoliosis Research Society-22 (SRS-22) questionnaire. Differences among the three groups were analyzed.

Results

A total of 9 patients were included in the 3CO, 22 in HGT group, 95 in PCO groups, respectively. Significant differences among the three groups were found in terms of operation time ($p = 0.011$), estimated blood loss ($p = 0.003$), and number of satellite rod techniques ($p = 0.013$). At pre-operation, the Cobb angles of main curves were 84.3 ± 24.6° in 3CO group, 99.1 ± 24.3° in HGT group, 60.0±16.8° in PCO group. At post-operation, significant post-operative improvements were found in the Cobb angles of the main curves, apical vertebral translation (AVT), segmental kyphosis (SK), and deformity angular ratio (DAR) in all three groups ($p < 0.001$). No significant correction loss was observed during the follow-up. Six complications were found in the 3CO group, 13 in the HGT group, and 40 in the PCO group.

Conclusion

PCO, 3CO, and HGT could be applied to dystrophic NF1 patients. The 3CO is also associated with increased perioperative complications.

Fig. 1. A 13-year-old female with dystrophic NF-1 kyphoscoliosis underwent T10/11 VCR+PSF, reducing Cobb angle from 140° to 70°, SK from 130° to 50°, DAR from 47° to 26° per level.

PODIUM PRESENTATION ABSTRACTS

59. Vertebrae and Morphometric Anomaly of Neuromuscular Scoliosis with Myelomeningocele Patients: Magnetic Ressonance Imaging Study

Farid Yudoyono, MD; Yosafat Kurniawan, MD

Hypothesis
Life expectancy of pediatric patients neuromuscular scoliosis with myelomeningocele (MMC) has continued to improve over the past several decades. However, little is known about the vertebrae and moprhometric anomaly.

Design
Retrospective Study.

Introduction
The authors aimed to provide a report on the vertebrae and morphometric anomaly of congenital scoliosis with myelomeningocele (MMC) patients.

Methods
A retrospective data on patient of congenital scoliosis with myelomeningocele 2020-2025. There was 18 patient recorded according inclusion criteria.

Results
We enrolled 18 participants, consisting of 12 females (66.6%) and 6 males (33.3%), This study revealed the prevalence more females are affected with both congenital scoliosis and MMC than males aged between 1 and 240 day old, with an average age of 24 day old. Pelvic incidence was 70.3°±23.1°, pelvic tilt was 25.5°± 11.2°, sacral slope was 43.7°± 12.6°. Vertebrae anomaly included Spina bifida (100%), low lying conus (72.2%), hemivertebrae (16.6%), syringomyelia (11.1%).

Conclusion
Congenital Scoliosis is among the most common and challenging comorbidities from which patients with MMC suffer. Although important epidemiological, vertebrae anomaly and spinopelvic morphometric trends are evident, larger, prospective studies are needed to discover ways to more accurately counsel and more optimally treat these patients.

60. Progression of Segmental Thoracic Kyphosis Following Thoracolumbar Hemivertebra Resection in Patients with Congenital Scoliosis

Jae Hyuk Yang, MD, PhD; Hong Jin Kim, MD, PhD; Hyung Rae Lee, MD; Jun Hyun Kim, MD; Seoung Woo Suh, MD, PhD

Hypothesis
Thoracolumbar hemivertebra resection (HVR) may be associated with detrimental effect due to progression of segmental thoracic kyphosis (TK) in patients with congenital scoliosis (CS).

Design
A single-center retrospective cohort study.

Introduction
HVR via the posterior approach is considered the surgical treatment of choice for CS in paediatric patients. However, alterations in sagittal alignment, particularly in the thoracolumbar region, may have adverse effects following HVR. However, few studies have reported on the radiological outcomes of segmental TK in children with CS.

Methods
A total of 26 CS patients who underwent HVR between T10 and L2 were retrospectively analyzed to evaluate changes in sagittal parameters at preoperative, postoperative, and last-follow-up status. Demographic data, operative outcomes, radiological variables, and complications were collected. Radiological variables included both coronal (Cobb's angle, coronal balance) and sagittal (sagittal vertical axis, TK, segmental TK, and lumbar lordosis [LL]) parameters. Spearman correlation analysis and multiple linear regression model were used to identify factors influencing segmental TK.

Results
HVR was most commonly performed at the T12 (n = 9, 31.0%) and L1 (n = 11, 37.9%) levels, with a mean of 2.6 instrumented segments, over a mean follow-up period of 5.3 years. The segmental TK was significantly corrected following HVR, from 24.5° to 11.8° ($P < 0.001$). However, a significant progression was observed at the last follow-up, with the segmental TK increasing to 39.4° ($P < 0.001$). Metal failure occurred in 42.3% (n = 11) of patients. Multiple linear regression analysis revealed that postoperative TK (B = 0.54, SE = 0.14; $P < 0.001$) was a significant factor influencing the progression of segmental TK.

Conclusion
Segmental thoracic hyper-kyphosis were observed following HVR in thoracolumbar lesion in patients with CS. Maintenance of postoperative TK is important to prevent the progression of the segmental kyphosis and catastrophic metal failures. In addition, postoperative bracing may be required to maintain thoracic kyphosis and prevent progression of segmental kyphosis until acceptable fusion and consolidation are achieved.

PODIUM PRESENTATION ABSTRACTS

61. The Utility of Cervical Vertebral Maturation Method for Staging Skeletal Growth and Curve Progression in Patients with Adolescent Idiopathic Scoliosis

Samuel Tin Yan Cheung, MBBS; Garvin Chi Chun Cheung; Jason Pui Yin Cheung, MD, MBBS, MS, FRCS; Prudence Wing Hang Cheung, PhD, BDSc (Hons)

Hypothesis
CVM has a utility in staging skeletal growth and curve progression in AIS.

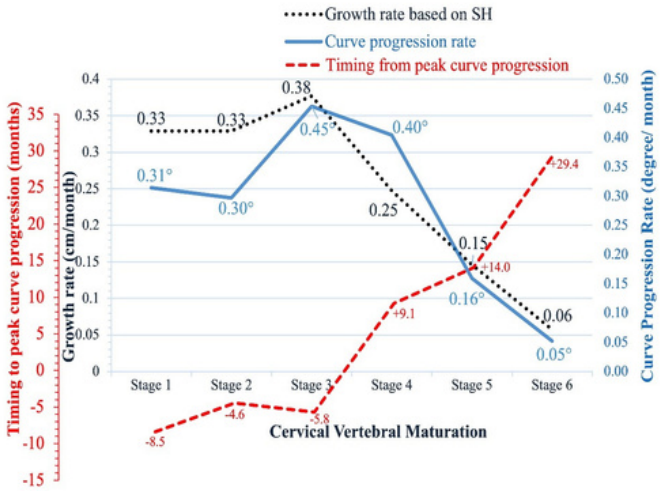
Design
142 AIS patients were prospectively followed from Risser stage 0, until growth completion. Longitudinal data collected includes arm span (AS), body height (BH), sitting height (SH), coronal Cobb angle, and maturity assessments from CVM and other indices. CVM was evaluated through its relationship with growth rates and curve progression rates.

Introduction
Cervical vertebral maturation (CVM) is a skeletal maturity method that can be assessed routinely on whole spine radiographs to minimise radiation exposure. Originally used in orthodontics, its role in staging adolescent growth spurt and curve progression in adolescent idiopathic scoliosis (AIS) remains unclear. This study aimed to investigate growth rates across CVM stages, its cutoff for indicating peak growth (PG) versus growth cessation (GC), and its relationship with coronal curve progression.

Methods
A total of 1107 spine radiographs corresponding to longitudinal growth rates were analysed to detect PG and GC in each patient, with predictive accuracy assessed using receiver operating characteristic (ROC) curve analysis. Curve progression rate of each CVM stage in treatment-naïve patients was plotted against timing to peak curve progression. Growth rates across stages were analysed using ANOVA. For subgroup analysis of curve progression, only treatment-naïve patients and those whose follow-ups occurred before the initiation of bracing or surgery were included. Curve progression was calculated by rate of Cobb angle change (degrees/month). The time difference between each visit and peak curve progression was calculated.

Results
CVM correlated most with PFMI ($\tau b = 0.662$, $p < 0.001$). CVM stage 3 and 6 showed the respective highest and lowest mean growth rates in SH and AS. CVM stage 3 predicted PG with an area under the curve (AUC) of 0.711-0.720. CVM stage 5 predicted GC with AUC of 0.840-0.850. CVM stage 3 had the highest curve progression rate (0.45° per month). Peak curve progression occurred 5.8 months after CVM 3, and 9.1 months before CVM 4, lagging behind PG by 6.5 months.

Conclusion
Conclusion CVM stage 3 indicates peak growth, while stage 6 marks growth cessation. In this cohort of AIS patients, GC is more accurately predicted than PG by CVM. Peak curve progression occurred between CVM stage 3 and CVM stage 4.



62. Efficacy of Suspension Bending Cast for Early Onset Scoliosis

Keisuke Masuda, MD, PhD; Vidyadhar V. Upasani, MD; Michael P. Kelly, MD; Peter O. Newton, MD

Hypothesis
We hypothesize that the suspension bending cast (SBC) provides effective non-surgical treatment for early onset scoliosis (EOS) and contributes to delaying the need for surgical intervention.

Design
Retrospective Cohort Study.

Introduction
Elongation-derotation-flexion Mehta casts are commonly used in the treatment of EOS. We developed a novel suspension bending cast (SBC) technique that enables coronal correction through suspension-assisted bending and rotational correction through molding. The aim of this study was to evaluate the long-term outcomes of SBC at a single institution and to identify prognostic factors associated with curve improvement.

Methods
A retrospective review was conducted on 49 patients with EOS who underwent SBC between 2011 and 2023. Inclusion criteria included initiation of casting under the age of 10 and a minimum follow-up

period of 2 years. Cobb angles were measured before the first cast, after the first cast, at the end of the last cast, and at final follow-up. Rib phase and rib-vertebral angle difference (RVAD) prior to initial casting were also measured. We analyzed rib phase, RVAD, curve improvement, and the type of scoliosis diagnosis.

Results

The median age at initial casting was 44 months. The median number of casts was 3, and the median follow-up period was 58 months. The time from the first cast application to surgery was 38.6 months. Of the 49 patients, 31% went from cast treatment to definitive fusion, and an additional 31% underwent additional surgery before definitive fusion. The median Cobb angle was 63° before casting, improved to 21° after the first cast, but progressed to 67° at the final follow-up. The improve group showed a significantly higher initial correction rate compared to the unchange and worsen groups. Idiopathic scoliosis group demonstrated a significantly greater initial correction than non-idiopathic group. No significant differences were observed in final Cobb angle or correction rate based on rib phase or RVAD.

Conclusion

The suspension bending cast showed high initial correction in patients with moderate to severe EOS and contributed to delaying surgical intervention. A higher correction rate after the first cast was associated with long-term curve improvement, indicating that initial correction of casting may be an important prognostic factor.

Suspension bending cast procedure

63. A Comprehensive Analysis of Potential Complications after Oblique Lumbar Interbody Fusion: A Review of Postoperative Magnetic Resonance Scans in Over 400 Cases

Su Hun Lee, MD, PhD; Dongwuk Son, MD, PhD

Hypothesis

Routine postoperative MRI after OLIF can detect clinically relevant complications that are otherwise underrecognized.

Design

Retrospective cohort study using routine 1-week postoperative MRIs in patients undergoing OLIF with indirect decompression.

Introduction

OLIF is a minimally invasive fusion technique that avoids posterior muscle dissection and achieves indirect decompression. While its clinical utility is growing, potential complications detectable only through imaging remain underexplored. This study aimed to assess early postoperative MRI findings after OLIF to identify subclinical or symptomatic complications.

Methods

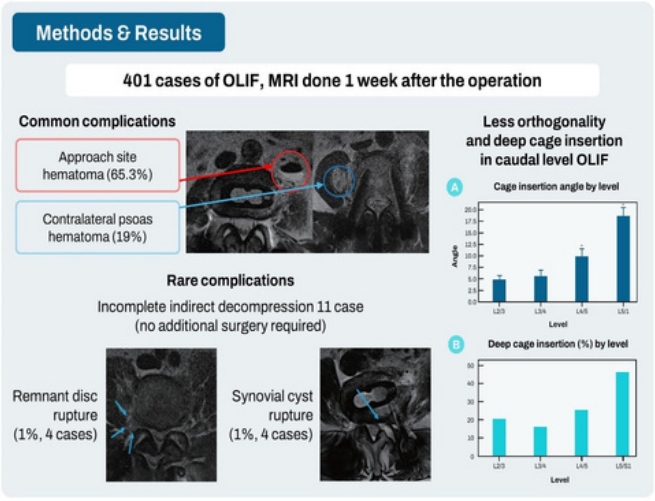
Among 650 OLIF cases between April 2018 and April 2022, 401 patients (650 levels) met inclusion criteria: indirect decompression via pre-psoas approach, posterior percutaneous screw fixation, and routine MRI 1-week post-op. Post-op MRIs were evaluated for approach site and contralateral psoas hematomas, cage position and insertion angle/depth, degree of indirect decompression

Results

Approach site hematomas were found in 65.3% of cases and contralateral psoas hematomas in 19%, both mostly asymptomatic. Deep cage insertion and steeper angles were more frequent at lower levels (L4/5, L5/S1), with one case showing right foraminal contact and mild radiculopathy. Radiologically insufficient decompression (post-op grade C) occurred in 4.66% but did not require revision. Remnant disc rupture occurred in 4 cases (1%), 2 with foot drop; one patient underwent revision. Synovial cyst rupture occurred in 4 cases, with one patient developing bilateral foot drop requiring emergency laminectomy.

Conclusion

Routine early MRI after OLIF reveals a range of complications—many subclinical, some serious. While hematomas and radiologic under-decompression were frequent but clinically benign, rare events like disc and synovial cyst rupture may cause significant symptoms. These findings support the value of routine MRI and meticulous technique in OLIF surgery.



Common and rare complications detected by routine postoperative MRI 1 week after OLIF. Caudal levels showed less orthogonal and deeper cage insertion, contributing to specific complications such as remnant disc and synovial cyst rupture.

64. Dry Spinal Tuberculosis: An Atypical Face of Spinal Koch's

Tushar N. Rathod, MS; Deepika Jain, MS; Yash Ved, MS

Hypothesis
There is a significant difference in neurological recovery patterns and overall prognosis between patients with dry and wet forms of spinal tuberculosis.

Design
A retrospective cohort study.

Introduction
Based on histopathology, 2 predominant forms of spinal tuberculosis (TB) are known: dry and wet types. Wet TB involves abscess formation and is the exudative form, whereas dry TB has mainly sequestrum formation with minimal exudate. The dry type shows poorer recovery patterns than the wet counterparts, due to vasculitis, ischemia, or tubercular myelitis, rather than isolated mechanical compression, which may lead to neurological deficit which may not respond to treatment.

Methods
Data of 7 years was analyzed from single centre IPD. A total of 240 patients with spinal TB were admitted through the study period, of which 22 had dry TB (Group 1). The remaining patients had wet TB, of which 22 best matched patients were selected using propensity score matching to form a comparison group. Clinico-radiological assesment was done. Measurements included vertebral body height loss, deformity, canal encroachment, cord diameter, altered cord signal intensity and loss of CSF space. Functionally, the ambulatory status of the patient at final follow-up and neurologic status measured by ASIA and LEMS scoring was assessed. Dry TB was diagnosed when imaging suggested granulation tissue (heterogenous hypo- or hyper-intensity on T2WI sequence), with at least 1 of the 2 factors (1) absence of anterior or posterior epidural abscess formation within the spinal canal (2) a canal encroachment of <30%.

Results
The dry type showed partial or no return to ambulation (75% vs 31.5% in wet, p=.01) at 12-months and the time taken to reach final ambulatory level was more (9.16 months vs 2.9 months in wet), despite having a lower average deformity (cobbs' angle 16.5° versus 20.95 in wet (p=.132)), lower mean canal-encroachment (24.9% vs 50.09% in wet, p<.01) and preserved posterior-CSF flow as compared to wet TB (p=.02). 6/20 (30%) of dry TB and 0% of wet TB were ASIA A, and 11/20 (55%) of dry TB and 18/22 (81.8%) of wet TB were ASIA E. (p=.04)

Conclusion
Poorer functional outcome is associated with dry type of TB in terms of time to ambulation and final ambulatory status despite having lesser bony destruction and abscess formation, with cosequently lesser mechanical cord compression.

65. The Leverage of Technique: High-Grade Spondylolisthesis Treated with Archimedes Manoeuvre – Insights from a Single Centre

Bhavuk Garg, MS; *Akashdeep S. Bali, MBBS, MS*; Anirudh D. Krishna, MBBS

Hypothesis
The Archimedes manoeuvre, for spondylolisthesis reduction during single-stage transforaminal lumbar interbody fusion (TLIF), provides a safe, effective, and reproducible method for achieving significant reduction and stabilization in patients with high-grade dysplastic spondylolisthesis.

Design
Retrospective.

Introduction
To describe the simple tips, tricks and surgical technique (Archimedes Manoeuvre) for a single-stage transforaminal lumbar interbody fusion for high-grade spondylolisthesis. We used the Cobb elevator to lever out the listhetic vertebrae using the sacrum as a fulcrum.

Methods
A Retrospective analysis from 2015 to 2023 with at least 2 years follow-up, patients aged over 10 years old with high-grade spondylolisthesis, operated using the described surgical technique, were reviewed. Data about blood loss, operative time, length of stay, and intraoperative and postoperative complications were noted. Meyerding grade (M), lumbar lordosis (LL), pelvic incidence

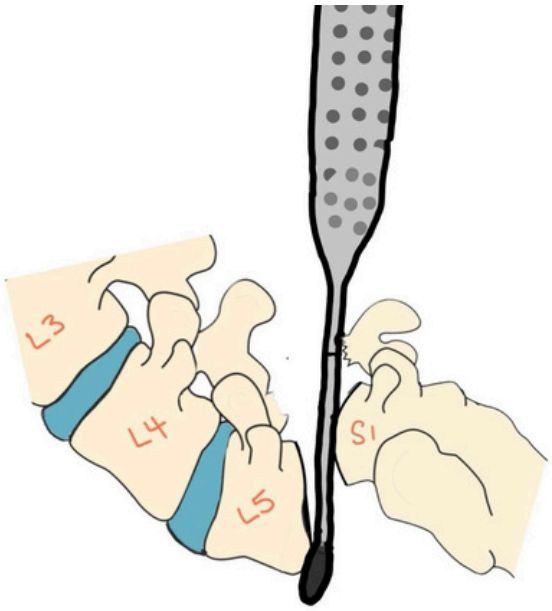
(PI), pelvic tilt (PT), lumbosacral angle (LSA), slip angle (SLIP), and severity index were measured on preoperative and last follow-up. Sagittal vertical axis (SVA) was used to assess sagittal balance.

Results

Of the 25 included patients, L5-S1 arthrodesis was performed in 23 cases, and L4-S1 arthrodesis was performed in 2 cases. Average surgical time was 134.5 ± 10.7 min; average blood loss was 433 ± 65 mL. The average length of stay was 2.5 ± 1.5 days. The SLIP angle improves from 31.6 ± 13.4 to 14.4 ± 8.8 ($p = 0.001$); the lumbosacral angle improves from 66.05 ± 11.6 to 85.9 ± 10.6 ($p = 0.01$); the Meyerding grade improves from 3.8 ± 0.6 to 1.6± 0.6, and the SVA decreased significantly ($p = 0.02$). No significant changes were observed in PI, PT and SS. Lumbar lordosis (LL) did not change significantly. One Patient required revision surgery to extend the construct. At last follow-up, no patient had a surgical site infection or nor was a pseudoarthrosis observed.

Conclusion

“Give me a lever (Cobb's) long enough and a fulcrum (posterosuperior part of sacrum) on which to place it, and I shall move the world (Listhetic Vertebrae) as quoted by Archimedes; this stands true for high-grade spondylolisthesis Although technically demanding, reduction and fusion with a one-stage all-posterior approach using the Archimedes manoeuvre proves to be a safe and effective.



The technique of leveraging the listhetic vertebrae

66. Efficacy Comparison of Combined Nanocrystalline Eggshell Hydroxyapatite with Umbilical Cord Mesenchymal Stem Cell (UC-MSC) Secretome and Commercial RhBMP-2 for Lumbar Interbody Fusion: Randomized Controlled Trial Study

Yudha Mathan Sakti, MD; Zikrina A. Lanodiyu, MD; Deas M. Emiri, MD; Wilhelmina W. Wijaya, MD

Hypothesis

Lumbar fusion augmentation using UC-MSC secretome has a comparable efficacy to Rh-BMP2 as the biologic material combination with nanocrystalline eggshell hydroxyapatite bone graft.

Design

Randomize Controlled Trial.

Introduction

Lumbar fusion is challenging in various spinal disorders. Since the bone regeneration process in spinal fusion is not part of natural healing, the risk of non-union exists due to various patient conditions. The concept of fusion using bone graft has shifted from autologous bone graft to synthetic or natural source bone graft The past decade has shown the rapid evolution of biological treatments to improve spinal fusions. However, there are concerns regarding the efficacy of umbilical cord mesenchymal stem cell (UC-MSC) secretome as biological augmentation. Our study will analyze efficacy of UC-MSC secretome and its comparison with Commercial RhBMP-2.

Methods

24 Patients with degenerative lumbar diseases planned for posterior lumbar inter-body fusion (PLIF) were included. The control group received block porous nanocrystalline eggshell hydroxyapatite (BPNEHA) bone graft referred as group A , while the 2 intervention groups received a combination of BPNEHA bone graft + commercial rhBMP-2 referred as group B and BPNEHA + UC-MSC secretome as group C. We evaluated the differences in radio-logical X-ray and CT Scan for final evaluation after 6 months. Functional parameters, inflammatory markers (WBC, ESR, CRP), liver function (SGOT and SGPT), and kidney function (BUN and Creatinine) were analyzed.

Results
All of groups show decreasing Pain Levels (VAS) with no significant difference. Significant functional output identified in Group B and Group C post PLIF with the sig. 0,030 and 0,045. Biologic augmentation either Rh-BMP2 or Secretome increase the inflammatory marker significantly but no sign of infection in blood workup. Secretome (group C) give a longer ESR until 28th day, compared to other groups. Radiological imaging show comparable significant fusion degree between Group B (BPNEHA + Commercial BMP2) and Group C (Bonegraft + UC-MSC Secretome).

Conclusion
Lumbar fusion using UC-MSC secretome combined with nanocrystalline eggshell hydroxyapatite bone graft is safe. Augmentation of UC-MSC secretome could give a similar result of fusion as well as using commercial Rh-BMP2

67. Optimal Placement of Supplemental Accessory Rods to Prevent Rod Fracture at the Lumbosacral Junction in Long Spinopelvic Fixation Using Lateral Interbody Fusion: A Biomechanical Experimental Study Using aSynthetic Bone Model and a Finite Element Model

Ryuichiro Nakanishi, MD; Shunji Tsutsui, MD; Ei Yamamoto, PhD; Takuhei Kozaki, MD; Akimasa Murata, MD; Hiroshi Yamada, MD

Hypothesis
The use of a longer, uncontoured accessory rod (AR) could reduce the incidence of rod fracture (RF) in a long spinopelvic fusion.

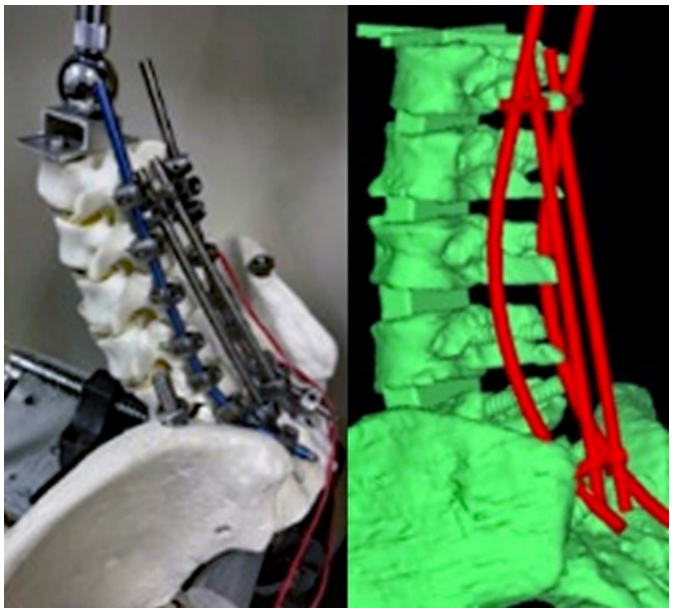
Design
Biomechanical study.

Introduction
High rates of postoperative RF at the lumbosacral junction have been reported after long spinopelvic fixation. Supplemental ARs and lateral interbody fusion are commonly-used and reportedly effective in the prevention of rod fractures. However, optimal AR placement to mitigate rod stress at the lumbosacral junction is unclear. We used a synthetic bone model and a finite element model concurrently to address their respective shortcomings.

Methods
Both models included the lumbar spine (L1-L5) and the pelvis, and were instrumented with screw and rod system and lateral interbody fusion cages to closely resemble actual surgical procedures. Four different constructs were: two primary rods (PRs) without ARs, PRs + contoured long ARs, PRs + short ARs, and PRs + straight long ARs. In our synthetic model, we applied vertical load to the constructs and measured rod strain at L5-S1 using strain gauges. We calculated a mean value of the five rods in each construct. In our finite element model, we measured maximum principal stresses at L5-S1 after the application of flexion/extension, lateral bending and axial rotation loads.

Results
In our synthetic bone model, there was significant reduction of rod strain by 52% in PRs + straight long ARs compared with PRs without ARs (p=0.023). Reduction of average principal stress in the finite element model was observed in PRs + straight long ARs by up to 44.2% (highest against flexion load) compared with PRs without ARs.

Conclusion
Concurrent biomechanical analyses using a synthetic bone model and a finite element model were conducted. We recommend straight long ARs to prevent RF at the lumbosacral junction in long spinopelvic fixation.



Synthetic bone and finite element models.

68. The Link Between a Growth Mindset and Health-Related Quality of Life in AIS Patients on Brace Treatment
Joelle L. Wang, MPsych(Clinical); Nicole Lee, PhD; Jess S. Ooi, DIPPMS; Kevin B. Lim, MD

Joelle L. Wang, MPsych(Clinical); Nicole Lee, PhD; Jess S. Ooi, DIPPMS; Kevin B. Lim, MD

Hypothesis
AIS patients on brace treatment who have a Growth Mindset report better HRQoL scores.

Design
Retrospective cohort study.

Introduction
This study explores the association between growth mindset - specifically related to intelligence and learning - and health-related quality of life (HRQoL) in adolescent idiopathic scoliosis (AIS) patients undergoing brace treatment.

Methods
AIS patients treated with bracing at a tertiary care children's hospital from 2021 to 2023 were enrolled. Patients completed the SRS-22r and the Growth Mindset Scale (GMS), and were divided into three distinct groups based on their scores from the GMS: Fixed Mindset (1.0-3.0), Intermediate Mindset (3.1-3.9), and Growth Mindset (4.0-6.0).

Results
A total of 208 patients met the inclusion criteria. Mindset distribution was as follows: 44% exhibited a Fixed mindset, 10% an Intermediate mindset, and 46% a Growth mindset. To improve clarity, patients with an Intermediate mindset were excluded from further analysis. T-test analysis revealed that AIS patients with a Fixed mindset reported significantly lower Management Satisfaction scores than those with a Growth mindset (3.47±0.74 vs. 3.81±0.73, p=0.002). After adjusting for confounders, multivariate analysis confirmed that a Fixed mindset was associated with lower Management Satisfaction compared to a Growth mindset (B = -0.270, 95% CI: -0.476, -0.064, p=0.011). Additionally, longer brace-wearing hours were linked to increased Management Satisfaction (B=0.022, 95% CI: 0.001, 0.043, p=0.033). However, there was no statistically significant difference in average daily brace-wearing hours between Fixed and Growth mindset groups (13.75±5.11 vs. 12.99±5.35, p=0.323), and multivariate analysis showed mindset did not influence brace-wearing hours (B=0.155, 95% CI: -1.310 – 1.619, p=0.835).

Conclusion
This study suggests that mindset orientation significantly impacts HRQoL in AIS patients, particularly regarding Management Satisfaction. These findings underscore the importance of considering individual mindset in patient care. Personalised interventions based on mindset may enhance patient satisfaction.

69. Delayed Extubation Following Corrective Surgery for Severe Kyphoscoliosis: What are the Roles of Pulmonary Arterial Hypertension and Chronic Respiratory Failure?

Zhen Liu, MD, PhD; Xiaokang Wang, MD; Zezhang Zhu, PhD; Yong Qiu, MD; Jie Li, MD, PhD

Hypothesis
The coexistence of pulmonary arterial hypertension (PAH) and type 2 respiratory failure (T2RF) constitutes the highest-risk profile following spinal deformity surgery.

Design
Patients were stratified into four cohorts by PAH/T2RF status. The outcomes was assessed through comparisons of delayed extubation rates and postoperative adverse event incidence.

Introduction
Severe kyphoscoliosis causes pulmonary dysfunction and chronic respiratory failure. Persistent hypoxemia elevates pulmonary arterial pressure, progressing to PAH. Surgical correction improves outcomes but carries high perioperative risks, particularly delayed extubation which prolongs ICU stays and increases mortality. The specific impact of preoperative T2RF and PAH on prolonged ventilation remains unstudied. This research investigates outcomes in severe pulmonary dysfunction patients stratified by T2RF and PAH comorbidity.

Methods
This retrospective single-center study analyzed 120 severe spinal deformity patients. Patients were stratified into four cohorts: Group A (PAH−/T2RF−), B (PAH−/T2RF+), C (PAH+/T2RF−), D (PAH+/T2RF+). The impact of PAH and T2RF on outcomes was assessed through intergroup comparisons of delayed extubation rates and postoperative adverse event incidence.

Results
Group D (PAH+/T2RF+) exhibited the most severe preoperative compromise (SPAP 55.0±25.8 mmHg, FVC 35.8±16.7% pred). This cohort had significantly higher delayed extubation rates (>12h: 75.0%, >24h: 37.5% vs others, p<0.05) and prolonged ICU stays (median 65.2h vs 14.9h Group A, p=0.016). Group D also showed the highest adverse event incidence (75.0% vs 11.0% Group A, p<0.001), including respiratory failure (50.0%), severe hypotension (62.5%), and heart failure (25.0%). Reintubation was required in 25.0% of Group D patients versus 2.2% in Group A (p=0.033). A representative Group D patient with preoperative SPAP 55 mmHg and FVC 22.1% pred died from cardiorespiratory failure despite maximal support.

Conclusion
The coexistence of PAH and T2RF constitutes the highest-risk profile for catastrophic outcomes following spinal deformity surgery, demonstrating prolonged mechanical ventilation, extended ICU stays, and elevated complications including cardiorespiratory failure. These findings reveal a synergy between PAH and T2RF that critically impairs postoperative cardiorespiratory compensation.

PODIUM PRESENTATION ABSTRACTS

70. The Efficacy of Dexa Vs QCT Vs MRI in the Histopathological Diagnosis of Osteoporosis and Their Correlation with Pedicle Screw Insertional Torque in Patients Undergoing Lumbar Fixation

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Hypothesis

BMD & T scores based on DEXA scans correlates best with Histopathological diagnosis of Osteoporosis and Pedicle Screw Insertional Torque (PSIT).

Design

Prospective Single Center Cohort Study.

Introduction

DEXA, QCT and MRI have been used to diagnose Osteoporosis, but their correlation with PSIT has never been studied.

Methods

Patients undergoing lumbar fixation surgery (L1 to L4) for degenerative disorders with age > 50 years were prospectively studied. Preoperative BMD assessment was done 72 hours prior to surgery by DEXA, QCT & MRI. During surgery bone biopsy sample were collected before putting the pedicle screw and was sent for histopathology (scoring system was developed, based on bone volume in sample, trabecular thickness & separation) - insertional torque of screw was measured with torque measuring device while inserting it. These intraoperative parameters were correlated with the preoperative measurements of DEXA, QCT & MRI by using Pearson's coefficient.

Results

53 patients were included in the study. Mean DEXA BMD value was 1.18±0.23, mean DEXA T score was (-)0.13±1.87. Mean QCT BMD value was 123.91±44.83, mean QCT T-score was (-)1.54±1.79. Mean MRI VBQ score was 2.71±0.69. Correlation of radiological parameters with biopsy and PSIT were done with both BMD and T scores. Correlation with QCT BMD with biopsy was (-)0.285, with PSIT was 0.271; QCT T score with biopsy was (-)0.261, with PSIT was 0.186. Correlation with DEXA BMD with biopsy was (-)0.121, with PSIT was 0.393 and DEXA T score with biopsy was (-)0.203, with PSIT, it was 0.437. Correlation with MRI score with biopsy was 0.224 and PSIT was (-)0.113. DEXA had better correlation with Torque, and QCT had better correlation with Biopsy, similar to that with MRI.

Conclusion

The correlation between DEXA and Pedicle Screw Insertional Torque was higher than that of either QCT or MRI. However, QCT had better correlation with Biopsy, similar to that of MRI. Biopsy as a confirmation of the osteoporotic status of the patient (as predicted by the preoperative investigations) failed to serve the purpose because all 3 investigations had a poor correlation. Hence DEXA scan still holds a better place as compared to QCT and MRI in terms of predicting the screw purchase in patients undergoing lumbar fixation.

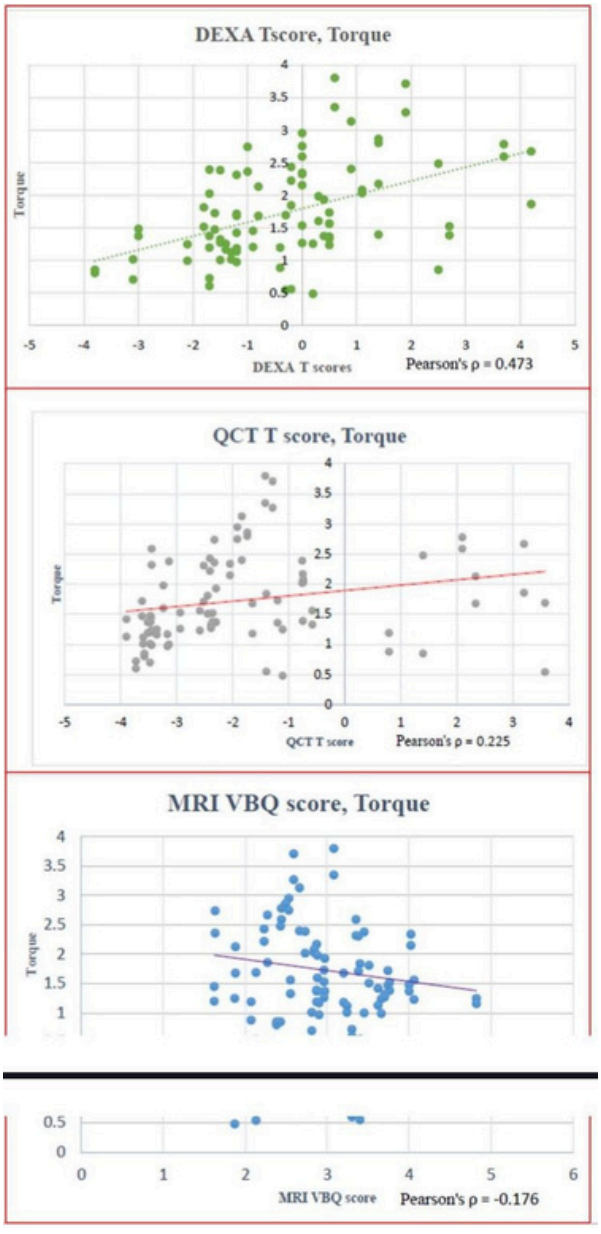


Fig 1: Scatter plots showing Correlation of PSIT with DEXA, QCT & MRI

PODIUM PRESENTATION ABSTRACTS

71. Plantar Foot Temperature as an Adjunct to Intraoperative Neuromonitoring in Spinal Deformity Surgery: A Case Report and Prospective Case Series of 89 Patients

Chang Hwa Ham, MD; Rizki Meizikri, MD; Seoung Woo Suh, MD, PhD

Hypothesis
Plantar foot temperature monitoring can serve as an ancillary indicator for detecting spinal cord compromise during spinal deformity surgery.

Design
A case report and a prospective observational case series.

Introduction
Multimodal intraoperative neuromonitoring (IONM) is the standard in spinal deformity surgery, but evoked potentials (EP) can be unobtainable or produce false positives. Since sympathetic tracts regulate peripheral vasoregulation, spinal cord injury may present as increased skin temperature. Plantar foot temperature monitoring (PFTM) may offer a useful adjunct for assessing spinal cord integrity in real time.

Methods
We prospectively included patients who underwent spinal deformity correction with concurrent IONM and PFTM between February 2024 and May 2025. Thermometers were applied to both plantar surfaces, and temperatures were recorded at incision, rod placement, closure, and at any time EP changes occurred. Body temperature was concurrently monitored at the esophagus. Intraoperative parameters, including estimated blood loss (EBL), transfusions, and use of inotropics, were recorded. Postoperative neurological status was evaluated. A representative case involving a 17-year-old patient with neuromuscular scoliosis is described.

Results
Eighty-nine patients were included: 5 syndromic, 4 neuromuscular, 2 juvenile, 5 congenital, 72 adolescent idiopathic scoliosis (AIS), and 1 Scheuermann's kyphosis. The male-to-female ratio was 13:76, with a mean age of 17.88 ± 8.88 years. Mean estimated blood loss was 735.8 ± 523.9 mL. Cobb angle improved from 61.2° ± 13.3° to 18.5° ± 11.2°, with a mean correction of 42.3° ± 10.8°. Plantar foot temperatures averaged 31.4 ± 2.8°C at incision, 31.6 ± 3.0°C during correction, and 31.3 ± 2.9°C at closure. EPs were unobtainable in 3 cases and inconsistent in 4. 3 patients encountered flat EPs and 9 cases had >50% EP amplitude reduction on one or both sides. One AIS patient developed postoperative motor deficit with paresthesia, accompanied by immediate EP loss and a 3.9°C increase in left foot temperature. A Stagnara wake-up test confirmed left leg weakness, which partially resolved with residual paresthesia.

Conclusion
Plantar foot temperature monitoring is a simple, non-invasive adjunct to IONM that may help detect spinal cord compromise when EPs are limited. Further validation is needed.

PFTM

72. Does Intraoperative Neuro-Monitoring(IONM) Alert Changes Correlate with Clinical Outcomes in Patients Undergoing Surgery for Degenerative Cervical Myelopathy?

Vikas Hanasoge, MBBS, MS; Saumyajit Basu, MS(Orth), DNB(Orth), FRCSEd; Aditya V. Guduru, MS(Orthopaedics); Dhruv Patel, MS

Hypothesis
There is a correlation between IONM signal changes and clinical outcomes.

Design
Prospective.

Introduction
Decompression with/without fusion in compressive cervical myelopathy patients is the standard of care. IONM is an important tool to evaluate spinal cord integrity during surgery. Motor-evoked potentials (MEPs) have higher sensitivity than somato-sensory evoked potentials (SSEPs) in detecting cord injury during the surgery.

Methods

A total of 58 patients divided into three groups: Group 1—no change in the amplitude of MEP at the end of surgery compared to baseline MEP (n = 45), group 2—improvement in the amplitude of MEP at the end of surgery compared to baseline MEP (n = 5), and group 3—reduction in the amplitude of MEP at the end of surgery compared to baseline MEP (n = 8). The clinical evaluation was done using modified Japanese Orthopedic Association (mJOA) and Nurick grading from January 2022 to December 2022, with a minimum follow-up of 1 year. Statistical analysis of quantitative data - mean, and standard deviation, and qualitative data- frequency (percentage). Paired t-tests - comparison of preoperative and postoperative functional scores. ANOVA tests with Bonferroni post hoc analyses - comparison between the three groups.

Results

Preoperatively, there was no statistically significant difference between the groups in mJOA score and Nurick grade. The mJOA score recovery rate (RR) at the end of follow up was 30.74% in group 1 and 37.34% in group 2 ($P < 0.001$). In group 3, the improvement was 11.71% and was not statistically significant. Nurick grading showed significant improvement at the end of follow up compared to preoperative in group 1 (2.5 at 1 year vs. 3.4 preoperatively, $P < 0.001$) and group 2 (2.6 at 1 year vs. 3.4 preoperatively, $P = 0.01$). However, no significant improvement was found in group 3 (2.8 at 1 year vs. 3.4 preoperatively, $P = 0.14$). Complications occurred in 11 patients (24.44%) which include incidental durotomy, post-operative hematoma, C5 palsy, Dysphagia, delayed wound healing.

Conclusion

Patients who had diminished IONM signals at the end of surgery for cervical myelopathy, as compared to the baseline, did not have a significant improvement in their mJOA score and Nurick grading by 1 year postoperatively. In contrast, patients with no variation or improvement in IONM signals showed significant neurological recovery.

E-POINT PRESENTATION ABSTRACTS

203. The Relationship Between Hamstring Tightness and Change Of Pelvic Tilt After Adult Spine Deformity Surgery

Ho-Joong Kim, MD, PhD; Seok-In Jang, MD; Jin-Ho Park, MD

Hypothesis
Hamstring tightness limits pelvic tilt (PT) change after ASD surgery and evaluated how the degree of hamstring tightness affects PT change following the surgery.

Design
Retrospective cohort study.

Introduction
The etiology of pelvic nonresponse (PNR), which is associated with adverse postoperative clinical outcomes, remains unclear. We hypothesized that hamstring tightness limits pelvic tilt (PT) change after ASD surgery and evaluated how the degree of hamstring tightness affects PT change following the surgery.

Methods
We determined an optimal cut-off value for the popliteal angle between patients with and without PJK. Based on the cut-off value for the popliteal angle, patients were classified into HT and non-HT groups. Radiographic spinopelvic parameters, PJK rate and PROMs were analyzed between the two groups.

Results
A total of 56 patients were included (HT: n = 12; non-HT: n = 44). A popliteal angle of 39.5° was identified as the optimal cut-off threshold for predicting PJK. There were no significant differences between HT and non-HT groups in preoperative spinopelvic parameters, bone mineral density, and body mass index. Postoperatively, the HT group demonstrated significant differences in PT/PI change (-0.061±0.101 vs. -0.211±0.131, p = 0.001) and PJK rate (8/12 [66.7%] vs. 7/44 [15.9%], p = 0.001). The HT group showed a significantly higher ODI score compared with the non-HT group (24.55±6.46 vs. 18.17±11.64, p=.035) at 6 months postoperatively.

Conclusion
Patients with preoperative hamstring tightness were more likely to exhibit persistent pelvic retroversion and demonstrate increased the PJK rate following ASD surgery. Evaluation of preoperative hamstring tightness should be considered in surgical planning.

205. Intraoperative Radiographic Factors Related to Postoperative Distal Adding-On in Lenke Type 1A Adolescent Idiopathic Scoliosis

Takeshi Fujii, MD, PhD; Satoshi Suzuki, MD, PhD; Kazuki Takeda, MD, PhD; Yasuhiro Kamata, MD, PhD; Soya Kawabata, MD, PhD; Takahito Iga, MD, PhD; Toshiki Okubo, MD, PhD; Osahiko Tsuji, MD, PhD; Masahiro Ozaki, MD, PhD; Narihito Nagoshi, MD, PhD; Takehiro Michikawa, PhD; Morio Matsumoto, MD, PhD; Masaya Nakamura, MD, PhD; Kota Watanabe, MD, PhD

Hypothesis
The angulation at the first disc below the lowest instrumented vertebra (LIV) and LIV tilt in the intraoperative radiographs can be a risk factor for distal adding-on (DA) in Lenke type A adolescent idiopathic scoliosis (AIS).

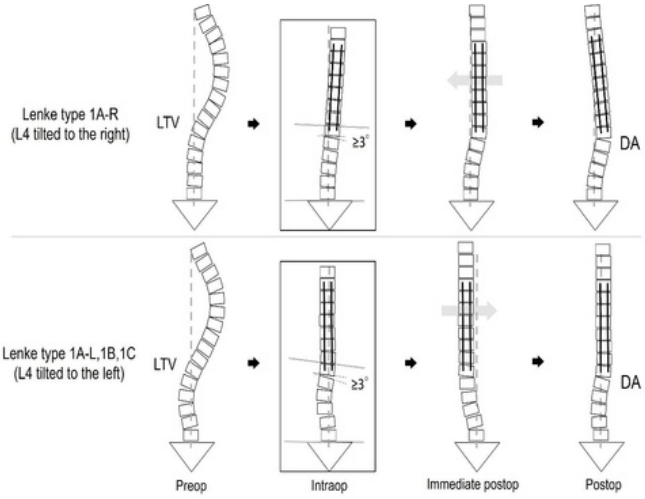
Design
A retrospective study of consecutive collected data.

Introduction
Distal adding-on (DA) is a common radiographic complication following selective thoracic fusion for Lenke type 1A AIS. However, the risk factors for DA in Lenke type 1A assessed using intraoperative radiograph remain unknown. The aim of this study was to investigate whether intraoperative radiograph can predict postoperative DA in Lenke type 1A AIS.

Methods
79 AIS patients with Lenke type 1A (Group A) who underwent posterior selective thoracic fusion were retrospectively evaluated. For comparison, another 79 with Lenke type 1B and 1C (Group BC) were included. The occurrence and factors associated with DA at postoperative 2 years were investigated using intraoperative radiographs. A subgroup analysis evaluated differences in radiographic factors based on the direction of L4 vertebral tilt—leftward (1A-L) versus rightward (1A-R). The definition of DA was referred to that by Wang et al. (Spine 2011).

Results
Of total 158 cases, 8 patients (10%) in Group A and 13 (16%) in Group BC developed DA at postoperative 2-year. Intraoperative radiographs in Group A showed that the mean angulation of the first disc below the LIV was significantly greater in DA group (-2.3 ± 2.3°) compared to non-DA group (-0.6 ± 1.7°). Patients with angulation of the first disc below the LIV greater than 3° were significantly associated with the occurrence of DA (odds ratio: 18.0, p<0.01) in Group A, as well as Group BC (odds ratio: 22.0, p<0.01). In Group A, the mean intraoperative LIV tilt angle was greater in the DA group (4.8 ± 7.0°) than in the non-DA group (1.2 ± 3.7°), with greater tilt observed in 1A-L compared to 1A-R. Multivariate analysis revealed that the intraoperative LIV tilt was significantly associated with DA in Group A, whereas not in Group BC.

Conclusion
In intraoperative radiographs showing the angulation greater than 3° at the first disc below the LIV and a larger LIV tilt angle were significantly associated with postoperative DA in Lenke type 1A. Surgeons should make more efforts to achieve horizontalization of the LIV intraoperatively especially in Lenke type 1A-L curves to avoid postoperative DA.



207. Congenital Craniovertebral Junction Anomalies - An Enigma Dissected.

Tushar N. Rathod, MS; Deepika Jain, MS; Yash Ved, MS

Hypothesis
Congenital atlantoaxial instability (cAAI) is associated with distinct patterns of bony and vascular anomalies that influence the severity of neurological impairment and surgical outcomes. A structured, anatomy-specific surgical approach—comprising targeted reduction, tailored fixation, and selective use of decompression leads to improved postoperative neurological and radiological outcomes with reduced complication rates.

Design
Observational Retrospective Study.

Introduction
The objective of this study was to assess the variation and quantify the anomalies associated with congenital AAI (cAAI), their neurological presentation, associated cord signal changes, post-operative functional and neuroradiological outcome, and possible complications. We have summarized the treatment options and their evolution over time. Broadly, the treatment includes reduction with/without release, followed by instrumentation. However, the various facets of treatment are marred with controversy, which include the ideal magnitude of correction, extent of fixation, choice of implant and approach, and need for foramen-magnum decompression (FMD). We have attempted to include technical notes pertaining to surgery for individual anatomical variations encountered during the course of the study. Stepwise approach for diagnosis and management strategies have been discussed.

Methods
Single-centre data from 6-years was analysed and a retrospective, observational study was done. Out of 103 AAI patients of various etiologies, 25 patients with congenital-AAI were identified and analysed for radiological parameters (C1-C2 angle, Posterior Occipito-Cervical Angle, Atlanto-Dens Interval, Space Available for Cord, Clivo-Canal Angle) and clinical parameters assessing neurology and function.

Results
Vascular (36%) and bony (92%) anomalies were frequent, with the most common being occipito-atlantal assimilation (68%). 84% patients had cord signal-intensity changes. Anomalous course and hypoplastic vertebral artery (VA) were seen in 16% patients each. 7/25 (28%) had irreducible-dislocations requiring anterior-release. The average C1-C2 angle (C1C2A) correction was 20.6° with the average post-operative C1C2A value being 22.36°.

Conclusion
cAAI poses additional challenges over other forms of AAI in having abnormal bony and vascular anatomy. Thorough planning and restoration of anatomy are essential for satisfactory clinical outcomes.

208. The Fusion Sequence and Risk Factors for Pseudarthrosis in Multilevel Anterior Cervical Discectomy and Fusion

Yoon Ha, MD, PhD; Jae Keun Oh, MD, PhD; *Hyun Woong Mun, MD*

E-POINT PRESENTATION ABSTRACTS

Hypothesis
This study aims to compare the fusion rates and mean fusion times across levels in 2-level and 3-level ACDF procedures, while also identifying risk factors associated with pseudoarthrosis.

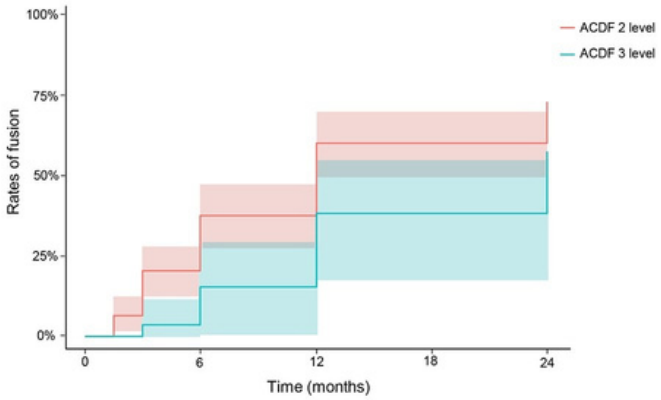
Design
Retrospective cohort study.

Introduction
Anterior cervical discectomy and fusion (ACDF) is commonly used to treat cervical myelopathy, radiculopathy, and deformity, but is associated with complications, including pseudarthrosis, which is particularly frequent in multilevel surgeries.

Methods
This retrospective study included 119 patients who underwent 2- or 3-level ACDF with a minimum follow-up of two years. Fusion was assessed by measuring angular and linear interspinous motion (ISM) on dynamic radiographs at 1.5, 3, 6, 12, and 24 months. Patient demographics, cage characteristics, and surgical methods were analyzed to identify risk factors for pseudarthrosis using Kaplan-Meier estimates and Cox proportional hazards regression.

Results
The cumulative fusion rate over 24 months was 73.1% in the 2-level group and 57.7% in the 3-level group, with a shorter median fusion time in 2-level ACDF (13.81 months) compared to 3-level ACDF (18.35 months, $p = 0.049$). In the 3-level ACDF group, the middle level fused the fastest (2.71 months), followed by the cranial and caudal levels (7.96 months vs. 18.12 months, $p < 0.001$). PEEK cage usage (HR = 2.309, $p = 0.052$) and 2- or 3-level ACDF (HR = 2.008, $p = 0.041$) were associated with increased pseudarthrosis risk.

Conclusion
Multilevel ACDF procedures, particularly at the caudal levels, demonstrate lower fusion rates and longer fusion times. PEEK cages may pose a higher pseudarthrosis risk in multilevel ACDF. These findings underscore the importance of selecting appropriate materials and techniques in multilevel ACDF to improve fusion outcomes. Further studies are warranted to optimize fusion strategies, especially for caudal levels in multilevel ACDF.



Cumulative Fusion Rates in Two-Level vs. Three-Level ACDF Over 24 Months by Kaplan-Meier Curve. This Kaplan-Meier curve shows the cumulative fusion rate over 24 months in patients with 2-level (red) and 3-level (blue) ACDF, with shaded areas indicating 95% confidence intervals. At 24 months, the total fusion rate was 73.1% (68/93) in 2-level ACDF and 57.7% (15/26) in 3-level ACDF. The median total fusion time was 13.81 months in 2-level ACDF compared to 18.35 months in 3-level ACDF (p-value = 0.049).

209. Prediction of Chiari Malformation and Syringomyelia in Adolescent Scoliosis from a Plain Radiograph using Deep Learning with Convolutional Neural Networks

Hiroyuki Tachi, MD; Katsuhisa Yamada, MD, PhD; Terufumi Kokabu, MD; Hideki Sudo, MD, PhD

Hypothesis
We hypothesized that deep learning utilizing convolutional neural networks (CNN) could identify Chiari malformation or syringomyelia (CM/SM) with adolescent scoliosis from plain spine radiographs.

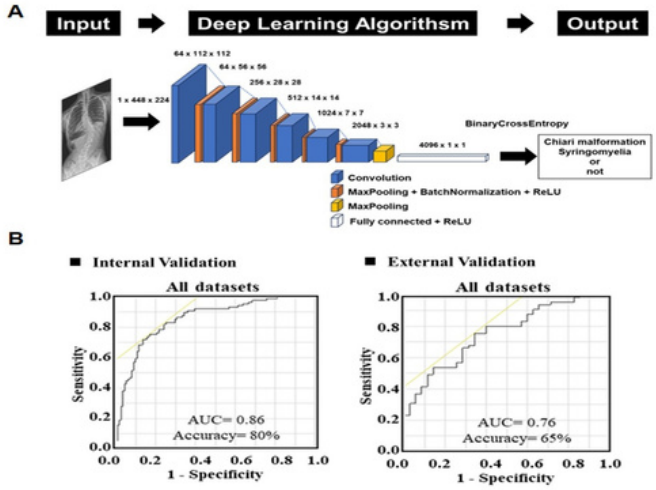
Design
Retrospective analysis of a consecutive, nonrandomized series of patients.

Introduction
In cases of adolescent scoliosis, CM/SM are sometimes diagnosed on MRI examination. However, it is difficult to accurately predict them from a plain radiographic image of the spine. Deep learning, in particular CNN, has been reported to be able to identify and diagnose diseases from medical images with high accuracy. The purpose of this study is to develop a deep learning algorithm (DLA) to predict of CM/SM from plain radiographs using CNN and to validate its accuracy.

Methods
Data from 220 patients with adolescent scoliosis who underwent MRI at our clinic from April 2000 to July 2024 (mean age 14.7-year-old (10-20), 108 with normal MRI, and 112 with CM/SM were used. The CNN model was developed and trained using standing long-cassette posteroanterior radiographs of the whole spine (Figure A). The binary classification of patients with normal MRI (adolescent idiopathic scoliosis (AIS)) and CM/SM was performed using a total of 200 radiographs, employing a five-fold cross-validation method for internal validation, and 20 images were used for external validation. Grad-CAM was used to visualize areas with the high features extracted by CNN.

Results
In internal validation, the area under the curve (AUC) and accuracy of the CNN model was 0.86 and 80%, with a sensitivity of 0.84, specificity of 0.74 (Figure B). In external validation, the AUC was 0.76 and the accuracy was 65%, with a sensitivity of 0.86, specificity of 0.54 (Figure B). Grad-CAM showed high feature density around the thorax.

Conclusion
The developed DLAs with CNN exhibited promising performance in classifying AIS with normal MRI findings and scoliosis associated with CM/SM from plain radiographs of the whole spine. The high feature density to the thorax in Grad-CAM suggests that scoliosis associated with CM and SM may be characterized by thoracic morphology compared to AIS.



A. Schematic of the convolutional neural network architecture utilized in the proposed framework for detecting Chiari malformation or syringomyelia. B. Area under the curve for internal and external validation.

212. The Effects of OLIF And PCO Combined with Posterior Internal Fixation in the Treatment of Adult Scoliosis For Derotation and Correcting Lateral Listhesis

Dechun Wang, MD; Chen Longwei, MS; Wei Jianwei, MS; Tian Jingchao, MS

Hypothesis
What is the corrective ability of Olif and posterior column osteotomy(PCO) combined with posterior internal fixation for intervertebral derotation and lateral listhesis correction in the treatment of adult degenerative scoliosis.

Design
This is a retrospective study.

Introduction
Adult spinal deformity (ASD) is usually rigid and requires a combined anterior–posterior approach for deformity correction. The objective of this research is to evaluate the effects of OLIF and posterior column osteotomy(PCO) combined with posterior internal fixation for intervertebral derotation and lateral listhesis correction.

Methods
36 consecutive patients diagnosed with ADS were included, with a mean age 67.14 years, who underwent two stages surgery: Stage1.OLIF ; Stage 2. PCO combined with posterior internal fixation between 2019 and 2024. The follow-up time were at least 18 monthes. The full-spine anteroposterior and lateral X-rays, as well as lumbar CT and MRI were obtained to measure the Cobb angle, lateral slip distance, vertebral rotation, spinopelvic parameters preoperatively, postoperatively(stage1, stage2)and at the final follow-up.

Results
Significant three-dimensional correction was observed following the first-stage OLIF and the second-stage PCO combined with posterior internal fixation. Radiological assessments were done preoperatively, postoperatively(stage1, stage2) and at the final follow-up. The Cobb angles decreased from 26.27°to 11.50°; 6.02°; 7.16° ($P < 0.001$).The lumbar lordosis(LL) increased from 27.72° to 36.94°; 37.48°;37.39° ($P < 0.001$). The lateral slip distance decreased from 9.12mm to 5.35mm; 3.73mm; 3.44mm. ($P < 0.001$)The axial rotation angles decreased from 8.92°to 6.96；2.48°； 2.39° ($P < 0.001$). PI 45.23°; 45.19°;44.72°:43.72°. PT 22.98°;18.85°;17.74°; 17.35°($P < 0.001$). SS 27.25°;26.33°; 24.66°; 25.39°($P < 0.001$). PI-LL 22.50°; 8.26°;5.24°;5.53°($P < 0.001$).

E-POINT PRESENTATION ABSTRACTS

214. Instrumentation Failure After Posterior Spinal Fusion in Adolescent Idiopathic Scoliosis: Incidence, Risk Factors, and Clinical Outcomes

Chang Ju Hwang, MD, PhD; *Myeong Geun Song, MD*

Hypothesis
We hypothesized that instrumentation failure is associated with radiographic and surgical factors, and that its occurrence adversely affects correction maintenance and distal curve alignment following posterior spinal fusion in AIS.

Design
Retrospective cohort study.

Introduction
Instrumentation failure including axial rod slip (ARS) and screw pull-out is a mechanical complication that can compromise surgical outcomes after AIS correction. Although uncommon, these failures can lead to correction loss and increased risk of distal curve progression or reoperation. This study aimed to determine the incidence and risk factors of instrumentation failure to improve preventive strategies in AIS surgery.

Methods
We retrospectively reviewed 456 AIS patients who underwent one-stage posterior spinal fusion between January 2020 and December 2023. Instrumentation failure was defined as the occurrence of either ARS (≥2 mm rod shortening at the LIV) or screw pull-out on follow-up radiographs. Patients were divided into Group A (instrumentation failure, n=76) and Group B (non-failure, n=380). Clinical, radiographic, and surgical parameters including Lenke type, LIV level, screw angulation, rod material, flexibility, correction rate, TL kyphosis, L-curve cobb angle and distal curve progression were analyzed.

Results
Instrumentation failure was identified in 76 patients (16.7%). Group A had significantly higher correction loss rate (11.35% vs. 3.96%, p=0.006) and distal curve progression (56.2% vs. 19.3%, p=0.005) compared to Group B. Unplanned reoperation due to instrumentation failure was required in 5 patients (1.1%). Instrumentation failure was significantly associated with lower flexibility (53.55 ± 10.02% vs. 58.67 ± 9.91%, p<0.001) and a greater preoperative L-curve Cobb angle (44.49 ± 4.53° vs. 37.18 ± 4.83°, p<0.001).

Conclusion
Instrumentation failure was observed at a higher incidence than previously reported in patients undergoing posterior spinal fusion for AIS, and showed significant associations with correction loss and distal curve progression. Lower flexibility and a larger preoperative lumbar curve were identified as significant radiographic risk factors. Early identification and awareness of these radiographic and surgical risk factors may help improve maintenance of correction and guide preventive strategies in AIS surgery.

217. Hidden Blood Loss in Posterior Spinal Fusion for Adolescent Idiopathic Scoliosis: Risk Factors and Development of a Prediction Model

Satoshi Takada, MD; Suken A. Shah, MD; Hiroshi Taneichi, MD, PhD; Peter G. Gabos, MD; Andrea Elsby, BS

Hypothesis
Hidden blood loss (HBL) significantly contributes to total blood loss in AIS surgery and can be predicted using patient-specific factors.

Design
Retrospective cohort study.

Introduction
HBL in PSF surgery for AIS represents a substantial proportion of total blood loss that is often overlooked in perioperative care. This study aimed to quantify HBL, identify its risk factors, and develop a predictive model.

Methods
We analyzed 902 patients who underwent PSF for AIS between 2005-2024. After excluding incomplete data, 738 patients were included. Patient blood volume was calculated using Nadler's formula, and total blood loss was estimated using Gross's formula based on pre- and post-operative hematocrit changes. HBL was defined as the difference between total blood loss and intraoperative blood loss, with adjustments for transfusions. Variables included age, sex, race, BMI, %BMI, preoperative and postoperative major curvature, correction percentage, and tranexamic acid use. Multivariate regression and ROC analyses were performed.

Results
The cohort consisted of 738 patients (mean age 14.4±2 years, 79% female). Mean HBL was 559±346 ml, accounting for 51.5±27% of total blood loss. Multivariate analysis identified five independent risk factors: BMI (p<0.001), preoperative hematocrit (p<0.001), age (p=0.002), preoperative major curvature (p=0.019), and number of fusion levels (p<0.001). Significant correlation was found between HBL and postoperative day 1 transfusion (p=0.03), but not intraoperative transfusion (p=0.14). ROC analysis determined optimal cutoffs of BMI ≥23 kg/m² and ≥11 fusion levels for HBL exceeding 15% of patient blood volume. The prediction model achieved R^2=0.63, RMSE=535, F-value=97.5 (p<0.001).

Conclusion
HBL accounts for over half of total blood loss in AIS PSF surgery. Higher BMI, elevated preoperative hematocrit, increased age, greater preoperative curve magnitude, and more fusion levels were independent risk factors. The correlation between HBL and postoperative day 1 transfusion highlights its clinical significance. The predictive model may help identify high-risk patients preoperatively, particularly those with BMI ≥23 kg/m² and ≥11 fusion levels.

219. Effect of Pelvic Fixation on Spinal Alignment, Proximal Junctional Kyphosis, and Gastrointestinal Complications in Spinal Fusion for Spastic Neuromuscular Scoliosis

Daiki Urayama, MD; Yuki Taniguchi, MD, PhD; Ayato Nohara, MD; Takashi Ono, MD; Hiroyuki Nakarai, MD; Kosei Nagata, MD; Hideki Nakamoto, MD, PhD; So Kato, MD, PhD; Yasushi Oshima, MD, PhD

Hypothesis
We hypothesized that pelvic fixation(PF) does not significantly affect postoperative spinal alignment and complication rates in spinal fusion(SF) for spastic neuromuscular scoliosis(sNMS).

Design
Retrospective cohort study.

Introduction
Postoperative spinal alignment following SF for sNMS remains poorly described. Given that inadequate spinal alignment has been associated with proximal junctional kyphosis (PJK) and gastrointestinal(GI) complications, this study aimed to compare alignment parameters and complications between patient groups with and without PF.

Methods
We retrospectively reviewed 62 sNMS patients (GMFCS IV or V) who underwent SF at two centers with ≥2-year follow-up. Patients were divided into lumbar fixation (L, n=45) and PF (P, n=17) groups. GI complications were defined as cases requiring new gastrostomy placement due to gastrointestinal symptoms. Postoperative radiographic parameters were compared between the groups, and the association with PJK and GI complications was evaluated. Statistical analyses were performed using unpaired t-tests for continuous variables and Fisher's exact test for categorical variables. A p-value < 0.05 was considered statistically significant.

Results
The mean age at surgery was 13.6 vs. 14.6 years (L vs. P, p = 0.24). Operative time and blood loss were 470 vs. 460 minutes (p = 0.80) and 1,350 vs. 1,060 mL (p = 0.06). Staged anterior-posterior

Design
surgery was performed in 13 L cases, all P cases had posterior-only fusion. Postoperative Cobb angle was corrected to 42° vs. 40° (p = 0.71), showing no significant difference. In contrast, pelvic obliquity(PO) improved to 13.8° vs. 8.2°, with a significant difference between groups (p = 0.03). Thoracic kyphosis and lumbar lordosis(LL) were 40° vs. 41° (p = 0.99) and –44° vs. –41° (p = 0.38), with no significant differences. No significant association with PF was found for either PJK (3 vs.1 cases, p = 0.99) or GI complications (2 vs.3 cases, p = 0.12). However, GI complications were significantly more frequent in patients with residual hyperLL (LL > 60°), occurring in 4 of 5 cases compared to 1 of 57 without (p = 0.004).

Conclusion
PF did not significantly affect sagittal alignment or rates of PJK and GI complications. However, it resulted in significantly better correction of PO. Residual hyperLL may be associated with increased GI complications.

221. A Predictive Nomogram for Surgery Necessity After Brace Treatment in Adolescent Idiopathic Scoliosis

Sehan Park, MD; Chang Ju Hwang, MD, PhD; Jae Hwan Cho, MD, PhD; Dong-Ho Lee, MD, PhD

Hypothesis
We hypothesized that a predictive model using baseline clinical and radiographic parameters could estimate the risk of surgery after brace treatment in AIS patients.

Design
Retrospective cohort study with predictive modeling.

Introduction
Bracing is standard for AIS patients with Cobb angles >25°, but some progress to require surgery. Although individual risk factors for brace failure are known, an integrated predictive model to estimate surgical necessity has not been established.

Methods
We included 205 AIS patients treated with bracing. Patients were classified into brace-success (no surgery by skeletal maturity) and brace-failure (surgery required during follow-up). Logistic regression identified predictors of brace failure. A nomogram was developed using age, height, initial Risser grade, largest Cobb angle, apical vertebral translation (AVT), and correction rate. The model was trained (70%) and validated (30%). Performance was evaluated via ROC curves, calibration plots, and the Hosmer-Lemeshow test.

Results

Surgery was required in 44 patients (21.4%). Significant predictors included younger age (p=0.003), shorter height (p=0.005), lower Risser stage (p=0.018), larger pre-brace Cobb angle (p<0.001), greater AVT (p<0.001), and lower correction rate (p=0.046). The nomogram demonstrated excellent discrimination (AUC=0.914 training, 0.812 validation) and good calibration (Hosmer-Lemeshow p=0.261 and 0.153). Calibration plots confirmed agreement between predicted and observed probabilities.

Conclusion

We developed a nomogram to predict the necessity of surgery in AIS patients after brace treatment. The model showed excellent predictive performance and may help guide personalized treatment planning. Further external validation is recommended.

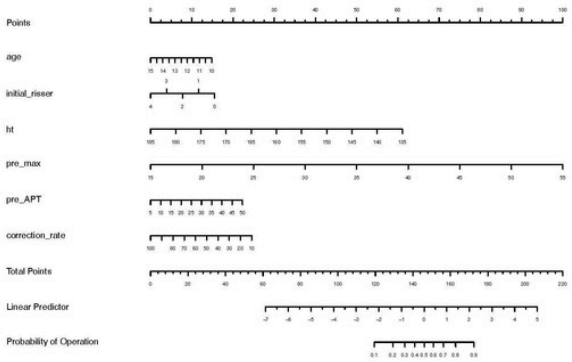


Figure caption: Predictive nomogram for estimating probability of surgery After Bracing In AIS. Variables Include Age, Initial Risser Stage, Height, Largest Cobb Angle, Apical Vertebral Translation, And Correction Rate.

222. Does Low Skeletal Muscle Mass Affect the Progression of Adolescent Idiopathic Scoliosis?

Kei Watanabe, MD, PhD; Masayuki Ohashi, MD, PhD; Hideki Tashi, MD; Yohei Shibuya, MD; Keitaro Minato, MD, PhD; Toru Hirano, MD, PhD; Kazuhiro Hasegawa, MD, PhD

Hypothesis

Skeletal musculature status influences adolescent idiopathic scoliosis (AIS) progression during adolescence.

Design

Retrospective cohort study.

Introduction

Brace treatment can contribute to the progression of adolescent idiopathic scoliosis, alongside bone maturity and curve severity. However, other contributing factors remain unclear. This study aimed to identify factors influencing adolescent idiopathic scoliosis progression, focusing on skeletal muscle mass.

Methods

The inclusion criteria were as follows: (1) female patients, (2) Risser grade 0-2 at the initial examination and ≤2 years post-menarche, (3) major Cobb angle of 10°-39° at baseline, (4) Risser grade ≥4 and ≥2 years post-menarche at the final evaluation, and (5) a follow-up of at least 2 years. In total, 149 adolescent idiopathic scoliosis patients were included. The assessed variables included major curve Cobb angle, age, height, age at menarche, extracurricular sports, scoliosis family history, curve type, Risser grade, body mass index, appendicular skeletal muscle mass index, trunk skeletal muscle mass index, and brace compliance. Skeletal muscle mass was measured using bioelectrical impedance analysis at bone maturity. Patients were classified into progression (≥10° Cobb increase; n=61) and non-progression group (n=88) groups for comparison.

Results

Significant differences (p<0.05) were observed between the non-progression and progression groups in height increase (6.9 cm vs. 10.8 cm), age at menarche (11.6 years vs. 12.2 years), curve type (major thoracic scoliosis: 67% vs. 92%), Risser grade (grade 0:33% vs. 57%), appendicular skeletal muscle mass index (6.13 kg/m² vs. 5.92 kg/m²), trunk skeletal muscle mass index (7.27 kg/m² vs. 6.97 kg/m²), and major Cobb angle at the final examination (30.0° vs. 44.4°). Multivariate analysis identified major thoracic scoliosis (OR 4.9, 95% CI 1.535-15.175), height increase (OR 1.2, 95% CI 1.031-1.360) and trunk skeletal muscle mass index (OR 0.3, 95% CI 0.101-0.914) as associated factors of curve progression.

Conclusion

Although skeletal maturity largely determines adolescent idiopathic scoliosis progression, trunk muscle mass may also play a role during growth. Future studies should explore targeted interventions to improve muscle condition for better scoliosis management.

Table: Comparison of investigating parameters between the 2 groups

parameter	Non-progression group (n=88)	Progression group (n=61)	P value
Age at initial examination [year]	11.7 (1.0)	11.6 (1.2)	0.8423
Body height at initial examination [cm]	153.8 (6.7)	151.3 (8.7)	0.0514
Body height increase (final-initial) [cm]	6.9 (4.6)	10.8 (5.5)	<0.0001
Age at menarche [year]	11.6 (1.0)	12.2 (1.3)	0.0010
Athletic club participation (+ / -)	Yes:52, No:36	Yes:36, No:25	0.9927
Past history related scoliosis (+ / -)	Yes:2, No:86	Yes:1, No:60	0.7842
Family history related scoliosis (+ / -)	Yes:13, No:75	Yes:7, No:54	0.5586
Curve type (thoracic / thoracolumbar)	MT: 59, TL: 29	MT: 56, TL: 5	0.0002
Sagittal modifier (- / normal)	-: 9, N: 79	-: 13, N: 48	0.0630
Major Cobb angle (initial) [°]	26.5 (6.1)	25.6 (6.4)	0.4016
Major Cobb angle (final) [°]	30.0 (6.2)	44.4 (10.6)	<0.0001
Risser grade at initial examination	0:29, 1-2:59	0:35, 1-2:26	0.0030
Body mass index [kg/m^2]	18.7 (2.5)	17.7 (2.3)	0.0099
Appendicular skeletal muscle mass index [kg/m^2]	6.13 (0.62)	5.92 (0.62)	0.0427
Trunk skeletal muscle mass index [kg/m^2]	7.27 (0.51)	6.97 (0.54)	0.0006
Brace treatment (+ / -)	Yes:16, No:72	Yes:17, No:44	0.1641
Follow-up period [month]	45.5 (17.6)	51.0 (18.4)	0.0647

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223. Brace Treatment Outcomes in AIS: A Retrospective Analysis Based on Distal Radius and Ulna Classification

Takahiro Mui, MD; Hideki Shigematsu, MD, PhD; Sachiko Kawasaki, MD; Takuya Sada, MD

Hypothesis
Brace treatment outcomes for adolescent idiopathic scoliosis (AIS) vary depending on skeletal maturity assessed using the distal radius and ulna (DRU) classification.

Design
Retrospective cohort study.

Introduction
Brace treatment plays a crucial role in preventing curve progression in AIS. At our institution, the Osaka Medical College (OMC) brace (underarm type) is routinely used for AIS management. According to current guidelines, bracing is recommended for untreated AIS patients aged ≥10 years, with Risser stages 0–2 and Cobb angles between 25° and 40°. However, in clinical practice, skeletal maturity and Cobb angle at initial presentation vary widely. Previously, we assessed the one-year risk of curve progression using the DRU classification and Cobb angle; however, the effectiveness of brace treatment stratified by skeletal maturity remains unclear. The aim of this study was to evaluate the outcomes of brace treatment based on skeletal maturity using the DRU classification.

Methods
AIS patients who underwent brace treatment between October 2014 and December 2022 were retrospectively reviewed. Patients with congenital, syndromic, or early-onset scoliosis were excluded. Based on the DRU classification, patients were stratified into three groups according to their risk of curve progression: high-risk (R6, R7), moderate-risk (R8), and low-risk (R9). Curve progression was defined as an increase of ≥6° in Cobb angle at the end of bracing or conversion to surgery prior to brace completion. Demographic data, radiographic parameters, and brace compliance were recorded. The curve progression prevention rates were compared among the three groups.

Results
A total of 63 AIS patients were included: 27 in the high-risk group, 25 in the moderate-risk group, and 11 in the low-risk group. The overall curve progression prevention rates were 33.3% in the high-risk group, 80% in the moderate-risk group, and 100% in the low-risk group. Within the high-risk group, prevention rates for pre-brace Cobb angles of 10–19°, 20–29°, and ≥30° were 50%, 33.3%, and 14.3%, respectively. In the moderate-risk group, the corresponding rates were 100%, 100%, and 66.7%. All patients in the low-risk group maintained 100% prevention.

Conclusion
Brace treatment outcomes based on the DRU classification suggest that bracing is particularly effective in preventing curve progression in AIS patients classified as moderate- and low-risk.

		High risk (R6,R7) n=27	Moderate risk (R8) n=25	Low risk (R9) n=11
Cobb angle at start of brace treatment	10-19°	4/8(50%)	3/3(100%)	3/3(100%)
	20-29°	4/12(33.3%)	7/7(100%)	6/6(100%)
	30° -	1/7(14.3%)	10/15(66.7%)	2/2(100%)

224. Reciprocal Change of Cervical Spine After Posterior Spinal Fusion For Lenke Type 1 and 2 Adolescent Idiopathic Scoliosis.

Kanji Mori, MD, PhD; Jun Takahashi, MD, PhD; Hiroki Oba, MD, PhD; Shinji Sasao, MD; Shota Ikegami, MD, PhD; Tetsuhiko Mimura, MD, PhD; Shinji Imai, MD, PhD

Hypothesis
Restoring thoracic kyphosis (TK) is important for improving cervical sagittal alignment in patients with adolescent idiopathic scoliosis (AIS).

Design
Retrospective analysis of prospectively collected data.

Introduction
Reciprocal sagittal alignment changes after AIS posterior corrective surgery have been reported in not only the lumbar spine, but also the cervical spine, but the evidence in cervical spine is not yet sufficient. Furthermore, much remains unknown about the effects of the cervical kyphosis on clinical outcomes in AIS.

Methods
Consecutive 45 patients (4 males and 41 females) with AIS, Lenke type 1 or 2 curves underwent a posterior spinal fusion, and a minimum of 24-month follow-up were collected from our prospective database. We investigated radiographic parameters and SRS-22r. Cervical hyperkyphosis was defined as postoperative cervical lordosis (CL) ≤-10°. The results obtained were statistically analyzed.

Results

Before surgery, cervical kyphosis (CL<0°) was present in 88.9% and cervical hyperkyphosis in 60%. There were no significant differences in age, sex, and Lenke type between the hyperkyphosis and the non-hyperkyphosis groups. Although postoperative CL increased significantly, cervical kyphosis and hyperkyphosis were observed in 73.3% and 26.7% of patients, respectively, 2 years after surgery. We found a significant correlation between ΔTK and ΔCL. Preoperative cervical kyphosis, ΔT1-slope, and ΔTK were independent associated factors for postoperative cervical hyperkyphosis. The cervical hyperkyphosis group had significantly lower some SRS-22r domains. The results of this study suggest that residual cervical hyperkyphosis after AIS surgery may affect clinical outcomes.

Conclusion

In posterior corrective surgery for patients with Lenke type 1 and 2 AIS, restoring TK leading to gain of T1-slope may lead to improvement of cervical sagittal alignment.

225. Shoulder Compensation in AIS Patients with Lenke Type 1 Following Posterior Spinal Surgery Utilizing a Transverse Process Hook Instead of Pedicle Screws as the Upper Instrumented Vertebra

Tinnakorn Pluemvitayaporn, MD

Hypothesis

To evaluate the impact of utilizing TP hooks as the UIV on shoulder compensation in AIS patients with Lenke type 1 following posterior spinal surgery.

Design

A prospective cohort study.

Introduction

Adolescent Idiopathic Scoliosis (AIS) frequently necessitates surgery to correct spinal deformities, typically using pedicle screws for instrumentation. However, there is growing interest in using transverse process (TP) hooks for the upper instrumented vertebra (UIV) due to their potential benefits, including reduced invasiveness, preservation of nearby vertebral structures, and a lower risk of proximal junctional kyphosis (PJK). The impact of this fixation method on postoperative shoulder compensation in AIS patients remains unclear.

Methods

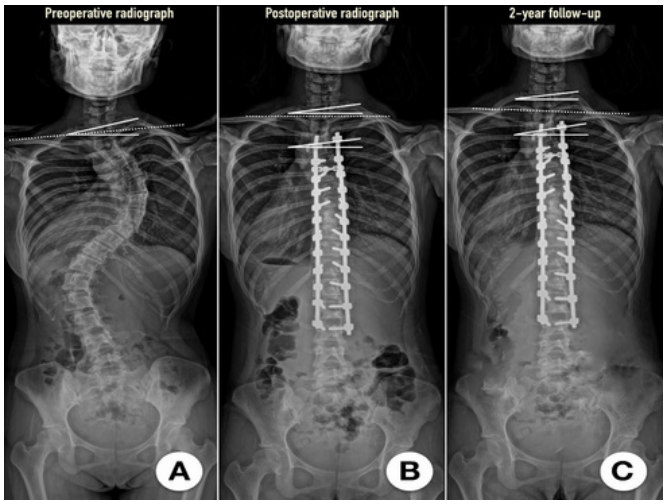
Between 2021 and 2025, AIS patients with Lenke type 1 who underwent posterior spinal surgery at our institution using TP hooks as the UIV were enrolled in the study. Pre- and postoperative shoulder asymmetry was assessed through clinical evaluations and radiographic measurements. Demographic, clinical, and radiographic data were collected and analyzed to determine outcomes related to shoulder compensation.

Results

A total of 168 AIS patients with Lenke type 1, with a mean age of 14.2 ± 2.9 years, participated in this study, with an average follow-up of 26.8 months. Following posterior spinal surgery using TP hooks as the UIV, shoulder balance showed significant improvement. Shoulder height decreased from 16.5 mm preoperatively to 9.0 mm at final follow-up ($p = 0.03$). T1 tilt was reduced from 5.7° to 4.0° ($p = 0.001$), and UIV tilt decreased from 12.9° to 4.6° ($p < 0.001$). No significant changes were found in clavicle angle or CC height difference (p 0.05). Statistically significant improvements were confirmed in shoulder height, T1 tilt, and UIV tilt at follow-up.

Conclusion

Using TP hooks as the UIV in posterior spinal surgery for AIS patients with Lenke type 1 significantly enhances shoulder symmetry and functional outcomes. These results suggest that TP hooks may help reduce shoulder compensation after surgery. Further studies are needed to assess the long-term outcomes and overall effectiveness of this fixation strategy in managing AIS.



Comparison of radiographic measurements: pre- (A), postoperative (B), and final follow-up (C).

227. Chronological Changes in Sagittal Alignment after Surgery in AIS Patients with Thoracic Lordosis

Shuzo Kato, MD, PhD; Satoshi Suzuki, MD, PhD; Kazuki Takeda, MD, PhD; Takahito Iga, MD, PhD; Toshiki Okubo, MD, PhD; Masahiro Ozaki, MD, PhD; Narihito Nagoshi, MD, PhD; Kota Watanabe, MD, PhD

Hypothesis
The cervical and global sagittal alignment of AIS patients with thoracic lordosis changes chronologically after thoracic corrective surgery.

Design
Retrospective cohort study.

Introduction
Although corrective surgery for adolescent idiopathic scoliosis (AIS) has traditionally focused on coronal alignment correction, increasing attention is now shifted to sagittal alignment due to its association with postoperative pain and health-related quality of life. However, sagittal alignment changes in thoracic lordosis patients, whose thoracic kyphosis is significantly reduced, remain unclear.

Methods
We retrospectively analyzed 72 AIS patients who underwent corrective surgery between 2008 and 2021 with a preoperative thoracic kyphosis angle(T5-12) of 0° or less. The average age was 16.0 ± 2.8 years, and there were 54 cases of Lenke classification type 1 and 18 cases of type 2. The average number of levels of fused vertebrae was 8.5 ± 1.9, the operation time was 140.2 ± 52.0 minutes, and the intraoperative blood loss was 298.0 ± 161.3g. The sagittal parameters included thoracic kyphosis (T2-5, T5-12), C2-7 angle, lumbar lordosis (LL), and pelvic incidence (PI), measured preoperatively, postoperatively one month (1POM), and postoperative two years (2POY). We investigated the changes in these parameters chronologically and analyzed them statistically.

Results
Preoperative T5-12 angle was -2.2 ± 2.5° and became kyphotic at 12.5 ± 13.3° ($p<0.01$) at 1POM. It was maintained at 12.8 ± 6.9° at 2POY. The T2-5 angle was increased through the observation period: 7.7 ± 6.7 preoperatively, 8.8 ± 5.4 at 1POM, and 9.5 ± 5.6 at 2POY. There was a significant difference between the preoperative and 2POY in T2-5 angle ($p=0.01$). Cervical alignment also improved significantly: preoperative C2-7 kyphosis, which was -11.6° ± 12.9° preoperatively, decreased to -1.7 ± 12.0° at 1POM ($p<0.01$) and -4.6 ± 12.0° at 2POY ($p=0.04$). Lumbar lordosis significantly increased chronologically from 38.1 ± 9.4° preoperatively to 40.7 ± 10.0° at 1POM ($p=0.01$) and 47.8 ± 11.3° at 2POY ($p<0.01$). Pelvic incidence showed no significant change ($p=0.35$-0.74).

Conclusion
Corrective surgery for AIS patients with thoracic lordosis significantly restored thoracic kyphosis and improved the sagittal alignment of the cervical and lumbar spine. These findings highlight the importance of addressing sagittal balance in surgical planning to optimize long-term outcomes.

230. Endoplasmic Reticulum Translocation of Mechanosensory S1PR2 Drives Neuronal Death after Distractive Spinal Cord Injury in Spinal Deformity Correction Surgery

Weishi Liang, MD; Yeqiu Xu, MD; Yong Hai, MD, PhD

Hypothesis
Distraction spinal cord injury (DSCI) is a severe complication following corrective surgery for spinal deformity, however, there is no effective treatment methods at present. The activation of S1PR2 resulting in enhancing expression of GRP78/PERK pathway and PANoptosis pathway, exacerbating DSCI-induced neuronal loss.

Design
A basic experimental study.

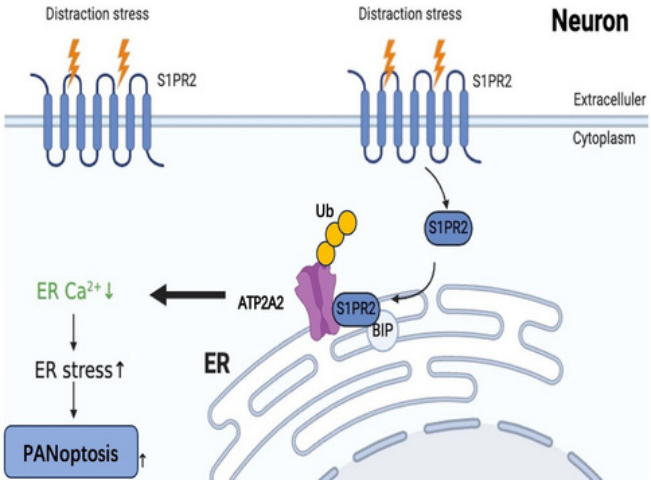
Introduction
Distractive spinal cord injury (DSCI) is a severe neurological complication of spinal deformity correction surgery. Neuronal loss is the main pathological feature after DSCI, however, its mechanism is unclear, and therapeutic interventions are lacking. We, through mimicking the spine distraction operation of spinal deformity correction surgery in rats, combined with cultured neurons undergone mechanical distraction, revealed a novel mechanism of mechanical distraction-induced neuronal loss.

Methods
The mechanistic studies utilized the established cell and rat models, employing methodologies including: RNA-seq, Histopathological analysis, Western blotting, qPCR.

Results
Here, we uncover a novel mechanotransductive pathway in which mechanical distraction induces the internalization of S1PR2 from the cell membrane into the endoplasmic reticulum (ER), triggering a cascade of ER stress driven by Ca^{2+} dysregulation and ultimately leading to neuronal PANoptosis. Mechanistically, ER-translocated S1PR2 interacts with ATP2A2, promoting its ubiquitin-proteasome-dependent degradation and thereby impairing its Ca^{2+}-ATPase activity. This post-translational modification disrupts ATP2A2-mediated calcium sequestration, resulting in ER Ca^{2+} depletion and subsequent ER stress, which potentiates PANoptosis. Notably, pharmacological inhibition of S1PR2 significantly improved hindlimb motor function and neural signal conduction efficiency in a rat DSCI model.

Conclusion
This study provides a paradigm-shifting mechanistic insight into DSCI pathogenesis and identifies S1PR2 inhibitors as promising translational therapeutics for DSCI treatment.

E-POINT PRESENTATION ABSTRACTS



This team uncovered a novel mechanism underlying neuronal loss following DSCI during spinal deformity correction surgery.

231. Effect of Low-Intensity Back-Strengthening on Preventing Deterioration of Posterior Pelvic Tilt and Spinal Alignment

Michio Hongo, MD, PhD; Yuji Kasukawa, MD, PhD; Daisuke Kudo, MD, PhD; Akiko Misawa, MD, PhD; Naohisa Miyakoshi, MD, PhD

Hypothesis
The back-strengthening exercise prevents the deterioration of sagittal spino-pelvic alignment.

Design
Case-control study

Introduction
Previous studies have demonstrated that a back-strengthening exercise improves lumbar lordosis and quality of life with a four-month program. However, the long-term effects remain unclear.

Methods
Postmenopausal women, with a mean age of 69 years and longitudinal chart records and radiographs spanning more than 2 years, were included. The exercise was instructed to 30 patients for home-based implementation (Exercise group). Patients were instructed to lie in a prone position with a pillow under the abdomen, slightly flexing the spine, and lift the upper trunk off the bed toward the neutral position for 5 seconds. Each contraction was repeated 10 times, performed once a day, five days a week. Approximately 200 patients served as a prospective control group, with 30 patients selected (Control group) to match age, body size, back extensor strength, and spino-pelvic alignment with the Exercise group. Lateral standing radiographs of the whole spine were evaluated for TK, LL, SVA, PT, and TPA. Isometric back extensor strength (BES) and grip strength were measured, and the measurements were compared between the groups.

Results
In the Exercise group, BES increased from 9.0 kg to 10.4 kg, while in the Control group, BES decreased from 8.9 kg to 7.8 kg, with a significant difference in the change of BES between the groups (p=0.013). Spino-pelvic alignment in the Exercise group showed no significant change over time, while in the Control group, there were significant increases in PT (p=0.034), TPA (p=0.016), and TK (p=0.04). Significant differences in the change in PT (p=0.031) and TPA (p=0.025) were observed between the groups.

Conclusion
The Exercise group demonstrated the maintenance of BES and spino-pelvic sagittal alignment, while a significant progression of kyphotic spinal deformity was found in the Control group. Considering the general deterioration of spino-pelvic sagittal alignment over time, back-strengthening exercise appears to prevent the progression of posterior pelvic tilt and spinal alignment.

234. Risk Factors for Allogeneic Red Blood Cell Transfusion in Pediatric Spinal Deformity Surgery: The Impact of Preoperative Autologous Blood Collection

Yasushi Iijima, MD, PhD; Toshiaki Kotani, MD, PhD; Tsuyoshi Sakuma, MD, PhD; Tsutomu Akazawa, MD, PhD; Shohei Minami, MD, PhD; Seiji Ohtori, MD

Hypothesis
We hypothesized that the lack of preoperative autologous blood

Design
Retrospective cohort study.

Introduction
Pediatric spinal deformity correction is often associated with substantial blood loss, making blood transfusion a common concern. Although previous studies have identified risks linked to allogeneic transfusion, few have assessed how preoperative autologous blood collection reduces its necessity. This study aimed to identify risk factors for allogeneic transfusion and evaluate the impact of autologous blood donation.

Methods
We reviewed 617 pediatric patients (<20 years) who underwent spinal deformity surgery between 2014 and 2023. The mean age was 15.0±2.3 years; 104 were male and 513 female. Diagnoses included idiopathic scoliosis (510 patients), congenital (39), neuromuscular (39), and syndromic (29). Mean fused levels were 9.4±3.1. Patients were grouped by whether they received allogeneic transfusion. Variables compared included age, sex, BMI, diagnosis, autologous blood use, fused levels, three-column osteotomy, global spinal alignment, and use of tranexamic acid. Logistic regression identified significant risk factors.

Results
Mean intraoperative blood loss was 398.4±349.0 mL. Autologous blood was successfully collected in 95.9% of patients. Allogeneic transfusions were given to 22 patients (3.6%). In logistic regression analysis, lack of autologous collection (P<0.001; OR=35.0) and non-idiopathic diagnoses (P=0.041; OR=15.3) were identified as significant risk factors.

Conclusion
Preoperative autologous blood collection markedly reduces the need for allogeneic transfusion in pediatric spinal deformity surgery. While patients with neuromuscular, syndromic, or congenital scoliosis may face limitations in autologous donation due to communication difficulties or surgical invasiveness, these findings support its proactive use whenever feasible. For high-risk patients unable to donate, clinicians should counsel families about transfusion needs. Our findings highlight the effectiveness of a structured blood management protocol, with one of the highest transfusion avoidance rates in the literature.

235. Patients and Their Parents Have a Poorer Perception of Trunk Appearance Than Surgeons After Posterior Spinal Fusion for AIS

Ivah X. Yeo; Johann Y. Boi; Jess S. Ooi, DIPPMS; Nicole Lee, PhD; Kevin B. Lim, MD

Hypothesis
AIS patients are more critical in the perception of their trunk appearance (shoulder balance and residual rib prominence) after PSF, compared their parents and surgeons.

Design
Retrospective cohort.

Introduction
A solid bony fusion and deformity correction are the two goals of PSF in the treatment of severe AIS. While surgeons prioritize safety and a pain-free and well-balanced spine, some patients and their parents rank cosmetic correction very highly. This study investigates the differences in the perception of trunk appearance after PSF for AIS, between patient, parent and surgeon.

Methods
Each patient was asked to rate trunk appearance after PSF for AIS using the Trunk Appearance Perception Scale (TAPS). Each response comprised of a score of body image viewed from the front, back, and on forward bending. At the same outpatient clinic visit, a parent and the surgeon completed the same survey.

Results
64 patients who underwent PSF for AIS at our centre between 2016 and 2023 were included for study (80% female, mean age 16.51±2.60 years, 20.51±13.33 months post-PSF). Mean total TAPS scores were 4.04±0.56 (patients), 4.10±0.68 (parents), and 4.17±0.68 (surgeon) respectively, with no statistically significant differences. There was a consistent moderate correlation between patient and parent scores (r=0.5, p<0.001) for all 3 sets. Kendall's Tau-b indicated moderate parent-patient agreement across all views and some moderate patient-surgeon agreement from the back. Surgeon ratings for front view did not correlate with patients' or parents' perceptions, and only correlated weakly with parents' perceptions on patients' bending forward.

Conclusion
Post-PSF, AIS patients are more critical of their body appearance (lowest TAPS scores) than their parents and surgeons (highest TAPS scores). Surgeons and care providers should be aware of this difference in perception. What they deem as an acceptable cosmetic correction from PSF may not be necessarily be so for the patient. A thorough discussion before surgery is important to manage expectations on cosmetic correction and trunk appearance post-op.

236. Establishing Maximal Outcome Improvement Threshold for SRS-22r in Patients with Severe Spinal Deformity: An Anchor-Based Analysis with A Minimum of 2-Year Follow-Up

Di Liu, MD; Jianguo T. Zhang, MD; Nan Wu, MD, PhD

Hypothesis
A measurable maximal outcome improvement (MOI) threshold for the SRS-22r score can be determined following surgery for severe spinal deformity.

Design
Retrospective study.

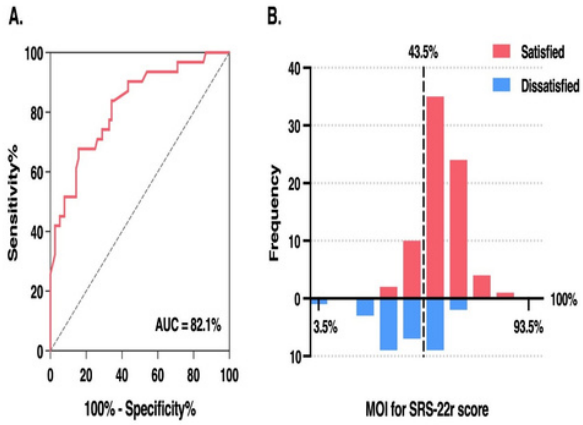
E-POINT PRESENTATION ABSTRACTS

Introduction
Clinically interpreting clinical outcomes following spinal deformity surgery remains challenging. Assessment tools are often limited by potential ceiling effects and overlook the influence of preoperative conditions on determining clinically meaningful thresholds. This study aims to establish the MOI threshold for the SRS-22r in severe spinal deformity.

Methods
One hundred and seven patients who underwent surgery for severe spinal deformity and had a minimum of 2-year follow-up were retrospectively included. The SRS-22r questionnaire was administered at baseline and at ≥ 2-year follow-up to determine the MOI threshold using the anchor-based method. Anchor questions were derived from the SRS-22r satisfaction, with postoperative satisfaction defined as scores ≥ 4 on both questions. The MOI was calculated as the changes in SRS-22r scores relative to the total possible improvement. Receiver operating characteristic (ROC) curve analysis was utilized to establish the optimal MOI threshold. Additionally, binary logistic regression analysis was conducted to identify predictors associated with achieving the MOI threshold.

Results
Significant radiographic and clinical improvements were obtained at a minimum 2-year follow-up. Dissatisfied patients had significantly lower scores in the SRS-22r satisfaction domain (3.1±0.4 vs. 4.5±0.4, $p < 0.001$) and subtotal scores (3.7±0.4 vs. 4.0±0.3, $p < 0.001$). The determined MOI threshold for the SRS-22r score was 43.5%. Logistic regression analysis indicated that male sex (OR = 0.8, $p = 0.022$) and surgical complications (OR = 0.7, $p < 0.001$) decreased the likelihood of achieving the MOI threshold. Conversely, preoperative neurological deficits were associated with increased odds of meeting this threshold (OR = 1.6, $p = 0.041$).

Conclusion
For patients with severe spinal deformity, the MOI threshold for the SRS-22r score was determined to be 43.5% at a minimum 2-year follow-up. Male patients and those with perioperative complications demonstrated a reduced likelihood of meeting the MOI threshold, whereas the preoperative neurological deficits was associated with an increased probability of achieving this threshold.



237. Selenium-Induced Zebrafish Model Recapitulates Key Features of Adolescent Idiopathic Scoliosis

Yuan Zhang, MD, PhD

Hypothesis
Excess inorganic selenium during a brief developmental window triggers oxidative cytoskeletal injury and side-specific apoptosis, producing reproducible three-dimensional spinal curvature in zebrafish.

Design
Dose- and age-response animal experiment; basic/translational science; level III.

Introduction
Selenium has a narrow nutritional range; surplus intake damages muscle-skeletal tissues. Field reports of curved fish from seleniferous lakes echo human AIS, yet no rapid vertebrate model exists. We tested whether controlled sodium selenite exposure can induce an AIS-like phenotype and probed underlying redox-cytoskeletal events.

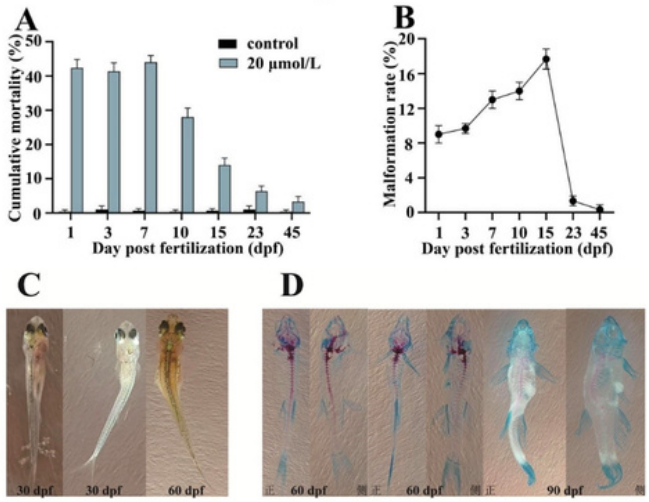
Methods
Embryos were reared in 0–25 μmol L^{-1} sodium selenite. Twenty μmol L^{-1} maximised deformity while preserving survival and was used for age testing (1–23 dpf). The optimal protocol—15 dpf larvae exposed 10 days then washed 5 days—generated three groups:

Results

- Deformity peaked at 17.7 % under the optimal protocol; 25 µmol L^{-1} raised mortality.
- Deformed fish accumulated the most selenium and showed the lowest GSH:GSSG, indicating oxidative stress.
- TUNEL rose 3.4-fold vs control; caspase-3↑, BAX↑, BCL-2↓.
- α/β-tubulin and G-actin signals fell ≥45 % in curved fish, confirming microtubule/microfilament collapse.
- Concave sides displayed higher apoptosis and weaker cytoskeleton than convex sides; control groups were symmetric.

Conclusion

Brief exposure of 15 dpf zebrafish to 20 µmol L^{-1} selenium reliably creates an AIS-like curve without congenital defects. Excess selenium provokes oxidative stress, asymmetric cytoskeletal failure and side-specific apoptosis, linking environmental selenium to spinal deformity. The model is rapid, inexpensive and suited to high-throughput screening of AIS mechanisms and therapies.



20 µmol L^{-1} selenium: cumulative mortality (A) and malformation rate peaking 17.7 % at 15 dpf (B); whole-mount (C) and Alcian-Alizarin spine images (D) demonstrate progressive curvature to 90 dpf.

238. Necessary Cervical Kyphosis Correction Angle (NeckCA) Based Surgical Algorithm for Cervical Spinal Deformity

Jin Hoon Park, MD, PhD

Hypothesis

A surgical algorithm that incorporates the Necessary Cervical Kyphosis Correction Angle (NeckCA) and ankylosis pattern can guide optimal osteotomy selection, thereby improving cervical alignment and reducing the risk of correction failure in cervical spinal deformity (CSD) surgery.

Design

Retrospective cohort study.

Introduction

Correction of cervical deformity requires meticulous preoperative planning to achieve ideal sagittal alignment and minimize complications. We propose a surgical algorithm (Figure) that integrates NeckCA and the distribution of ankylosis to determine the appropriate osteotomy strategy.

Methods

We retrospectively reviewed patients who underwent surgical correction for CSD between 2012 and 2024. The Necessary Cervical Kyphosis Correction Angle (NeckCA) was calculated using the formula: "C2 slope – 15 + COGT1 tilt", representing the angle required to achieve ideal alignment. Surgical strategies followed an algorithm based on ankylosis pattern and NeckCA. Flexible deformities and facet ankylosis were treated with posterior-only Grade II osteotomies. Anterior ankylosis required combined anterior Grade IV and posterior Grade II osteotomies, while PSO was added if further correction was needed. Patients were classified into favorable or unfavorable radiologic outcome groups, and clinical outcomes were compared between groups, and multivariate linear regression analysis was conducted to identify risk factors associated with kyphosis progression.

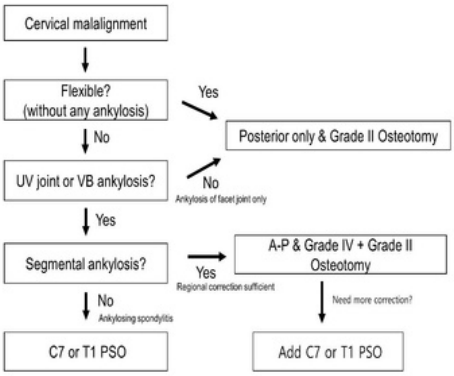
Results

Both groups showed significant improvements in Neck VAS and modified JOA scores postoperatively. However, the favorable radiologic group demonstrated significantly greater improvement in Neck VAS (Δ3.8 ± 0.6 vs. Δ3.0 ± 0.8, p=0.012) and higher postoperative modified JOA scores (16.5 ± 0.8 vs. 15.9 ± 0.7, p=0.043). Multivariate linear regression analysis revealed that failure to achieve NeckCA correction was an independent risk factor for kyphosis progression (β = 8.692, 95% CI: 3.277–14.108, p=0.003).

Conclusion

Patients who achieved sufficient NeckCA correction through the proposed surgical algorithm demonstrated favorable radiologic outcomes and better clinical improvements. An algorithmic approach that integrates NeckCA and the distribution of ankylosis is effective in selecting appropriate osteotomy strategies for cervical spinal deformity correction.

Figure



Surgical algorithm for cervical deformity correction.

240. Utilization of Suspension-Side-Bending Casting for Early Onset Scoliosis

Kaiying Shen, MD; Peter O. Newton, MD

Hypothesis

suspension-side-bending (SSB) casting is a non-inferiority and more simplified mothed by comparing with EDF casting in the treatment for EOS patients with main thoracic or thoracolumbar structural curve (mt/tl-EOS).

Design

A prospective cohort and a retrospective match-paired study.

Introduction

Serial casting is a popular delay strategy for treating EOS. The outcomes of SSB casting as an alternative method for EOS patients remain unclear.

Methods

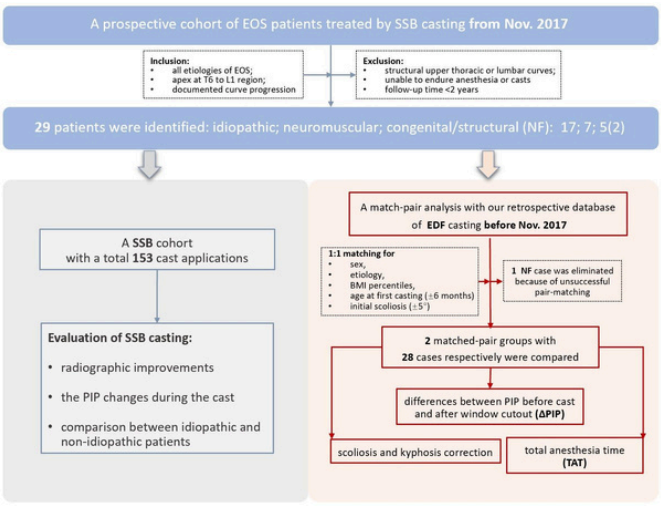
We reviewed a prospective, consecutive series of mt/tl-EOS patients following adoption of the SSB casting technique. Patient demographics, radiographic measurements, and anesthesia data were recorded. Correction rates of scoliosis and kyphosis, the changes of peak inspiratory pressure (PIP) and total anesthesia time (TAT) were compared between idiopathic and non-idiopathic patients. The identified SSB cases were 1:1 matched with EDF casting cases by BMI, age at first casting, initial scoliotic and kyphotic magnitude, and in cast correction rate, ΔPIP, and TAT were compared.

Results

29 patients undergoing SSB casting with a mean of ≥2 years follow-up were identified. Casting was successful in reducing the scoliosis and transitioning to bracing 6/29 cases. Ten patients remain in active cast treatment. There was a significant increase of PIP with a reduction after window cutout, but it did not reach the same level as baseline (Freidman, $p < 0.001$). Idiopathic patients obtained the higher correction rates of scoliosis (70.6 ± 7.2% vs. 49.2 ± 23.2%, $p = 0.005$), kyphosis (47.2 ± 17.5% vs. 33.3 ± 14.5%, $p = 0.027$), lower ΔPIP (6.0 ± 1.7 vs.8.6 ± 1.7 cm H2O, $p < 0.001$) and less TAT (18.0 ± 3.0 vs. 22.0 ± 3.7 min, $p < 0.001$) than non-idiopathic patients in SSB cast application. With a comparison of EDF casting by pair-matching, no differences were found in both scoliosis and kyphosis correction ($p = 0.274$; and $p = 0.785$); however, the ΔPIP and TAT were found to be reduced in the SSB group (6.9±2.1 vs. 11.3±2.2 cm H2O, $p < 0.001$; and 19.4±3.8 vs. 27.7±3.4 min, $p < 0.001$).

Conclusion

1. SSB casting is a simple, safe and viable alternative casting technique for patients with mt/tl-EOS.
2. The idiopathic patients obtained the higher correction of scoliosis and kyphosis, lower ΔPIP and less TAT.
3. The increases in PIP of SSB casting were significantly less than seen with EDF casting, and SSB casting required less time under anesthesia in comparison with EDF casting.



243. Pulmonary Function Before and After Spinal Deformity Surgery in Patients with Marfan Syndrome

Yuki Taniguchi, MD, PhD; So Kato, MD, PhD; Hiroyuki Nakarai, MD; Hideki Nakamoto, MD, PhD; Kosei Nagata, MD; Sakae Tanaka, MD, PhD; Yasushi Oshima, MD, PhD

Hypothesis
We hypothesized that pulmonary function in patients with Marfan syndrome (MFS) undergoing spinal fusion is influenced not only by curve severity but also by musculoskeletal features specific to MFS, and that greater correction may lead to functional improvement.

Design
Single-center retrospective cohort study.

Introduction
The relationship between spinal deformity and pulmonary function in MFS is poorly understood. This study aimed to evaluate perioperative changes in pulmonary function and identify associated factors.

Methods
We retrospectively reviewed MFS patients aged 10 to 39 years who underwent primary spinal fusion for spinal deformity at our institution. Radiographic parameters and surgical data were extracted to analyze factors associated with preoperative pulmonary function. In patients with follow-up pulmonary function tests (PFTs) at least one year postoperatively, we assessed changes in PFTs and investigated predictors of postoperative pulmonary function.

Results
A total of 35 patients (13 males, 22 females) were included. The mean age at surgery was 15.9 years (range, 10–36). The average preoperative Cobb angle was 64.6°, and mean preoperative %FVC was 75.3%. Preoperative %FVC was not significantly correlated with the Cobb angle or thoracic height but was significantly correlated with preoperative BMI (R^2=0.48, P<0.001) and was lower in patients with coexisting pectus excavatum (81.0% vs. 56.2%, P=0.01). In the 24 patients with follow-up PFTs more than one year postoperatively, mean %FVC decreased significantly from 73.5% to 65.3% (P<0.001). Patients whose %FVC improved postoperatively had significantly larger preoperative Cobb angles (81.0° vs. 64.0°, P=0.04) and tended to have greater correction angles (49.3° vs. 37.6°, P=0.07). Postoperative %FVC showed a strong correlation with postoperative BMI (R^2=0.54, P<0.001) but only a weak correlation with final thoracic height (R^2=0.21, P=0.02).

Conclusion
In MFS patients with spinal deformity, pulmonary function was more closely associated with coexisting pectus excavatum and low BMI than with spinal curvature severity. The reduced BMI likely reflects sarcopenia associated with the underlying disease. Although patients with larger preoperative curves may experience postoperative improvement in %FVC, multiple factors influence outcomes, and careful consideration is needed when planning surgical treatment.

244. Influence of Postoperative Coronal Malalignment Following Long Instrumented Fusion in Patients with Adult Spinal Deformity: Evaluation of Clinical Outcomes and Mechanical Complications

Jin-Sung Park, MD, PhD; Se-Jun Park, MD, PhD; Dong-Ho Kang, MD; Chong-Suh Lee, MD, PhD; HyunJun Kim, MD

Hypothesis
Postoperative coronal malalignment negatively impacts clinical outcomes and increases the risk of mechanical complications.

Design
A retrospective observational study of adult spinal deformity(ASD) patients who underwent ≥5-level fusion to the sacrum and achieved optimal sagittal alignment(PI–LL ≤10°) postoperatively.

Introduction
While optimal sagittal alignment is a key goal in ASD surgery and is linked to improved health-related quality of life, coronal alignment has been less studied. This study evaluated the impact of coronal malalignment on clinical outcomes and mechanical complications in ASD patients with satisfactory sagittal correction.

Methods
Coronal alignment was assessed using coronal balance distance(CBD), the horizontal distance between the C7 plumb line and central sacral vertical line. Patients with CBD ≥3cm were assigned to the coronal imbalance(CI) group, and those with CBD <3cm to the coronal balance(CB) group. Clinical outcomes were evaluated using visual analog scale(VAS) scores for back and leg pain, the Oswestry Disability Index(ODI), and the SRS-22 questionnaire. Mechanical complications such as proximal junctional kyphosis(PJK), proximal junctional failure(PJF), and rod fracture were evaluated. Clinical outcomes and the incidence of mechanical complications were compared between the groups.

Results
A total of 112 patients were included, with a mean follow-up of 46.8 months. Of these, 24 patients(21.4%) were in the CI group (mean CBD: 3.6±0.4cm), and 88 in the CB group (mean CBD: 1.1±0.7cm). The CI group showed significantly higher back pain VAS scores (52.5±19.8 vs. 40.1±24.0, p=0.022) and lower appearance scores on the SRS-22 (2.8±0.6 vs. 3.4±0.9, p=0.002). No significant differences were observed in leg pain VAS, ODI, or other SRS-22 domains. The overall rates of PJK, PJF, and rod fracture were similar between groups. However, the rate of revision surgery for rod fracture was significantly higher in the CI group(5/5) compared to the CB group (5/29, p<0.001).

E-POINT PRESENTATION ABSTRACTS

Conclusion
Postoperative coronal malalignment in ASD patients, even with ideal sagittal correction, was associated with greater back pain and lower appearance satisfaction. Although coronal alignment did not influence the overall incidence of mechanical complications, it significantly increased the risk of revision surgery for rod fractures.

246. Is There a Role for Preoperative Bone Health Screening In Adolescent Idiopathic Scoliosis with Large Stiff Curve? – A Retrospective Study with Minimum 5 Years Longitudinal Follow-Up

Adam Yiu-chung Lau, MBBS, FRCS; Kenneth Guangpu Yang, PhD, MBBS; Cheukkin Kwan, MBChB; Alec Lik Hang Hung, FRCS; Wayne YW Lee, PhD; Tsz-Ping Lam, MBBS, FRCS; Jack Chun-yiu Cheng, MD, FRCS

Hypothesis
Preoperative bone health assessment should be considered in adolescent idiopathic scoliosis with large stiff curve.

Design
Single centre retrospective study.

Introduction
Routine preoperative bone health assessment is recommended for older adults undergoing elective spinal reconstruction. This study aims to evaluate whether preoperative bone qualities correlate with spine flexibility, curve magnitude, vertebral wedging and surgical outcomes in adolescents with idiopathic scoliosis.

Methods
Consecutively surgically treated AIS girls presenting with severe curve requiring posterior spinal fusion were recruited. Preoperatively they received DXA bilateral femoral neck and Quantitative CT of lumbar spine. Standing and dynamic supine side-bending X-rays were performed to assess the spine flexibility index. Vertebral wedging angle was measured with standing biplanar EOS X-rays. Surgical outcomes were assessed with curve correction and any complications.

Results
59 AIS girls (mean age 16.9±3.7 years and average major Cobb 66.3±13°) were recruited. Preoperative fulcrum flexibility was 53.3%, prone flexibility 26.6%, lateral bending 36.6%, and post-operative correction 61.1%. Prone and fulcrum flexibility were significantly correlated with Cobb angle, apical vertebral wedging angle, as well as LS spine bone stiffness (N/mm) in FEA analysis of the preoperative CT spine. Vertebral wedging angle and number of pedicle anomalies were correlated with Cobb angle but not bone qualities. In this cohort with minimum 5 years longitudinal follow-up, preoperative bone qualities were not correlated with adverse surgical outcomes and post-operative correction.

Conclusion
Preoperative bone qualities were not correlated with vertebral wedging, pedicle anomalies and adverse surgical outcome in Adolescent Idiopathic Scoliosis. However, the findings of stiff curve's (reduced prone and fulcrum flexibility) significant correlation with suboptimal bone qualities may influence surgeons' decisions on preoperative optimisation, traction, pedicle screw density and also suitability of fusionless growth modulation surgery.

Pearson's Correlation coefficient between bone qualities and spine flexibility (Prone, Fulcrum and Lateral Bending)

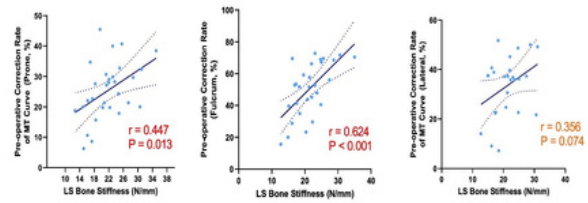
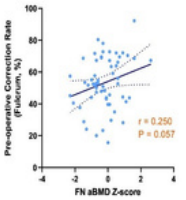


Table 1 Univariable and multivariate linear regression (Pre-op flexibility (Fulcrum))

	Univariable analysis			Multivariable analysis		
	Unadjusted Estimates	95% CI	*P*-value	Adjusted Estimates	95% CI	*P*-value
LFNaBMDZscore	0.042	-0.000 – 0.084	0.053	0.006	-0.033 – 0.045	0.753
Age	0.002	-0.009 – 0.014	0.715	-0.004	-0.015 – 0.006	0.387
Height	0.002	-0.005 – 0.008	0.553	0.003	-0.003 – 0.008	0.370
Cobb angle	-0.007	-0.010 – -0.005	<0.001	-0.007	-0.011 – -0.004	<0.001
VB wedging angle	-0.011	-0.020 – -0.002	0.016	-0.004	-0.014 – 0.006	0.414
IVD wedging angle	-0.004	-0.017 – 0.008	0.473	0.004	-0.010 – 0.018	0.565



247. Clinical Effectiveness of Rigo Chêneau Versus Boston-style Orthoses in Adolescent Idiopathic Scoliosis: 1-year Interim Analysis of a Prospective Randomised Controlled Trial

Gabriel Chun Yin Sung, BASc(GHD); Anjaly Saseendran, MS, BS; Lee Yin Goh, MS; Kenny Y. Kwan, MD, FRCS(C)

Hypothesis
RCO is superior to traditional brace TLSO in controlling curve progression in AIS.

Design
This is an interim analysis at 12 months of a randomised controlled trial with planned follow-up until patients showed skeletal maturity.

Introduction
The current most effective non-operative treatment to prevent curve progression in AIS patients is by spinal bracing.

Methods
Patients referred to a specialist scoliosis clinic in Hong Kong who meet the SRS indications for bracing were recruited. Recruited eligible patients were randomized to 1 of the 2 intervention arms: conventional thoracolumbarsacro orthoses (TLSO) and Rigo Chêneau orthoses (RCO). Main outcomes included changes in continuously measured Cobb angle and dichotomously measured curve progression status in 2D radiographic images at baseline and subsequent follow-up at 12 months, either improved/stable (<6° increase in Cobb angle) or deteriorated (≥6° increase in Cobb angle).

Results
A total of 134 patients were recruited and randomized but only data from 40 participants (TLSO group: n=26, RCO group: n=14) completing 12 months follow-up were included in the current analyses. Shapiro-Wilk test indicated normal distribution in both continuous outcome parameters. Longitudinal analyses from baseline to 12 months have shown no overall statistically significant difference between the two treatment groups for changes in Cobb angle (standardized means difference effect measures for change between groups (Cohen's d) = -0.02, 95% CI -0.46 to 0.43). Subgroup analyses showed significant Cobb angle reduction in the TLSO group (mean difference = -3.31°, paired t = 3.11, p < 0.005) but changes in the RCO group were not significant (paired t = 1.75, p = 0.10). Cobb angle in the TLSO group improved or remained stable in 73% of patients at 12 months from baseline and 76% in the RCO group improved or remained stable. Both groups combined, Cobb angle in 95% of patients remained stable or improved at 12 months follow-up and Fisher's exact test showed no difference in curve progression between treatment groups.

Conclusion
Regardless of orthoses type, curve progression improved or remained stable, demonstrating non-inferiority of RCO as compared to traditional bracing. Further study is required to determine differences in comfort level and 3D control.

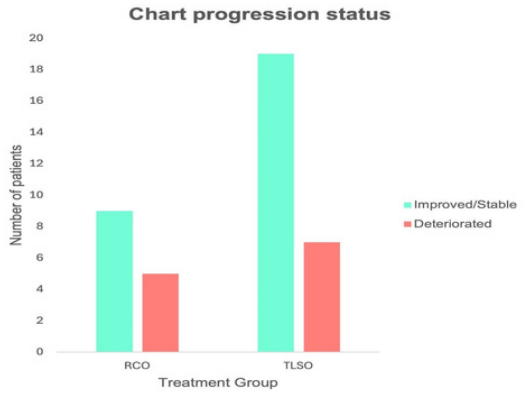


Chart progression status at 12 months follow-up

250. Factors Influencing Satisfaction at 2 Years Postoperatively with Posterior Spinal Fixation for Adolescent Idiopathic Scoliosis in Lenke Class 1 and 2

Takuma Fukuzawa, MD, PhD; Shota Ikegami, MD, PhD; Hiroki Oba, MD, PhD; Masashi Uehara, MD, PhD; Daisuke Kurogouchi, MD, PhD; Tetsuhiko Mimura, MD, PhD; Shinji Sasao, MD; Jun Takahashi, MD, PhD

Hypothesis
The postoperative correction rate affects satisfaction two years after surgery.

Design
Retrospective cohort study.

Introduction
There are several reports on patient satisfaction with PSF surgery for AIS. However, there are few reports that mention what specifically affects medium- to long-term satisfaction. Our purpose is to investigate patient satisfaction (SRS-22r Satisfaction) with PSF surgery for Lenke classification Type 1 and 2 AIS at two years post-surgery, and investigate X-ray parameters immediately after surgery and two years post-surgery that affects to a decline in satisfaction.

Methods
We include 160 patients who underwent posterior spinal fixation in our department between 2008 and 2023 and were followed up for more than two years. The strength of the correlation between various items immediately after surgery and two years after surgery, and satisfaction on the SRS-22r two years after surgery was calculated using Spearman's rank correlation coefficient. For satisfaction two years after surgery, those with a score of 4 or higher were classified as the S group, and those with a score of less than 4 were classified as the NS group. Risk factors for entering the NS group were evaluated using logistic regression analysis.

Results

PostoperativeT1Tilt was correlated with satisfaction two years after surgery (Spearman's rank correlation coefficient ρ = 0.179, P = 0.023). No significant correlation was found between the postoperative Cobb angle of the main curve, the rate of correction, and satisfaction two years after surgery. At 2 years postoperatively, the main Cobb angle (ρ = -0.185, P = 0.019) and TL/L Cobb angle (ρ = -0.258, P < 0.001) were negatively correlated with satisfaction at 2 years postoperatively. A correlation was observed between T1 tilt at 2 years post-surgery and satisfaction at 2 years post-surgery (ρ = 0.216, P value < 0.05). At two years postoperatively, satisfaction was 4.0 ± 0.75 on average, with 109 patients in the S group and 51 in the NS group. Multivariate analysis using logistic regression analysis showed that a large T1 tilt at two years postoperatively was an independent risk factor for entering the NS group (OR = 1.05, P =0.02).

Conclusion

2 years postoperative T1Tilt may affect patient satisfaction with PSF two years after surgery for AIS classified as Lenke 1 or 2.

251. C7 Pelvic Angle: A Useful Parameter for Spinopelvic Alignment Evaluation in Lenke 1 and 2 Adolescent Idiopathic Scoliosis

Benlong Shi, PhD

Hypothesis

C7 pelvic angle (C7PA) is associated with other spinopelvic alignment parameters in patients with Lenke 1 and 2 adolescent idiopathic scoliosis (AIS), and has a value in predicting pelvic incidence (PI) – lumbar lordosis (LL) mismatch after selective thoracic fusion (STF).

Design

A single center retrospective study.

Introduction

Recently a 40-year follow-up study reveals that the mismatch between PI and LL is the key risk factor for worse patient-reported outcome in AIS patients. On the other hand, regarding to the sagittal alignment in adult degenerative scoliosis, the preoperative vertebra pelvic angle (PA) have been proved to be correlated with postoperative changes in the sagittal plane and patients' quality of life. Similarly, we assumed that the vertebra PA might also be an important influencing factor for spinopelvic alignment in AIS patients.

Methods

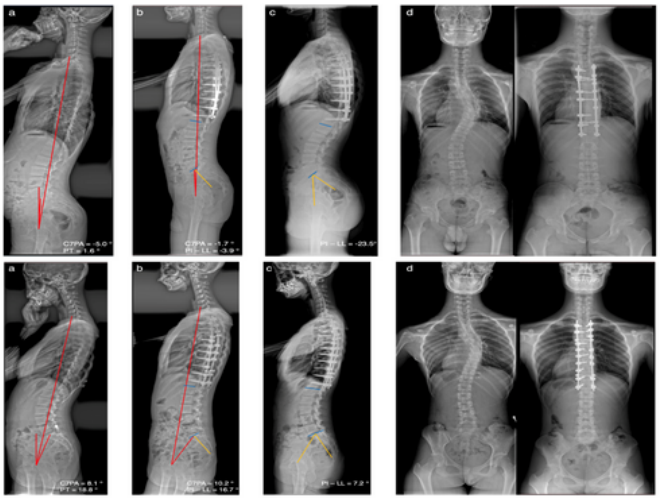
PI-LL greater than 9° was defined as PI-LL mismatch. Pearson correlation analysis and receiver operating characteristic (ROC) curves analysis were performed to explore the association between variables and outcomes. Multivariable logistic regression analysis was used to identify the independent risk factor for PI-LL mismatch at final follow-up.

Results

A total of 106 patients were enrolled in this study. Patients in the PI-LL match group had higher SVA, PI, pelvic tilt (PT), C7PA before surgery. There was a positive correlation between C7PA and PI-LL both preoperatively (r = 0.736, p < 0.001) and postoperatively (r = 0.903, p < 0.001). The association between SVA, LL and C7PA were also statistically significant. When C7PA ≤ 0.3×PT preoperatively, the incidence of sagittal imbalance and PI-LL mismatch significantly increased at last follow-up. ROC curves analysis revealed that (0.3×PT – C7PA) had the highest area under curve (AUC) when compared with other parameters. Multivariable logistic regression demonstrated that C7PA ≤ 0.3×PT was the key independent risk factor of PI-LL mismatch at final follow-up [odds ratio = 6.38, p = 0.005).

Conclusion

C7PA was strongly correlated with spinopelvic parameters especially with PI-LL both before and after surgery in patients with Lenke 1 and 2 AIS. The C7PA could serve as a crucial factor influencing PI-LL outcome after STF. Specifically, patients were at a significantly higher risk of PI-LL mismatch at final follow-up when preoperative C7PA ≤ 0.3×PT.



E-POINT PRESENTATION ABSTRACTS

252. The Intra-rater and Inter-rater Reliability of the Risser Sign, Proximal Femur Maturity Index and Proximal Humeral Ossification System

Ryuichiro Nakanishi, MD; Shunji Tsutsui, MD; Masanari Takami, MD; Akimasa Murata, MD; Takahiro Kozaki, MD; Hiroshi Yamada, MD

Hypothesis
In the assessment of the skeletal maturity during adolescent idiopathic scoliosis (AIS) management, the Proximal Femur Maturity Index (PFMI) and/or Proximal Humeral Ossification System (PHOS) demonstrate higher intra- and inter-rater reliability than the Risser sign (RS) in whole-spine radiograph.

Design
Retrospective single-center study.

Introduction
The accurate assessment of skeletal maturity is critical for determining treatment strategy for AIS patients. Although the RS has been historically used, it has been reported to have suboptimal reliability. Recently, PFMI and PHOS have been developed and reported to have high reliability. This study aimed to compare the intra- and inter-rater reliability among RS, PFMI and PHOS.

Methods
Standard whole spine ateroposterior radiographs, including the humeral head and proximal femur, from 52 AIS patients were randomly distributed to four raters with various levels of training in our department: a spine attending, a board-certified orthopedic surgeon, a spine fellow and an orthopedic resident. The raters were asked to classify skeletal maturity according to the RS, PFMI and PHOS. There were two rounds of trials, each done two weeks apart. The Cohen's kappa (κ) coefficient was calculated for the intra-rater and inter-rater reliability.

Results
The intra-rater κ coefficient for a spine attending, a board-certified orthopedic surgeon, a spine fellow and an orthopedic resident was 0.79, 0.54, 0.93, 0.58 (average, 0.71) for RS, 0.62, 0.67, 0.76, 0.56 (average, 0.66) for PHOS, and 0.72, 0.64, 0.91, 0.7 (average, 0.74) for PFMI, respectively. The inter-rater κ coefficient for the RS, PHOS and PFMI was 0.47, 0.45 and 0.55 in the first trial, and 0.43, 0.4 and 0.66 in the second trial, respectively.

Conclusion
The PFMI had more reliable κ values for both the intra-rater and inter-rater coefficient, even in the orthopedic resident. For staging of skeletal maturity on standard scoliosis radiographs, PFMI might be more reliable system compared to RS or PHOS.

256. Prediction of Angle Loss after L4/5 OLIF: Development of a Risk Stratification Model

Su Hun Lee, MD, PhD; *Dongwuk Son, MD, PhD*

Hypothesis
Preoperative disc angle, sacral slope, and cage position are predictive of postoperative segmental angle loss following single-level L4/5 OLIF.

Design
Retrospective radiographic cohort study with risk model development.

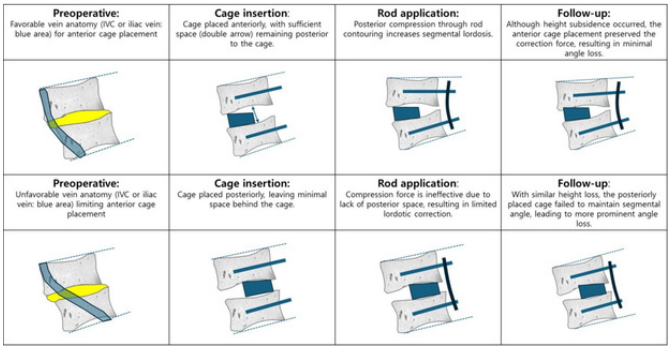
Introduction
Oblique lumbar interbody fusion (OLIF) offers indirect decompression and disc height restoration, yet segmental angle loss after surgery remains a concern, especially at L4/5. This study aimed to evaluate radiographic predictors of angle loss and to develop a simple risk stratification model.

Methods
Eighty patients who underwent single-level L4/5 OLIF with posterior percutaneous screw fixation and 2-year radiographic follow-up were analyzed. Parameters included preoperative disc angle (DAPRE), sacral slope (SS), and cage position (Cage_Y). Segmental angle loss was defined as a decrease in disc angle postoperatively. Angular subsidence was defined as a further decrease at 1-year follow-up. Multivariate logistic regression and ROC analysis were used to identify independent predictors and establish cut-off values.

Results
DAPRE > 6.0°, SS < 32.0°, and posterior cage placement (Cage_Y < 1.9 mm) were independently associated with angle loss. DAPRE was the strongest predictor (OR = 7.9). Greater initial angular gain was linked to subsequent angular subsidence. A simple additive risk score (0–3) based on these three factors showed increasing incidence of angle loss: 0% (score 0), 13.6% (score 1), 40.0% (score 2), and 81.3% (score 3). Posterior cage placement and greater angular gain also predicted angular subsidence over time.

Conclusion
Preoperative DAPRE, sacral slope, and cage position are strong predictors of postoperative alignment maintenance following L4/5 OLIF. This clinically applicable risk model may guide surgical planning and patient counseling.

E-POINT PRESENTATION ABSTRACTS



Schematic illustrating the impact of cage position on postoperative angle maintenance. Anterior cage placement allows more effective lordotic correction and sustains angle despite subsidence, whereas posterior placement limits correction and increases risk of angle loss.

258. Deep Learning-Based Method to Predict Long-Term Outcome of Bracing in Adolescent Idiopathic Scoliosis

Guilin Chen, MD; Jie Wang, BS; Aoran Maheshati, MD; Jianguo T. Zhang, MD; *Nan Wu, MD, PhD*

Hypothesis

The long-term outcome of bracing in AIS patients can be precisely predicted by deep-learning algorithms.

Design

This investigation was structured as a retrospective, multicenter cohort study to develop and validate a deep-learning algorithm for predicting long-term bracing outcomes in AIS.

Introduction

Bracing is an established method to prevent the progression of moderate AIS. However, its efficacy in a specific patient remains uncertain. Deep learning can be used to predict the outcome of a certain treatment. This study aims to develop a CNN/Transformer-based algorithm for predicting the long-term outcomes of bracing in AIS Patients.

Methods

Patients with AIS who underwent bracing were retrospectively recruited. Follow-ups for each patient were categorized into five periods: V0 represents the initial visit, V1 marks the visit when the first brace was worn, V2 indicates a short-term follow-up typically 0.5–1 year after V1, V3 refers to a long-term follow-up 1–2 years after V1, and V4 denotes the final follow-up, characterized by a Risser sign of 4 or 5 or progression to surgery. The interval between V0 and V1 was less than one month. Standing full-spine coronal radiographs from V0 and V1, along with clinical information including age, sex, and Risser sign, were used as inputs. A CNN/Transformer-based algorithm was developed to predict the thoracic and lumbar angles for each patient.

Results

A total of 213 patients who met the inclusion criteria were recruited from two independent centers. The overall mean age was 12.34 ± 1.90 years. Thoracic Cobb angles were similar between two groups (24.86 ± 8.17° in cohort 2 vs. 26.51 ± 10.01° in cohort 1), while thoracolumbar/lumbar angles were significantly higher in the cohort 2 (26.48 ± 7.17° vs. 23.78 ± 7.63°). The curve type distribution included single curve (33.4%), double curves (57.7%), and triple curves (8.9%). Three-fold cross-validation was applied. The root mean squared error (RMSE) and mean absolute error (MAE) of the algorithm using V0, V1, and clinical information as inputs were 5.78 and 4.06 for the thoracic curve (R^2 = 0.81) and 5.27 and 3.75 for the lumbar curve (R^2 = 0.75), respectively.

Conclusion

The deep learning-based algorithm developed in this study demonstrated strong predictive performance for thoracic and lumbar curve angles in patients with AIS undergoing bracing.

259. Predictors of Brace Treatment Failure in Adolescent Idiopathic Scoliosis: Impact of Age, Curve Type, and Cobb Angle

Shinji Sasao, MD; Hiroki Oba, MD, PhD; Shota Ikegami, MD, PhD; Masashi Uehara, MD, PhD; Daisuke Kurogouchi, MD, PhD; Tetsuhiko Mimura, MD, PhD; Takuma Fukuzawa, MD, PhD; Jun Takahashi, MD, PhD

Hypothesis

This study aimed to identify independent risk factors for brace treatment failure, examine the correlation between initial in-brace Cobb angle and curve progression, and assess the relationships among age, curve type, initial in-brace Cobb angle, and treatment success.

Design

Retrospective single-center cohort study.

Introduction

Also known as a thoracolumbosacral orthosis, an underarm brace is often used to non-invasively prevent curve progression in adolescent idiopathic scoliosis (AIS) for main thoracic- and thoracolumbar/lumbar-type curves. Recent studies have identified several risk factors for brace treatment failure, particularly initial in-brace Cobb angle.

Methods

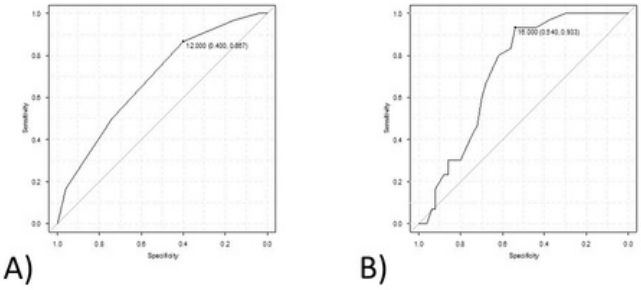
80 consecutive patients (76 girls and 4 boys; mean age: 12.0±1.2 years) commenced treatment with an underarm brace. Brace treatment failure was defined as a final Cobb angle of ≥50°, surgery, or curve progression ≥6°. A spinal surgeon evaluated standing long-cassette antero-posterior radiographs the pre-treatment, initial in-brace, and final follow-up time points. Measurements included main curve Cobb angle, curve type, shoulder balance, coronal balance, and initial in-brace correction rate. Multivariate analysis was conducted to classify patients into the bracing success and failure groups. We employed receiving operator characteristic analysis to determine cutoff values based on age and initial in-brace Cobb angle.

Results

The cohort of 80 patients were followed for a mean of 1123±436 days. Overall success rate was 62%, with 19 patients requiring surgery and 30 experiencing bracing failure. Bracing success cases exhibited significantly lower pre-treatment Cobb angle (29.1° vs. 31.7°; P=0.038), lower initial in-brace Cobb angle (15.5° vs. 21.0°; P<0.001), and higher in-brace correction rate (48.6% vs. 32.9%; P<0.001). Multivariate analysis identified younger age (+1 year, odds ratio 0.44; P=0.006) and higher initial in-brace Cobb angle (+10°, odds ratio 5.0; P=0.009) as independent predictors of treatment failure, with cutoff values of 12 years and 16°, respectively. Therapeutic outcomes varied significantly by curve type and age. Notably, lower success rates were seen for <12 years old and thoracic curves.

Conclusion

For patients aged ≥12 years, controlling Cobb angle to <16° at the initial underarm brace fitting may prevent significant curve progression and reduce the likelihood of surgery.



A) B)

260. Determining the Normative Reference Values for Acute-phase Inflammatory Markers 3 Days after Spinal Deformity Surgery by Using the E-norms Method

Ze Liu, MD; Di Liu, MD; Nan Wu, MD, PhD; Jianguo T. Zhang, MD

Hypothesis

The application of the e-norms method to establish a normative reference range for acute-phase inflammatory marker levels three days following spinal deformity surgery facilitates the early detection of postoperative surgical site infections (SSIs).

Design

A retrospective analysis.

Introduction

Given the severe consequences of SSI, early diagnosis and treatment are imminent. Postoperative inflammatory markers are commonly used to screen for SSI. However, the suitability of these markers for early SSI detection remains uncertain due to the absence of established normative reference values.

Methods

This study retrospectively enrolled the baseline demographics, surgical details and radiographic measurements of 417 patients who underwent spinal deformity surgery. The e-norm method was employed to calculate the reference values of inflammatory markers on the 3rd postoperative day. The derived reference values were subsequently compared with those generated by conventional methods and with those currently utilized in clinical practice for the detection of SSIs.

Results

According to the e-norm method, the normal white blood cell count on the third postoperative day is 5.85-12.09 (x10^9/L), neutrophil count is 3.98-9.98 (x10^9/L), percentage of neutrophils is 70.6-84.96 (%), lymphocyte count is 0.81-1.89 (x10^9/L), CRP concentration is 7.56-96.48 mg/L, and ESR is 10.32-40.52 mm/h. The results show that the average value measured by the two different methods is nearly identical, and the range of the e-norm method is relatively wider than that of the traditional method. Importantly, the frequency of SSI patients with abnormal inflammatory markers at 3 days postoperatively identified by e-norm methods was higher than that identified by conventional methods. Moreover, the reference values defined by the e-norm method demonstrate significantly better sensitivity and specificity compared to traditional methods and clinically applied reference values.

Conclusion
These reference values obtained via the e-norm method exhibit superior accuracy in screening for postoperative SSIs compared to values derived from traditional methods or those currently utilized in clinical practice. Therefore, the e-norm method may serve as a reliable and time-efficient alternative for establishing reference values for acute-phase inflammatory markers following spinal surgery.

261. Psychosomatic Influence of Different Brace Treatments in Adolescent Idiopathic Scoliosis

Satoru Demura, MD, PhD; Kei Watanabe, MD, PhD; Toshiaki Kotani, MD, PhD; Tomoyuki Asada, MD, PhD; Hideyuki Arima, MD, PhD; Yu Yamato, MD, PhD; Akira Matsumura, MD, PhD; Yuki Taniguchi, MD, PhD; Toru Doi, MD, PhD; Shoji Seki, MD, PhD; Ryo Sugawara, MD, PhD; Hiroki Oba, MD, PhD; Haruki Ueda, MD, PhD; Shinji Takahashi, MD, PhD; Satoshi Suzuki, MD, PhD; Takumi Takeuchi, MD, PhD; Naobumi Hosogane, MD

Hypothesis
Differences in brace treatment may have a psychosomatic impact on patients with adolescent idiopathic scoliosis (AIS).

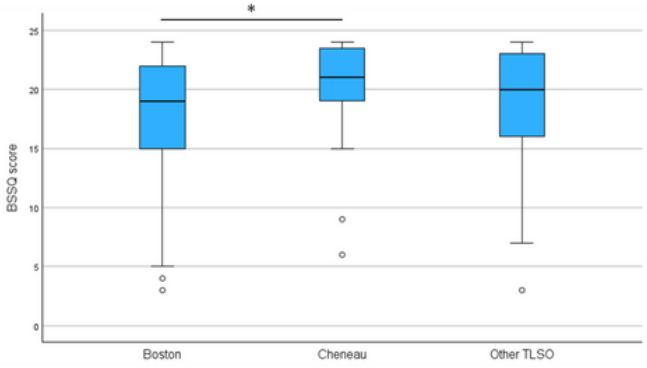
Design
Multicenter Prospective Cohort Study.

Introduction
Brace treatment is commonly employed to control curve progression in skeletally immature patients.While several studies have examined compliance and the psychosomatic effects of brace treatment, few have investigated these effects in relation to the type of brace using prospective longitudinal data.

Methods
We prospectively collected data from multiple centers on AIS patients undergoing brace treatment. The inclusion criteria were as follows: age 10–15 years, Cobb angle of 20–40 degrees, Risser grade below 4, and an apical vertebra below T7. A total of 264 patients were included (mean age: 12.4 years; 246 girls, 18 boys). Among them, compliance was monitored using temperature loggers in 159 patients. During follow-up, patient-reported outcome measures (PROMs), including the SRS-22r, the Bad Sobernheim Scoliosis Questionnaire-Brace (BSSQ-brace), and radiographic data, were evaluated. PROMs were administered at baseline, 4 months, and 1-year follow-up.

Results
The distribution of curve types was as follows: main thoracic (51.9%), lumbar (39.4%), and double curve (8.7%). The mean Cobb angle before brace treatment was 29.2 ± 4.4 degrees. No significant differences in pre-brace and 1-month post-brace Cobb angles were observed among different brace types. At 1 year post-treatment, the mean Cobb angle was 29.0 ± 6.9 degrees, indicating effective prevention of curve progression ($p < 0.01$). For patients using compliance monitors, the average brace wear time was 16.1 hours per day. Regarding brace types, the original Boston brace was used in 57.4% of patients, the Chêneau brace in 14.3%, and other rigid TLSO braces in 28.3%. At 1 and 4 months after brace initiation, significant differences were observed in BSSQ-brace scores. However, by the 1-year follow-up, no statistical differences were observed among brace types. The total SRS-22r score at 4 months and the function domain at both 4 months and 1 year showed significant changes. A significant difference in total SRS-22r scores at 1 year was observed.

Conclusion
The type of brace used in AIS patients significantly influenced BSSQ scores in the early treatment period. A significant difference in the total SRS-22r score at 1 year was observed in the function domain.



262. The Impact of Paraspinal Muscle Degeneration on Postoperative Loss of Pelvic Retroversion Correction in Degenerative Spinal Deformity with S2 Screw Fixation

Jie Li, MD, PhD; Ziqiang Liu, MD

Hypothesis
Paraspinal muscle degeneration contributes to the loss of posterior pelvic tilt correction following surgery for degenerative spinal deformity with fixation to S2 screws.

Design
69 degenerative scoliosis (DS) patients undergoing S2-instrumented corrective surgery were enrolled. Exclusions: prior spine surgery, infection, or neoplasms. Preop lumbar MRI quantified muscle metrics. Standing lateral full-spine (SLFS) radiographs measured pelvic tilt (PT) preop, postop, and final follow-up (FFU). Spearman/Mann-Whitney U analyzed muscle-parameter/ΔPT correlations.

Introduction
DSD prevalence rises in aging populations; pathogenesis involves IDD, osteoporosis, muscular imbalance. Impairing QoL. Surgical correction key for realignment/symptom relief; PC pivotal. Postop complications (frequent, outcome-impacting) strongly correlate with PC loss. Psoas/PM degeneration link to DSD onset/progression: Psoas dysfunction → reduced LL + APT; PM degeneration → THK + PPR.

Methods
Psoas major degeneration was quantified using the normalized total psoas cross-sectional area (NTPA) measured at the L3/L4 level. Paraspinal muscle degeneration was assessed using the Goutallier classification (GC) and fatty infiltration (FI). Postoperative measurements of pelvic tilt (PT) were obtained from standing full-spine radiographs acquired preoperatively, postoperatively, and at the final follow-up. ΔPT (change in PT) was calculated as final follow-up PT minus postoperative PT. Spearman correlation analysis and Mann-Whitney U tests were utilized to examine the relationships between muscle parameters (NTPA, GC, FI) and PT changes (ΔPT).

Results
Negative FI-ΔPT correlation (r=-0.304,p=0.011) indicated higher FI associated with greater PT increase during FU. GC≥2 patients showed significantly larger final FU PT versus lower grades (p=0.030), confirming postop PT increases associate with paraspinal FI.Negative NTPA-ΔPT correlation (L3:r=-0.246,p=0.042) suggested PT elevation linked to psoas atrophy.

Conclusion
Paraspinal fatty infiltration (FI) and psoas atrophy are significant risk factors for postoperative posterior pelvic tilt correction (PPTC) loss. We recommend incorporating preoperative paraspinal/psoas muscle quality assessment to optimize surgical planning and develop tailored rehab protocols, mitigating correction loss risk.

263. AQP10 and MMD May Be New Biomarkers or Intervention Targets for AS Patients

Li Zhang, MD; Zhi Zhao, MD; Yingsong Wang, MD; Yanrui Yang, MD; Tao Li, MD; Zhibo Song, MD

Hypothesis
Megakaryocytes(MKS) play a crucial role in the occurrence and development of ankylosing spondylitis(AS), and the cytokines associated with them have the potential to become biomarkers or new intervention targets for AS patients.

Design
Bioinformatics Analysis.

Introduction
AS can lead to severe spinal deformities, seriously affecting the quality of life of patients. However, the pathogenesis of AS is still unclear, and exploring the molecular mechanisms of AS is of great significance for the diagnosis and treatment.

Methods
Single-cell analysis was performed to identify key cells and their differentially expressed genes (DEGs) in AS through public databases. Key genes were further validated through enrichment analysis, construction of PPI network, three machine learning algorithms including LASSO model, Boruta model and SVM-RFE model, and expression validation. Afterwards, key genes were subjected to construction and evaluation of nomogram model, immune infiltration analysis, regulatory network analysis, and drug prediction, which were used to probe the molecular regulatory mechanisms.Then we performed pseudo-time and cellular communication analyses of MKS.

Results
Among all six samples in the single-cell dataset, 53,354 cells were acquired to analyze. Single-cell analysis revealed that MKS are primary cell types affected in AS patients, with 176 significantly DEGs identified. Following the training set, 138 DEGs were identified between AS patients and the control group. And two key genes, AQP10 and MMD, were identified finally. The area under the ROC curve for the AS prediction model constructed with AQP10 and MMD was 0.836. High expression of AQP10 mainly enriched Itga B Rhogap Rhoa, and AQP10 had the strongest correlation with more differential immune cells. Meanwhile, high expression of MMD primarily enriched Variant Mll Enl Fusion To Transcriptional Activation, and MMD had the strongest correlation with effector memeory CD4 T cell. Then, the hsa-mir-335-5p was predicted simultaneously by AQP10 and MMD, and arsenic was jointly predicted in the AQP10 and MMD. Furthermore, the expression trend of AQP10 and MMD during MKS differentiation was consistent, and the erythrocytes and natural killer cells had interaction in AS.

Conclusion
Megakaryocytes are main cells affected in the pathogenesis of AS patients, AQP10 and MMD are expected to become new biomarkers or intervention targets for AS patients.

264. Morphometric and Functional Assessment of the Diaphragm Using Computed Tomography in Patients Undergoing Kyphosis Deformity Correction

Rushikesh B. Shahade, MS; Tushar N. Rathod, MS

Hypothesis
Surgical correction of thoracolumbar kyphosis may restore diaphragm to optimal length, improving its contraction and excursion per Frank-Starling law, potentially enhancing respiratory function.

Design
Retroprospective observational.

Introduction
The diaphragm, a musculotendinous structure separating the thoracic and abdominal cavities, plays a vital role in respiration. Kyphotic deformities can alter thoracic cavity dimensions, affecting diaphragm shape and excursion, and thereby impairing respiratory function. In particular, reduced thoracic volume and increased anteroposterior diameter may overstretch the diaphragm beyond its optimal functional range. This study aims to evaluate morphometric and functional changes in the diaphragm using computed tomography (CT) in patients undergoing surgical correction of thoracolumbar kyphosis.

Methods
A study of 48 patients with severe kyphosis requiring surgery. Patients were grouped by deformity apex: Proximal Thoracic (T1–T6), Main Thoracic (T6–T12), and Lumbar (L1–L5). Pre- and post-op assessments included CT-based diaphragm measurements and Cobb's angle. Breath-holding time was a functional marker. AP diameter (D12 to xiphoid), chest height (T1 sup. endplate to diaphragm base), dome height, and Cobb's angle were recorded.

Results
Most patients (60.42%) were aged 11–20 years. Vertebral column resection (VCR) was performed in 87.5%. The anteroposterior diaphragm diameter significantly decreased in the main thoracic region (12.84±2.64 cm to 10.87±2.42 cm, p=0.001), with a non-significant decrease in the lumbar and increase in the proximal thoracic regions. Right hemi-diaphragm dome height improved significantly in the main thoracic (3.83±0.67 cm to 4.25±0.70 cm, p=0.008) and lumbar regions (3.66±0.67 cm to 4.33±0.18 cm, p=0.026); left side changes were not significant. Vertical chest cavity height increased significantly bilaterally. Breath-holding time improved postoperatively, especially in the main thoracic group (33.10±5.43 s to 38.37±7.89 s, p=0.001). Cobb's angle improved from 72.09° to 32.90° (p<0.001), indicating substantial deformity correction.

Conclusion
Kyphosis correction surgery signicantly improves diaphragmatic function and respiratory mechanics, particularly in the main thoracic region.

266. "ARC Force" Maneuver in Neglected Irreducible Posteriorly Displaced Type 2 Odontoid Fractures: A Case Series

Chitranshu Shrivastava, MS

Hypothesis
In patients with neglected posteriorly displaced Type 2 odontoid fractures, closed reduction techniques are inadequate; however, a single-stage open reduction using the ARC force maneuver followed by atlantoaxial fusion can restore spinal alignment and achieve favorable clinical and radiological outcomes.

Design
Case series.

Introduction
Posteriorly displaced Type 2 odontoid fractures are uncommon, and most acute cases documented in the literature can be successfully reduced using traction, followed by stabilization with cervical orthosis, halo immobilization, or surgical fixation. However, limited research addresses the management of neglected cases.

Methods
We reviewed the management of three neglected retro odontoid fractures with 100 percent translation and cord changes, in whom a single staged reduction maneuver using ARC force(Anterior Rotation with Cantilever force). Following reduction, an atlantoaxial fusion was performed.

Results
Post-operative mean Nurick grade improvement to 2 from 4 was observed. Regarding radiological outcomes, the mean space available for the cord preoperatively was 9.18mm, which was restored to 15.8 mm postoperatively. POCA and CCA were achieved within normal limits.

Conclusion
Closed reduction is ineffective in managing neglected retro-odontoid type 2 fractures. However, open reduction using the ARC force maneuver has yielded suitable clinical and radiological outcomes.

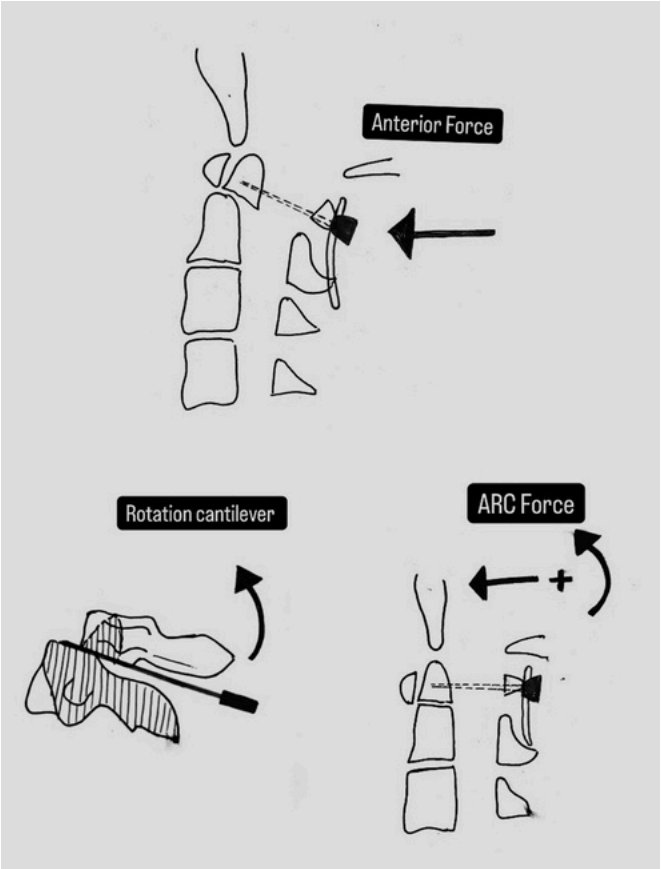


Figure showing illustration of ARC force maneuver for reduction of posterior displaced odontoid fracture

267. Impact of Declining Birth Rates on the Temporal Trend in the Prevalence of Idiopathic Scoliosis in South Korea: An Analysis of School-based Screening Data, 2008–2023

Sang Hyun Park, MD; *Jae Hyuk Yang, MD, PhD*; Hong Jin Kim, MD, PhD; Hyung Rae Lee, MD; Jun Hyun Kim, MD; Seoung Woo Suh, MD, PhD; Kanghun Yu, MD

Hypothesis
Birth rate may be significantly correlated with temporal trend in the prevalence of idiopathic scoliosis.

Design
A large-scale, population-based, retrospective observational study.

Introduction
The evidence for school-based scoliosis screening programs is currently indeterminate, given the conflicting opinions among healthcare professionals. This study aims to estimate the trend in the prevalence of adolescent idiopathic scoliosis (AIS) from the school-based scoliosis screening programs in South Korea over the recent 15-year follow-up.

Methods
This population-based retrospective study was conducted based on prospectively collected data of school-based scoliosis screening program for schoolchildren aged 10 to 14 years, 2008-2023. The primary outcomes were the temporal trend of annual prevalence of AIS between 2008 and 2023 and the correlation trends between the prevalence of AIS and the collected population census data, such as total fertility rate, and crude birth rate.

Results
The prevalence of AIS showed a gradually decreasing trend over the 15-year follow-up, ranging from 6.63% (95% CI: 6.48-6.78) in 2012 to 2.87% (95% CI: 2.72-3.02) in 2023. This trend was significantly correlated with the total fertility rate ($r = 0.882$, $P < 0.001$) and crude birth rate ($r = 0.845$, $P < 0.001$). The prevalence ratio of AIS (Seoul per metropolitan region) was significantly correlated with the total birth ratio (Seoul per metropolitan region) ($r = 0.643$, $P = 0.011$). For girls with AIS, there was a significant correlation between menarche age and Cobb's age over a 15-year follow-up ($r = -0.414$, $P = 0.008$).

Conclusion
The findings of this study suggest that the prevalence of idiopathic scoliosis showed a decreased trend between 2008 and 2023, potentially influenced by the total fertility rate. Additionally, the increasing tendency in curve magnitude among females observed in the school scoliosis screening program appears to be affected by the decreasing age of menarche.

268. Automatic Cobb Angle Calculation for Adolescent Idiopathic Scoliosis Using AI-Enhanced Vertebra-Focused Landmark Detection

Guan-Ting Liu, MS; Khac-Tuan Tran, MS; Quoc-Thinh Dinh, PhD; Chi-Kuang Feng, MD; Cheng-Yang Liu, PhD

Hypothesis
An AI-driven landmark detection system offers a fast and accurate method for automated Cobb angle estimation, demonstrating performance levels suitable for integration into clinical workflows.

Design
This study was a retrospective validation conducted using both publicly available and clinically acquired spine X-ray datasets.

Introduction
The Cobb angle is the clinical gold standard for quantifying spinal curvature in adolescent idiopathic scoliosis, serving as a critical parameter for diagnosis, progression monitoring, and treatment planning. However, manual measurement is labor-intensive and prone to inter-observer variability, potentially affecting clinical decision-making. Automating Cobb angle estimation using artificial intelligence offers a promising solution to enhance measurement efficiency, reduce subjectivity, and improve consistency in the management of scoliosis.

Methods
We developed a vertebra-focused landmark detection model using a ResNet-34 backbone to automatically identify vertebral centers and corners. The Cobb angle is calculated by detecting the most tilted vertebrae from T1 to L5. Input X-rays were standardized and processed via heatmaps and offset regression. The model was trained on the AASCE 2019 dataset and validated on 160 PA-view X-rays from adolescents with idiopathic scoliosis (aged 8–18) at Taipei Veterans General Hospital (IRB#2022-07-031CC), with expert-annotated Cobb angles as ground truth.

Results
The system achieved a symmetric mean absolute percentage error of 9.39% versus expert Cobb angle measurements, with inference time of 0.056 seconds per image (17.66 FPS). It accurately estimated angles from 2° to 78°, covering mild to severe scoliosis. Visual overlays confirmed precise vertebral landmark detection and alignment, supporting its clinical applicability.

Conclusion
This AI-based system provides accurate, real-time Cobb angle estimations that closely align with expert measurements, offering a scalable and cost-effective solution for scoliosis screening and longitudinal monitoring. Future work will focus on validating performance in extreme curvature cases and advancing toward clinical deployment and regulatory approval.

E-POINT PRESENTATION ABSTRACTS

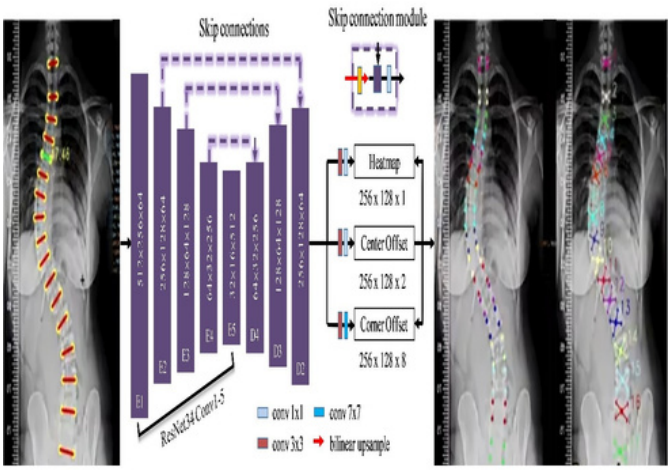


Figure 1. Architecture of AI-enhanced vertebra-focused landmark detection for automatic Cobb angle calculation.

269. Three-dimensional Evaluation of Pre- and Postoperative Arterial Dynamics in Patients with Lenke Type 1 and 2 AIS

Noriaki Sako, MD; Masashi Miyazaki, MD, PhD

Hypothesis
The aorta in patients with AIS will change its course as the spine is corrected.

Design
Single Institution Retrospective Study.

Introduction
While previous studies have reported positional changes of the aorta following surgical correction in adolescent idiopathic scoliosis (AIS), the spatial relationship between the spine and aorta after posterior correction remains poorly understood.

Methods
Thirty-one Lenke 1.2 AIS patients who underwent posterior correction surgery were included. Pre- and postoperative thoracic CT scans were reconstructed using Mimics to generate 3D models of the vertebrae (T1–L2) and the aorta. The curve index (CI) and tortuosity index (TI) were calculated from centerline measurements. Additionally, in transverse sections, the following parameters were measured: distance b (shortest distance between the vertebral body and the aorta), distance d (distance from the posterior wall of the vertebral body to the aorta), aorta-vertebral angle (α), and vertebral rotation angle (γ).

Results
Postoperatively, both CI and TI significantly decreased ($p < 0.001$), and a strong correlation was observed between ΔCI and ΔTI ($r = 0.806$). Distance d increased by an average of 3.6 mm from T6 to T10 ($p < 0.05$), and γ significantly decreased from T7 to T10. These findings indicate that posterior spinal correction—particularly the restoration of thoracic kyphosis and vertebral derotation—directly contributed to the anteromedial shift of the aorta.

Conclusion
Three-dimensional spinal correction in AIS, even via posterior approach, results in measurable positional changes of the aorta. These findings highlight the importance of preoperative vascular assessment and careful implant placement planning.

270. Three-Dimensional Analysis of Vertebral and Disc Deformities in Thoracic Adolescent Idiopathic Scoliosis

Hideki Tashi, MD; Masayuki Ohashi, MD, PhD; Yohei Shibuya, MD; Masayuki Sato, MD; Mio Kubota, MD, PhD; Tsuyoshi Arabiki, MD

Hypothesis
Three-dimensional (3-D) morphology of vertebral bodies and intervertebral discs can represent curve morphology and severity in thoracic adolescent idiopathic scoliosis (AIS).

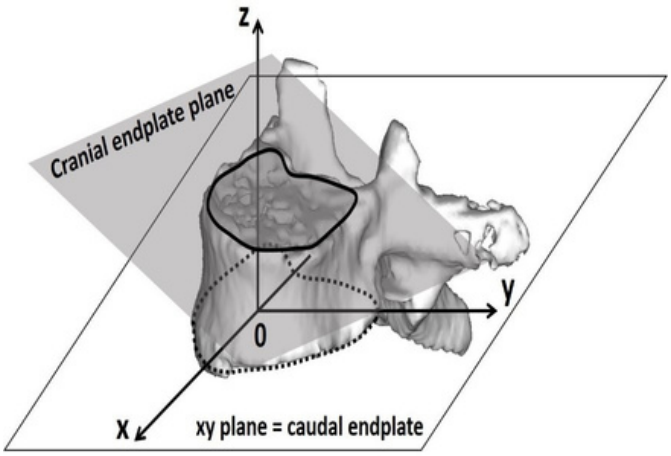
Design
A cross-sectional study.

Introduction
We aimed to evaluate 3-D morphology of peri-apical vertebral bodies and discs using CT images and analyze relationships with curve magnitude.

Methods
Forty preoperative girls with thoracic AIS (Lenke type 1 in 27 patients and type 2 in 13; average age, 17.2 years) were included. For 3-D measurements of CT images, we used ZedView software (Lexi, Japan) and set the local reference frame of each vertebra based on the caudal endplate (Figure). The vertebral and discal endplate plane angle (V-EPA and D-EPA) was defined as the angles between the cranial and caudal endplates of the vertebra and the disc, respectively. The rotational angle (RA) was defined as the angle between the antero-posterior vectors of the vertebra in question and the vertebra one level inferior (clockwise = positive). We performed 3-D measurements from 2-level distal (V+2, D+2, R+2) to 2-level proximal (V-2, D-2, R-2) relative to the apical vertebra (V0). The sum of V-EPA (V-sum) and that of D-EPA (D-sum) from V-2 to V+2 were calculated, and the correlations with Cobb angle of main thoracic curve in standing and side-bending radiographs.

Results
The mean V-EPA was 4.8° for V-2, 5.2° for V-1, 7.9° for V0, 4.9° for V+1, and 3.0° for V+2, which was the largest in V0 ($p < 0.001$). The mean D-EPA was 3.6° for D-2, 3.8° for D-1, 4.0° for D+1, and 3.9° for D+2 ($p > 0.05$). The mean RA was -3.2° for R-2, -1.9° for R-1, 0.6° for R+1, and 2.6° for R+2, in which the absolute RA value was significantly smaller at D-1 ($p < 0.001$). V-sum was significantly correlated with side-bending Cobb angle ($p < 0.01$, $r = 0.42$), while D-sum was correlated with standing Cobb angle ($p < 0.001$, $r = 0.50$).

Conclusion
From 2-level distal to 2-level proximal to the apex, vertebral deformity was greatest at the apex and segmental rotation was smaller adjacent to the apex, while discal deformities were similar. Correlation analysis indicated that standing Cobb angle mainly depended on the discal deformity but curve flexibility was mainly due to the vertebral deformity. Our results will provide new insights for 3-D segmental correction of thoracic AIS.



271. Selective vs. Non-selective Thoracolumbar/Lumbar Fusion in Lenke 6C AIS: Impact on Thoracic Curve Correction and Clinical Outcomes

Thanase Ariyawatkul, MD; Monchai Ruangchainikom, MD; *Korawish Mekariya, MD*; Kasidit Laorkanjanakul, MD; Chatupon Chotigavanichaya, MD; Sirichai Wilartratsami, MD; Ekkapoj Korwutthikulrangsri, MD; Surin Thanapipatsiri, MD

Hypothesis
Selective thoracolumbar/lumbar fusion (SLF) can achieve comparable residual thoracic Cobb angles and SRS-22 scores to non-SLF in the treatment of Lenke 6C AIS.

Design
Retrospective analysis utilized a prospectively collected database.

Introduction
SLF in Lenke6C AIS is challenging due to the presence of dual structural curves. Currently, no studies directly compare the radiological and clinical outcomes of SLF with non-SLF in this subgroup.

Methods
Lenke 6C patients who underwent posterior spinal fusion with more than 2 years of follow-up were included. Radiographic parameters were assessed preoperatively, postoperatively, and at the final follow-up. SRS-22 scores were also collected and compared between the SLF and non-SLF groups.

Results
A total of 48 patients were included (SLF: 23, non-SLF: 25), with a mean age of 14.6 years and an average follow-up of 6.4 years. Demographic and preoperative radiographic parameters were comparable between groups, except for a lower preoperative thoracic Cobb angle (42.2° vs. 51.0°, $p = 0.024$) and greater thoracic curve flexibility (24.6% vs. 15.1%, $p = 0.019$) in the SLF group. At final follow-up, thoracic curve correction was significantly lower in the SLF group (45.0% vs. 61.3%, $p = 0.019$). However, the residual mean thoracic Cobb angle was not significantly different (22.9° vs. 19.8°, $p = 0.118$). No significant differences were observed in final lumbar Cobb angle, coronal balance, shoulder height, or sagittal parameters including thoracic kyphosis between groups. Operative time and blood loss were significantly less in the SLF group (both $p < 0.001$). SRS-22 scores at the final follow-up were comparable between groups across all domains.

Conclusion
Selective thoracolumbar/lumbar fusion is a viable treatment option in carefully selected Lenke 6C patients, providing acceptable spontaneous thoracic curve correction and comparable SRS-22 scores while minimizing perioperative morbidity and preserving motion segments.

E-POINT PRESENTATION ABSTRACTS

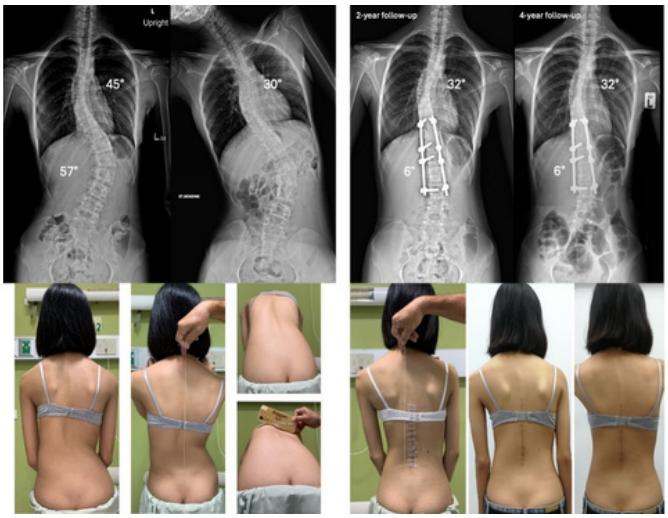


Figure 1. Clinical photographs and radiographs of a 14-year-old female with Lenke 6C AIS who had a 45° thoracic curve that corrected to 30° on active bending. Following SLF from T10-L3, the thoracic curve improved to 32° postoperatively and was maintained at the 4-year follow-up. Photographs show improved waistline and lumbar hump, with acceptable thoracic prominence, coronal balance, and shoulder height at the final assessment.

272. Comparison of Sagittal Alignment and Motion Preservation Following Total Laminotomy Versus Hemilaminectomy in Cervical Intradural Extramedullary Tumor Surgery

Kyung Hyun Kim, MD, PhD; Hyun Jun Jang, MD; *Jaemin Kim, MD*

Hypothesis

Unilateral hemilaminectomy better preserves cervical alignment and segmental motion than total laminotomy following resection of intradural extramedullary tumors.

Design

A retrospective comparative study of patients undergoing cervical intradural extramedullary (IDEM) tumor resection via unilateral hemilaminectomy or total laminotomy, assessing cervical alignment and range of motion (ROM) preoperatively and postoperatively.

Introduction

Unilateral hemilaminectomy is a standard minimally invasive approach for lumbar intradural extramedullary (IDEM) tumors, but its cervical application is limited due to concerns about exposure and instability. Few studies have compared radiographic outcomes of different posterior approaches for cervical IDEM tumor resection.

Methods

This retrospective study included 28 patients who underwent cervical intradural extramedullary tumor resection between 2018 and 2024. Ten patients underwent unilateral hemilaminectomy, and eighteen underwent total laminotomy. Radiographic parameters including C2 to C7 Cobb angle, sagittal vertical axis (SVA), T1 slope, cervical range of motion (ROM), and segmental ROM at the operative level were measured preoperatively, and at one month and one year postoperatively. Segmental ROM was assessed from dynamic flexion-extension radiographs. Intergroup comparisons were analyzed using the Mann–Whitney U test.

Results

At one-year follow-up, the hemilaminectomy group showed a significantly smaller increase in C2 to C7 sagittal vertical axis compared to the total laminotomy group (median delta SVA: minus 1.71 millimeters versus plus 3.07 millimeters, p equals 0.0416), indicating better preservation of sagittal alignment. While there was no significant difference in overall cervical ROM at one year (p equals 0.83), segmental ROM at the operated level was significantly better preserved in the hemilaminectomy group at both one month (p equals 0.0254) and one year (p equals 0.0131).

Conclusion

Unilateral hemilaminectomy demonstrated superior outcomes in maintaining postoperative cervical sagittal alignment and segmental mobility compared to total laminotomy. These findings suggest that hemilaminectomy may be a biomechanically favorable and motion-preserving alternative in cervical intradural extramedullary tumor surgery.

273. The Analgesic Effect of Postoperative Continuous Intravenous Nefopam in Multilevel Degenerative Lumbar Spinal Fusion: A Randomized Double-Blind Placebo-Controlled Trial

Borriwat Santipas, MD; Panya Luksanapruksa, MD; *Sirichai Wilartratsami, MD*

Hypothesis

Continuous intravenous nefopam infusion reduces postoperative morphine consumption without increasing adverse events in patients undergoing multilevel lumbar spine fusion.

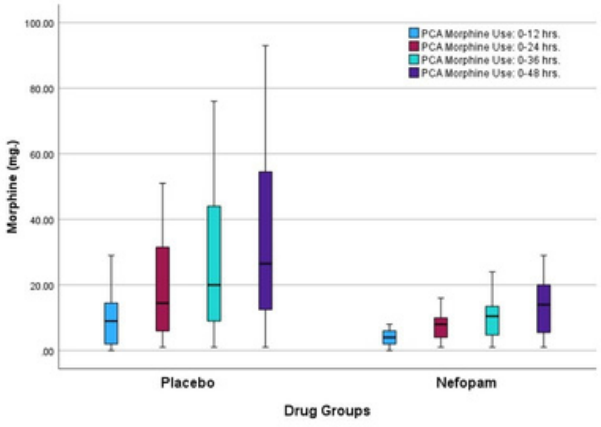
Design

Prospective, randomized, double-blind, placebo-controlled trial.

Methods
Sixty-six patients undergoing decompressive laminectomy and fusion for degenerative lumbar spinal stenosis (≥3 levels) were randomized to receive either continuous nefopam infusion (80 mg in 500 mL NSS over 24 hours) or placebo (500 mL NSS) postoperatively. All patients received standardized multimodal analgesia including IV morphine PCA. The primary outcome was total morphine consumption at 24 hours. Secondary outcomes included pain scores at rest and during movement, cumulative morphine use at 12, 36, and 48 hours, and adverse events.

Results
Morphine consumption at 24 hours was significantly lower in the nefopam group (n=33; 10.44±8.40 mg) compared to placebo (n= 33; 20.49±16.60 mg; p=0.013). Similar trends were seen at 36 hours (13.44±9.99 mg vs. 28.42±22.54 mg; p=0.009) and 48 hours (18.00±12.36 mg vs. 35.60±27.14 mg; p=0.016). Morphine reduction was significant between 24–36 hours (p=0.005) and 24–48 hours (p=0.012). Pain scores at rest and during movement did not differ significantly between groups (p>0.05). Rates of nausea/vomiting and tachycardia were comparable between groups.

Conclusion
Continuous intravenous nefopam infusion effectively reduces postoperative morphine requirements without increasing adverse events following multilevel lumbar spine fusion. These findings support its integration into multimodal analgesic protocols in spine surgery.



274. Genetic Awareness Among Scoliosis Care Providers: A National Survey Toward Integration of Genomic Medicine into School Health Screening

Reimi Sogawa, MPH; Satoshi Komatsubara, MD, PhD; Yumi Tanaka; Masakazu Ishikawa, MD, PhD; Kensuke Kumamoto, MD, PhD

Hypothesis
We hypothesized that scoliosis care providers may not be aware of the usefulness of genetic testing in scoliosis screening.

Design
A cross-sectional, anonymous, web-based questionnaire survey targeting medical professionals involved in scoliosis care.

Introduction
Scoliosis affects 2–3% of the Japanese population, mostly as idiopathic cases. However, some have genetic syndromes like MFS, where scoliosis occurs in 50–80% and may cause severe systemic issues. Early detection is vital. Current school screenings focus on AIS via visual exams, often missing genetic etiologies. With recent advances in genomic medicine, genetic testing is becoming more accessible, emphasizing the need to integrate genetic assessment into scoliosis screening and care to improve diagnostic accuracy and prevent delayed diagnoses.

Methods
Between April and May 2025, a nationwide web-based survey was conducted targeting medical professionals involved in scoliosis care across Japan. The survey explored participants' awareness of scoliosis genetics, perceptions of current screening systems, experience with hereditary scoliosis, use of genetic referral pathways, and views on collaboration with genomic medicine.

Results
A total of 164 medical professionals completed the survey. Over 70% recognized the limitations of physical examination-based screening, and more than 80% believed that incorporating specialized diagnostic tools is necessary. Nearly all participants acknowledged the genetic contribution to scoliosis, and over 70% had clinical experience managing hereditary scoliosis. While family history was routinely assessed in clinical practice, only about 40% of respondents had referred to patients for genetic evaluation. Awareness of certified genetic counselors was reported by approximately 50% of respondents; however, more than 90% expressed strong interest in interdisciplinary collaboration with genetic medicine specialists to improve patient care.

Conclusion
This nationwide survey reveals that scoliosis care providers widely recognize both the genetic factors contributing to scoliosis and the limitations of current school-based screening methods. Integrating genomic evaluation into routine scoliosis care and school health screenings represents a promising step toward precision medicine, enabling earlier detection of syndromic scoliosis and improving long-term outcomes for affected patients.

275. Radiation-Free 3D Assessment of Back Height Differences via Three-Dimensional Depth Sensing in Adolescent Idiopathic Scoliosis: Prospective, Single-Center, Observational Study

Sha Chen, MD; Chen Liu, MD; Xiao-min Chen, MD; Yin-ling Sun, MD; Jia-hao Mou, MD; Honggen Du, MD

Hypothesis
We hypothesize that back height difference (BHD) measured via a three-dimensional (3D) depth-sensing imaging system can serve as a reliable, radiation-free parameter for assessing adolescent idiopathic scoliosis (AIS).

Design
Cross sectional studies.

Introduction
Radiographic evaluation using the Cobb angle remains the gold standard for quantifying the degree of spinal curvature in AIS. However, repeated exposure to ionizing radiation poses additional health risks. Despite its high specificity (97.1%), the forward-bend test combined with scoliometer measurements has only moderate sensitivity (71.1%), potentially overlooking subtle or early deformities. Recent advances in 3D depth-sensing technology aim to address these gaps by generating more precise and detailed assessments of spinal deformities without radiation. Back height difference (BHD), reflecting asymmetry in back-surface contours, represents a promising parameter for non-invasive scoliosis assessment using 3D depth-sensing systems. BHD measurements were validated and obtained via a 3D depth-sensing imaging system as an effective AIS assessment tool and investigated correlations among BHD, ATR, and Cobb angle to ascertain BHD's potential as a reliable alternative measure in routine clinical practice.

Methods
This study is a prospective, single-center, observational study. 36 AIS were enrolled to compare the reliability between a scoliosis measuring scale and a three-dimensional depth-sensing imaging system. Additionally, 128 patients were included to evaluate the correlation of BHD with the angle of trunk rotation (ATR) and the Cobb angle.

Results
BHD showed excellent reliability (intraclass correlation coefficient >0.90), strong correlation with ATR ($R \leq 0.874$; $p<0.001$), and moderate correlation with Cobb angle ($R \leq 0.653$; $p<0.001$). Subgroup analyses showed the highest correlation in thoracic curves. BHD was sensitive in detecting advanced deformities and maintained strong correlations in mild curves.

Conclusion
Although not a substitute for radiographs, BHD provides a radiation-free tool for early AIS screening and management, with good reproducibility and alignment with radiographic and trunk rotation measures. Notably, its radiation-free nature aids in reducing exposure among pediatric cohorts.

276. The Impact of Sugammadex on TOF Recovery and MEP Reliability during Intraoperative Neuromonitoring in Pediatric Scoliosis Surgery: A Cohort Study

Min-Han Kuo, MD; Hsiang-Ling Wu, MD; Shang-Liang Wu, Biostatistician; Jan-Wei Chiu, MD; Chi-Kuang Feng, MD

Hypothesis
Neurologic deficits occur in 0.26–1.75% of scoliosis surgeries. Intraoperative neuromonitoring (IONM) provides an essential safety alert to the surgical team to halt the procedure if a neurologic injury is imminent. However, neuromuscular blocking agents such as rocuronium can suppress IONM signals, potentially causing monitoring failure. We hypothesize that administering Sugammadex will be safely applied for Taiwanese children and rapid recovery to a train-of-four (TOF) ratio > 0.9, thereby improving the reliability of motor-evoked potential (MEP) signals during intraoperative neuromonitoring.

Design
A retrospective cohort study was conducted at a single medical center, including patients aged 12–18 years who underwent scoliosis correction surgery between January 2023 and December 2024. Rocuronium was continued in all cases until just minutes before Sugammadex (2 mg/kg) was given. The timing was chosen because the risk of neurologic injury increases during subsequent steps, including pedicle screw insertion, Ponte osteotomy, and the scoliosis correction maneuver. MEP and TOF data were recorded every minute after Sugammadex administration.

Introduction
MEP detection is more successful when the TOF ratio is ≥ 0.9. This underscores the importance of achieving sufficient neuromuscular recovery to obtain reliable MEP signals during intraoperative neuromonitoring.

Methods
For each patient, the time to reach TOF > 0.9 and the time for MEP amplitude to return to baseline were measured separately for the left upper limb and left lower limb, over at least 10 minutes of monitoring after Sugammadex administration. Linear regression was used to examine the relationship between TOF and MEP recovery times.

Results
14 pediatric patients were included in the analysis. Linear regression was performed with A as the time to reach TOF > 0.9 and B as the time for MEP to return to baseline, yielding the equation $B = 1.4902 + 0.6056 \times A$. The slope was 0.6056 (SE 0.067, $p \approx 8.22 \times 10^{-9}$), indicating a highly significant positive relationship between A and B. R^2 was 0.786, indicating that A accounted for approximately 78.6% of the variation in B.

Conclusion
Reliable MEP signals during intraoperative neuromonitoring were observed after the TOF ratio exceeded 90% of baseline. Thus, the timing of TOF recovery is a critical predictor of MEP signal restoration in pediatric scoliosis surgery.

277. Predictive Factors of Antidepressant usage amongst new patients attending a spine clinic: A Cross-sectional Observational Study

Shubham Kumar M, MS; Saumyajit Basu, MS(Orth), DNB(Orth), FRCSEd; Harsh Patel, MBBS, MS; Ajay VM, MS; Ayon Ghosh, MS; Vikas Hanasoge, MBBS, MS

Hypothesis
New Patients attending a spine clinic with chronic neck or back pain have a higher incidence of antidepressant usage.

Design
Cross sectional Observational Study.

Introduction
Chronic pain and its associated psychological comorbidities are common among patients attending spine outpatient departments. Non-opioid psychotropic medications, including antidepressants, anticonvulsants, anxiolytics, and muscle relaxants, are frequently prescribed as part of multimodal pain management strategies. However, data on their prevalence and prescribing patterns in spine OPDs remain limited.

Methods
Study was conducted over 6 months in the spine outpatient department at a tertiary care centre. A total of 520 consecutive patients with chronic back and neck pain were assessed using structured questionnaires and chart review. Data on Demographics, psychotropic drug prescriptions, pain characteristics and comorbidities were collected. Statistical analysis was performed using Stata.

Results
Out of 520 new patients 94 (18.1%) were prescribed psychotropic drug with combination such as Tricyclic antidepressants (TCA) + Gabapentinoid n= 20 (21.27 %) being most common followed by SNRI + Gabapentinoid n=18 (19.14). Among standalone drugs Antidepressants such as selective serotonin-norepinephrine reuptake inhibitors (SNRIs) and SSRI n=21 (22.3%) were more popular and tricyclics (TCAs) n= 5 (5.3.6%), Gabapentinoids like Pregabalin n=4 (4.25%) and Gabapentin n=8 (8.51%) were specifically given for sleep disturbance or neuropathic pain. Multivariate analysis showed that Higher pain intensity (OR= 2.72), smoking (OR = 10.76), duration of pain (>6 months) (OR = 1.90), Higher ODI score ($p<0.001$), site of pain (neck or both) ($p=0.014$), and occupations like household work or unemployment were independent predictors of antidepressant drug use ($p < 0.005$). Sleep deprivation showed a strong association ($p < 0.001$).

Conclusion
18.1 % patients with back pain/neck pain received antidepressants prior to OPD visit. Independent predictors of antidepressants use are factors like sleep disturbance, smoking, and higher pain severity. These findings highlight the need for integrated pain and psychological management in spine care.

278. Incidence and Risk Factors of Pulmonary Embolism Following Pedicle Screw Augmentation with a High-Viscosity, Low-Pressure Technique

Dong Ki Ahn, MD, PhD; *Ki Chol Park, MD*; San Kim, MD; Jiseon Ahn, MD; Yong Kim, MD

Hypothesis
We hypothesized that a high-viscosity, low-pressure augmentation technique is associated with a low incidence of pulmonary embolism (PE). We also aimed to identify procedural risk factors for intravenous cement leakage, a precursor to PE.

Design
In this retrospective observational study, we analyzed 182 patients who underwent pedicle screw augmentation using a standardized high-viscosity, low-pressure protocol to determine the incidence of PE and cement leakage and to identify associated risk factors.

Introduction
Cement augmentation of pedicle screws enhances fixation strength in patients with osteoporosis. This study investigated the incidence of pulmonary embolism (PE) when using a specific technique designed to reduce cement leakage: a high-viscosity, low-pressure injection through large-cannula (2.5 mm) fenestrated screws. Intravenous leakage was used as a surrogate marker to evaluate PE risk.

Methods
In 182 patients, 919 screws were augmented using fenestrated pedicle screws and 1.6 cc of high-viscosity cement per screw. The injection was performed under lateral fluoroscopic guidance and was halted immediately if leakage was observed. Postoperative radiographs and, if needed, CT scans were used to confirm any cement leakage.

Results
Asymptomatic pulmonary embolism occurred in 3 of 182 patients (1.6%). Cement leakage was found in 58 cases (31.9%). The number of augmented screws was a significant factor associated with leakage. A subgroup analysis showed intravenous leakage was significantly more frequent in non-fractured vertebrae (4.5%) than in fractured vertebrae (1.7%) (p=0.020).

Conclusion
Augmentation with this high-viscosity, low-pressure technique is relatively safe, with a 1.6% asymptomatic PE rate. To minimize risk, surgeons should limit the number of screws being augmented and exercise greater caution when injecting into non-fractured vertebrae.

279. Motion-Favoring LIV Selection One or Two Levels Above the LTV in Thoracic Major Idiopathic Scoliosis: Is It Safe?

Seon-Jin Yoon, MD, PhD; Yongjung J. Kim, MD

Hypothesis
Selection of the last instrumented vertebra (LIV) one or two levels proximal to the Last Touched Vertebra (i.e. LTV−1 or LTV−2) is motion-favoring and safe in idiopathic scoliosis (IS) surgery if LIV is determined by the most proximal vertebra touched by center sacral vertical line (CSVL) with preoperative traction X-ray and remains touched by CSVL after final 3D corrective instrumentation.

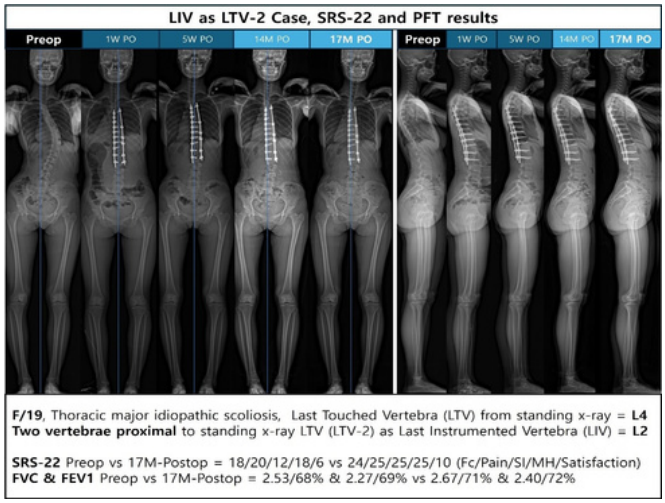
Design
Prospective single-arm.

Introduction
The surgical goals for IS are not only to achieve 3D correction of the spinal deformity but also to preserve as many motion segments as possible. The purpose of this study is to evaluate the safety and feasibility of selecting a LIV at LTV-1 or LTV-2 during a posterior segmental spinal instrumentation and fusion (PSSIF) for thoracic idiopathic scoliosis using pedicle screw constructs.

Methods
Radiographic and clinical assessments of 19 IS patients were included (Lenke types 1 and 2) after PSSIF. The LIV was selected as the LTV of the preoperative traction radiograph. This level was designated as LTV–1 or LTV–2, based on its position relative to the LTV of standing preoperative radiograph. Outcome measures included the Scoliosis Research Society-22 (SRS-22) questionnaire, pulmonary function tests (PFT), and radiographic evaluation using the Poor Radiographic Outcome (PX) criteria.

Results
Motion-favoring surgery was performed (LTV-1, N = 16; LTV-2, N = 3) with a minimum follow-up of 1 year (average 1.57 years). The mean age at the time of surgery was 18.15 years. The mean major curve angle improved from 60.3 degrees to 14.8 degrees ($P < 0.0001$). Only one patient in the LTV-2 group met the PX criteria at final follow-up due to adding-on complication (5.2%) while no complications in the LTV-1 group. Among the SRS-22 subdomains, improvements were observed in satisfaction (3.1 to 4.3, $P < 0.001$) and self-image (3.0 to 3.6, $P < 0.01$). No significant difference was observed in PFT results. Compared to a historical dataset reporting 17 poor outcomes and 27 favorable outcomes, the present study demonstrates a significantly safer profile ($P < 0.01$).

Conclusion
This study demonstrates that selecting the LIV one or two levels proximal to the LTV on standing radiographs, as part of a motion-favoring scoliosis correction strategy, is a feasible and potentially safe approach in patients with thoracic major scoliosis.



A Case of Idiopathic Scoliosis Treated with LIV at LTV-2.

E-POINT PRESENTATION ABSTRACTS

280. Reliability and Validity of the Thai Version of Spinal Appearance Questionnaire in Adolescent Idiopathic Scoliosis

Sittichai Yomtako, MD; Thamrong Lertudomphonwanit, MD; Pittavat Leelapattana, MD

Hypothesis
Thai version of SAQ (TH-SAQ) is valid and reliable to assess spinal appearance in patient with AIS.

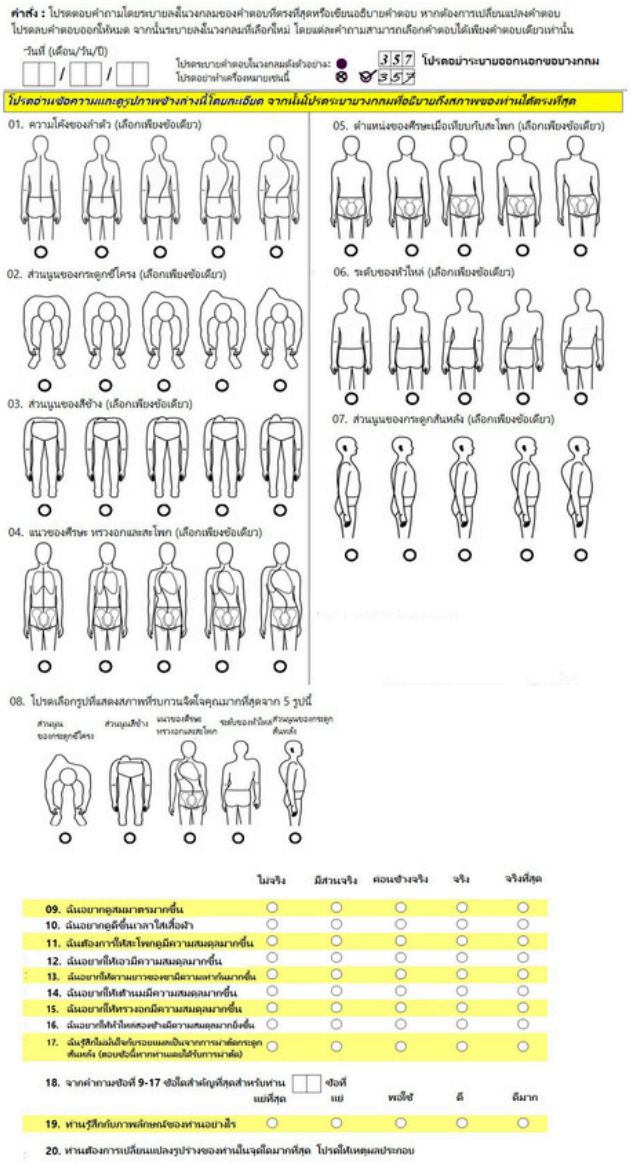
Design
Validation study of cross-cultural adaptation of the Spinal Appearance Questionnaire (SAQ).

Introduction
The SAQ is widely used to assess the perception of spinal appearance in patients with adolescent idiopathic scoliosis (AIS). However, there is no culturally adapted, reliable and validated SAQ for Thai AIS patients.

Methods
Translation/back-translation of the English version of the SAQ was processed following AAOS guideline. The Thai version of the SAQ (TH-SAQ) and appearance domain of the Thai version of the Scoliosis Research Society-22 Outcomes questionnaire (TH-SRS-22) were completed by 40 patients with AIS at day 0 and at 2 weeks after the first completion. Reliability was assessed using intraclass correlation coefficients (ICC) and Cronbach's α value. Convergent validity was evaluated by comparing TH-SAQ and TH-SRS-22 appearance domain scores and discriminant validity by analyzing relationships between 1) TH-SAQ scores and patient's radiographic, and 2) TH-SAQ scores and photographic appearance.

Results
The TH-SAQ showed satisfactory test-retest reliability, with intraclass correlation coefficient of 0.840 (95% CI =0.750-0.929). Internal consistency was excellent, with Intradomain correlation ranging from 0.8008-0.8544 (P< 0.05). The convergent validity demonstrated a moderate correlation between the overall TH-SAQ and TH-SRS-22 appearance domain and major curve magnitude, with ρ =0.3744, 0.4440 (P< 0.05). The Correlation between total TH-SAQ and major curve magnitude was also significant, with r = 0.440 (P<0.05). We also found weak to moderate correlation between specific SAQ domain score and specific visual aspect of deformed spine. Discriminant validity was confirmed by significant differences of overall TH-SAQ and 7 individual domain scores among patients in observation, bracing, surgery recommendation or post-surgery group (P < 0.05).

Conclusion
The Thai version of SAQ questionnaire showed satisfactory validity and reliability in the evaluation of spinal deformity appearance for Thai speaking patients with adolescent idiopathic scoliosis.



Thai spinal appearance questionnaire

281. What Factors Determine Postoperative L4 Tilt in Patients with Lenke Type 5 Curve Treated with Anterior Short Fusion Surgery?

Satoshi Inami, MD, PhD; Satoshi Takada, MD; Hiroshi Moridaira, MD, PhD; Masahiko Takahata, PhD; Haruki Ueda, MD, PhD; Tomoya Kanto, MD; Hiroshi Taneichi, MD, PhD

Hypothesis
In the Lenke type 5 curve of adolescent idiopathic scoliosis (AIS) treated with anterior short fusion surgery (ASF), there are factors that predict postoperative L4 tilt, and a prediction formula can be established.

Design
Retrospective cohort study.

Introduction
The purpose is to clarify the factors that determine the postoperative L4 tilt in patients with Lenke type 5 curve.

Methods
70 patients with AIS who underwent ASF for the Lenke type 5 curve were included. The average age was 16 years, the minimum follow-up was 24 months. Measured parameters were L4 tilt, lumbar Cobb angle (L-Cobb), thoracic Cobb angle (T-Cobb), apical vertebra translation (AVT), coronal balance (C7CSVL), sacral slant (SS) at preop, postop, final follow-up. Lumbar curve correction rate (CR), Cobb angle between UIV and LIV (UIV-LIV), LIV deviation from CSVL (LIV-CSVL), LIV tilt, disk angle just below LIV (LIVDA) at postop and final follow-up. Relevance between final follow-up L4 tilt and the measurement factors were analyzed by single regression analysis. Stepwise logistic regression analysis was performed using the significant factors in the above analysis. In addition, a prediction formula for final follow-up L4 tilt was created by multiple regression analysis with preoperative and surgery-related factors as explanatory variables ($p < 0.05$).

Results
Mean value (preop/postop/ff) were L4 tilt: 22/5.2/4.6, L-Cobb: 44.3/13/14.7, T-Cobb:28.4/14.3/16.1, AVT:-42.6/-12/-12.5, C7CSVL:-19.2/-14.6/-4.2, ST:6.7/4.8/4.1. Postoperative factor (post/ff) were CR: 72.5/67.2, UIV-LIV: -2/0.1, LIV-CSVL: -11/-10.6, LIV tilt: -1.5/-2.1, LIVDA: 5/4.8. The results of logistic regression analysis, in which the objective variable was a value larger than the mean value of ff L4 tilt (i.e. 4.6), were: UIV-LIV (OR: 1.35 , 95% CI: 1.08 – 1.69, $p = 0.001$), pre C7CSVL (OR = 0.9, 95% CI = 0.82 – 0.98, $p = 0.004$), post LIVCSVL (OR = 0.76, 95% CI = 0.62 – 0.93, $p = 0.0002$). The prediction formula by multiple regression analysis was ff L4 = -2.84 + 0.38UIV-LIV + 0.37ST – 0.068C7CSVL - 0.1AVT ($R2 = 0.55$, $p < 0.001$, t value: UIV-LIV 6.29, ST 3.19, C7CSVL 2.2, AVT 2.88).

Conclusion
UIV-LIV showed the largest value in the odds ratio and the t value, so was considered as having great influence on the ff L4 tilt. In this series, the mean postoperative UIV-LIV was 2 degrees of overcorrection, which would have resulted in good correction of L4 tilt.

282. An Obstetrical and Gynecological Insight to Measure the Gender-Specific Issues Including Menstrual Disorders in Patients with Scoliosis – A Genuine Step Toward Empowering Women's Inclusive Health

Tejaswin Jha, MS; Bhavuk Garg, MS; Buddhadev Chowdhury, MS; Nishank Mehta, MS; Akashdeep S. Bali, MBBS, MS; Smita Manchanda, MD; JB Sharma, MD

Hypothesis
Female patients with scoliosis, particularly those with congenital and syndromic subtypes, have a significantly higher prevalence of menstrual irregularities, reproductive abnormalities, and adverse obstetric outcomes compared to age-matched controls without scoliosis.

Design
This is an ambispective study conducted in a single tertiary care centre extended from January 2021 to November 2022. A total of 292 female patients were included (192-retrospective and 100-prospective). Additionally, 50 age-matched females without scoliosis were recruited as the control group.

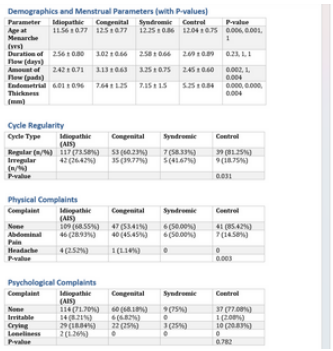
Introduction
Scoliosis is a complex spinal deformity with potential implications beyond musculoskeletal health. Despite extensive research on scoliosis pathogenesis, its impact on menstrual, reproductive, and obstetric outcomes remains underexplored.

Methods
Participants were assessed through clinical evaluation, questionnaires, and ultrasonographic examination. Parameters studied included age at menarche, cycle regularity, bleeding characteristics, physical/psychological symptoms, and ultrasonographic findings. Obstetric outcomes were recorded where applicable. Statistical tests included Fisher's exact test and Bartlett's test for variance.

Results
Mean age at menarche was delayed in scoliosis patients, especially in congenital scoliosis (12.5 ± 0.77 years) compared to controls (12.04 ± 0.75 years). Menstrual irregularities, menorrhagia, and dysmenorrhea were significantly higher in congenital and syndromic scoliosis groups. Physical complaints were significantly more common in scoliosis groups than controls ($p = 0.003$), but psychological symptoms showed no statistical difference. Endometrial thickness and incidence of follicular cysts/bulky ovaries were significantly elevated in congenital and syndromic scoliosis groups. 86 % of obstetrical patients had unplanned caesarean sections, mostly due to cephalopelvic disproportion; no cases of spontaneous abortion or infertility were recorded.

Conclusion

Scoliosis, particularly of congenital and syndromic origin, is associated with delayed menarche, menstrual irregularities, and gynecologic abnormalities. Although obstetrical data were limited, trends suggest potential complications that merit further investigation. Larger, long-term prospective studies are needed to clarify these associations.



Demographics and Menstrual Parameters (with P-values)

Parameter	Idiopathic	Congenital	Syndromic	Control	P-value
Age at Menarche (yrs)	11.56 ± 0.77	12.5 ± 0.77	12.25 ± 0.86	12.04 ± 0.75	0.006, 0.001, 1
Duration of Flow (days)	2.56 ± 0.80	3.02 ± 0.66	2.58 ± 0.66	2.69 ± 0.89	0.23, 1, 1
Amount of Flow (pads)	2.42 ± 0.71	3.13 ± 0.63	3.25 ± 0.75	2.45 ± 0.60	0.002, 1, 0.004
Endometrial Thickness (mm)	6.01 ± 0.96	7.64 ± 1.25	7.15 ± 1.5	5.25 ± 0.84	0.000, 0.000, 0.004

Cycle Regularity

Cycle Type	Idiopathic (AIS)	Congenital	Syndromic	Control
Regular (n/%)	117 (73.58%)	53 (60.23%)	7 (58.33%)	39 (81.25%)
Irregular (n/%)	42 (26.42%)	35 (39.77%)	5 (41.67%)	9 (18.75%)
P-value				0.031

Physical Complaints

Complaint	Idiopathic (AIS)	Congenital	Syndromic	Control
None	109 (68.55%)	47 (53.41%)	6 (50.00%)	41 (85.42%)
Abdominal Pain	46 (28.93%)	40 (45.45%)	6 (50.00%)	7 (14.58%)
Headache	4 (2.52%)	1 (1.14%)	0	0
P-value				0.003

Psychological Complaints

Complaint	Idiopathic (AIS)	Congenital	Syndromic	Control
None	114 (71.70%)	60 (68.18%)	9 (75%)	37 (77.08%)
Irritable	14 (8.21%)	6 (6.82%)	0	1 (2.08%)
Crying	29 (18.84%)	22 (25%)	3 (25%)	10 (20.83%)
Loneliness	2 (1.26%)	0	0	0
P-value				0.782

Ultrasound Findings (with P-values)

Finding	Idiopathic	Congenital	Syndromic	Control	P-value
NAD	85	43	6	42	
Follicular Cyst	27	16	4	5	0.5228, 0.0039, 0.0021
Bulky Ovary	7	6	1	2	0.2546, 0.0027, 0.0021
Endometriosis	0	1	0	0	
Ascitis	1	1	1	1	
PCOD	4	0	0	0	
Fibroid	1	0	0	0	

Results Table

283. The Effect of Rod Properties and Correction Techniques on Rod Bend-Back in Adolescent Idiopathic Scoliosis Surgery

Noriaki Yokogawa, MD; Satoshi Kato, PhD; Takaki Shimizu, MD; Satoru Demura, MD, PhD

Hypothesis

We hypothesized that using stronger, pre-bent rods with the Coplanar method would reduce rod bend-back and lead to better restoration of thoracic kyphosis than traditional techniques.

Design

This was a retrospective, single-center, comparative observational study.

Introduction

In adolescent idiopathic scoliosis (AIS) with a main thoracic curve, restoring thoracic kyphosis is a critical surgical goal. Conventional manual-bent rods can suffer from altered mechanical properties and intraoperative "bend-back," limiting sagittal correction. We have adopted pre-bent rods, with theoretically superior mechanical strength, and the Coplanar method, a technique considered advantageous for kyphosis restoration.

Methods

We reviewed patients with Lenke type 1 or 2 AIS who underwent posterior fusion at our institution between 2011 and 2025. Patients were divided into three groups: manual-bent rod with rod rotation (Group M), pre-bent rod with rod rotation (Group P), and pre-bent rod with the Coplanar method (Group C). To minimize bias, we used propensity score matching to adjust for baseline characteristics (age, sex, preoperative Cobb and kyphosis angles, Ponte osteotomies, rod material). We then compared the Cobb angle correction rate, postoperative thoracic kyphosis, and concave rod bend-back rate between the matched groups (M vs. P; M vs. C).

Results

After matching, there were no significant differences between Group M (n=10) and Group P (n=10) in Cobb correction (69.2% vs. 72.8%), postoperative kyphosis (18.5° vs. 19.4°), or bend-back rate (53.4% vs. 49.3%). Similarly, no significant differences were found between Group M (n=8) and Group C (n=8) for Cobb correction (67.7% vs. 72.6%), postoperative kyphosis (18.4° vs. 21.1°), or bend-back rate (47.2% vs. 48.0%).

Conclusion

Contrary to our hypothesis, the choice of a pre-bent rod or the use of the Coplanar technique had a limited effect on rod bend-back and final kyphosis. Our findings suggest that achieving optimal sagittal correction may depend more on other factors, such as performing adequate surgical releases to ensure sufficient spinal flexibility, rather than on rod type or insertion technique alone.

284. The Difference in Arm Span and Height is Expected to Reduce the Screening Range and Monitor the Progress of Scoliosis

Li Zhang, MD; Zhi Zhao, MD; Yingsong Wang, MD; Tao Li, MD; Yanrui Yang, MD; Zhibo Song, MD; Zhaoquan Zhang, MD

Hypothesis

The difference in arm span and height is significantly correlated with scoliosis, which can indirectly reflect the condition of scoliosis.

Design

A retrospective study combined with current situation survey.

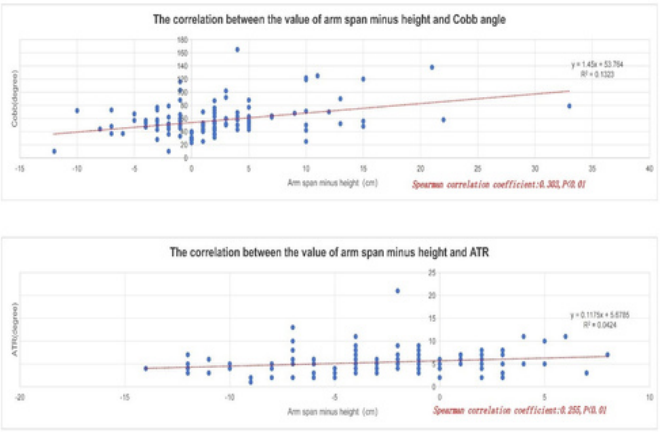
Introduction

Due to the lateral curvature of the spine, the height of patients with scoliosis is lower than that in a healthy state, resulting in an increase in the difference in arm span and height. There is little research on whether the difference in arm span and height can reflect the condition of scoliosis.

Methods
120 patients with scoliosis requiring surgery, 80 adolescents suspected with scoliosis and 49 healthy controls from June 2023 to October 2024 were included. Personal information such as gender, age, height, arm span, weight, as well as the angle of trunk rotation(ATR) and Cobb angle were collected. Analyze the correlation between ATR, Cobb angle, and the difference in arm span and height, and whether personal factors such as gender affect the difference in arm span and height.

Results
Among 120 patients with scoliosis requiring surgery, there were 32 males and 88 females, with a median age of 13.0 years and a median Cobb angle of 52°. 80 adolescents suspected with scoliosis, including 23 males and 57 females, with a median age of 14.0 years and a median ATR of 6°. Among the 49 healthy controls, there were 34 males and 15 females with a median age of 15.0 years. There were significant differences (P<0.01) in gender, age, height, arm span, weight, and the difference in arm span and height among the three groups. The difference in arm span and height was correlated with Cobb angle and ATR, with correlation coefficients of 0.303 and 0.306, respectively (P<0.01). However, the difference in arm span and height was not correlated with age(P=0.239) or gender(P=0.845), and there was no statistical difference between different age(P=0.112) and gender groups (P=0.845).

Conclusion
The difference in arm span and height was correlated with Cobb angle and ATR, and was not affected by gender or age, and it was expected to become an indicator for narrowing the screening scope of scoliosis and monitoring the progression of scoliosis.



The correlation between the value of arm span minus height and Cobb angle and ATR

287. Domain-Generalizable Cobb Angle Estimation via a Segmentation-Based Deep Learning Pipeline

Chih-Yi Lu, Ph.D. student; Chun-Yi Hsieh, MD; Chi-Kuang Feng, MD; I-Yun L. Hsieh, PhD

Hypothesis
Segmentation-based deep learning models can achieve clinically acceptable accuracy in Cobb angle measurement and generalize across institutions with inconsistent imaging settings.

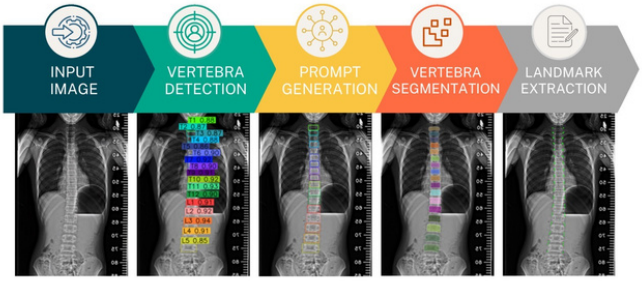
Design
Experimental study using multi-center radiographic datasets with domain shifts.

Introduction
Adolescent idiopathic scoliosis affects 2–4% of adolescents and requires accurate Cobb angle measurement for monitoring. Manual measurement is a clinical standard, but it is time-consuming and subject to inter-observer variability. While AI-based methods have been proposed, few studies have evaluated their performance across institutions. These methods are classified as landmark or segmentation. Landmark approaches detect keypoints but were shown to be prone to misidentification, reducing accuracy. In contrast, segmentation methods delineate vertebrae, preserve interpretability, and enable more consistent results. We propose a segmentation-based pipeline that balances accuracy and robustness across institutions.

Methods
This study uses spinal X-rays from Taipei Veterans General Hospital (TVGH, PA view) and London Health Sciences Centre (LHSC, AP view), which differ in brightness and resolution. The model is trained on TVGH data and evaluated on LHSC data to assess generalizability. The pipeline integrates RF-DETR for vertebral detection, SAM2.1 for contour segmentation, and geometric analysis for Cobb angle computation. Each image is annotated with three angles: main, upper, and lower compensatory curves. Evaluation metrics include AP@0.50, Dice coefficient, and absolute angular error with respect to expert annotations.

Results
On the TVGH test set, the model achieves IoU=0.963 and Dice=0.948. Mean absolute errors are below 5° across all angles, e.g., 2.19° and 2.5° for the main curve compared to two observers. The model maintains stable performance on the unseen LHSC test set, with errors under 5°. Notably, the AI model achieves 94% agreement within 5° with observer 1 on the main curve, which exceeds the 89% agreement between the two human observers. This demonstrates the AI model's superior consistency in Cobb angle assessment.

Conclusion
The proposed pipeline achieves clinically acceptable accuracy and generalizes across domains. RF-DETR shows sensitivity to domain shift, whereas SAM2.1 remains stable. Future work focuses on using curriculum learning to improve robustness under unfamiliar imaging conditions.



Overview of the proposed framework

288. Pedicle Corticalization Rate Predicts Thoracic Screw Accuracy in Adolescent Idiopathic Scoliosis

Yuan Zhang, MD, PhD

Hypothesis
Higher pedicle corticalization rate (PCR) independently predicts grade-3 screw breach or abandonment during thoracic instrumentation for AIS.

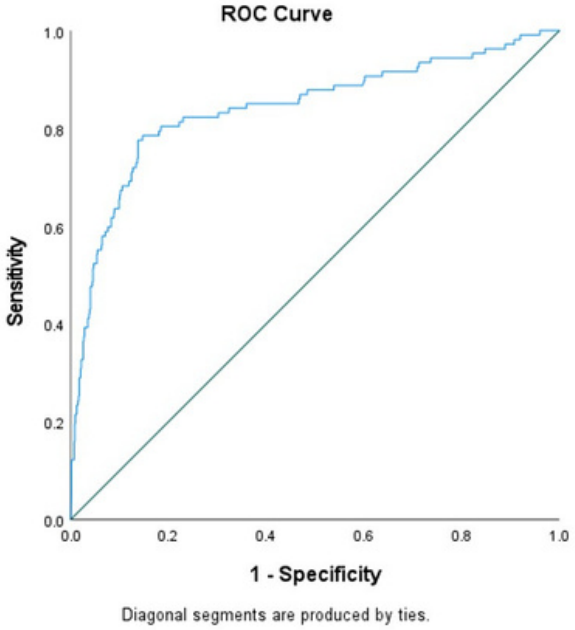
Design
Retrospective cohort study; level III evidence.

Introduction
Highly corticalized thoracic pedicles complicate free-hand screw insertion in adolescent idiopathic scoliosis (AIS). Advanced guidance improves accuracy but is not universally available. A quantifiable metric to flag risky pedicles could help allocate these resources. Prior cadaveric work linked narrow pedicles to breach, yet few studies quantified cortical thickness itself. We hypothesised that PCR measured on axial CT would correlate with breach severity and provide a useful threshold.

Methods
Sixty-one AIS patients (Aug 2021 – Aug 2024) with ≥ 12-month follow-up underwent posterior screw-rod correction at a tertiary spine center. Post-operative CT graded 927 thoracic screws (Rao 0–3). Pedicle corticalization rate (PCR %) was calculated for 958 pedicles, including abandoned attempts. Non-parametric tests, logistic regression and ROC analysis assessed PCR as a predictor of grade-3 breach or abandonment; inter-/intra-observer reliability used intraclass correlation (ICC).

Results
Breach occurred in 37.1 % of screws (grade 1 4.4 %, grade 2 18.9 %, grade 3 13.8 %); lateral 26.1 %, medial 11.1 %. Abandonment affected 3.2 % of pedicles when PCR ≥ 72 %. Critical breaches (medial > 2 mm or lateral > 4 mm) accounted for 21.1 %, yet no neurological, vascular, or revision events were observed. PCR correlated with breach grade (ρ 0.61, p < 0.001) and independently predicted grade-3 breach/abandonment (OR 5.6 per 10 % rise). A 41.8 % cutoff gave AUC 0.82, sensitivity 79 %, specificity 74 %; ICCs were ≥ 0.92.

Conclusion
PCR is a fast, objective tool that stratifies thoracic screw risk in AIS. Free-hand insertion appears safe when PCR ≤ 40 %, whereas PCR > 42 % merits navigation, in-out-in trajectory, or hook anchors. Routine PCR measurement may reduce severe breaches without added cost and could be automated.



Receiver-operating-characteristic curve showing pedicle corticalization rate (PCR) as a predictor of grade-3 breach or abandonment: area under the curve = 0.82 (95 % CI 0.78–0.86). A PCR cutoff of 41.8 % provided 79 % sensitivity and 74 % specificity for identifying high-risk pedicles.

289. Ten-year Surgical Results of Posterior Spinal Fusion for Adolescent Idiopathic Scoliosis Lenke 5C Curves

Daisuke Kurogochi, MD, PhD; Hiroki Oba, MD, PhD; Shota Ikegami, MD, PhD; Masashi Uehara, MD, PhD; Tetsuhiko Mimura, MD, PhD; Takuma Fukuzawa, MD, PhD; Shinji Sasao, MD; Jun Takahashi, MD, PhD

E-POINT PRESENTATION ABSTRACTS

Hypothesis
To determine the 10-year postoperative outcome, correction loss, and compensatory curve behavior of posterior spinal fusion (PSF) for AIS Lenke 5C curves and clarify the timing, if any, of correction loss.

Design
Retrospective study.

Introduction
The introduction of three-dimensional corrective fixation of scoliosis using pedicle screws has enabled stronger spinal correction. Reports are now emerging on the long-term results of posterior spinal fusion (PSF) for adolescent idiopathic scoliosis (AIS). This study examined the 10-year postoperative outcome, correction loss, and compensatory curve behavior of PSF for AIS Lenke 5C curves.

Methods
18 patients with AIS Lenke 5C curves who underwent PSF between August 2007 and August 2013 and followed for more than 10 years postoperatively were retrospectively enrolled for comparisons of Cobb angle of the thoracolumbar/lumbar (TL/L) and main thoracic (MT) curves, L3, L4, and L5 tilt, C7 plumb line (C7PL), and clavicle angle (CA) using radiographic images obtained preoperatively and at 1 week and 2, 5, and 10 years postoperatively.

Results
The mean Cobb angle of the MT and TL/L curves at preoperative were significantly corrected from 1 week to 10 years postoperatively at all time points compared with preoperative values. L3 tilt, L4 tilt and L5 tilt were not correction loss at 10 years. In sagittal parameters, T12-S1 lumbar kyphosis may gradually increase and SVA may shift posteriorly compared to preoperatively. In the evaluation of clinical outcomes, SRS-22r showed a significant difference in self-image and high satisfaction 10 years after surgery.

Conclusion
PSF for AIS Lenke 5C curves retained scoliosis correction at 10 years postoperatively. The significantly improved SRS-22r self-image domain at 10 years after surgery indicated good clinical results. Long-term observational studies of a larger number of cases are needed to monitor the effectiveness of PSF.

291. Surgical Safety and Outcomes of Adult Spinal Deformity in Patients Aged 80 and Older

So Kato, MD, PhD; Yuki Taniguchi, MD, PhD; Naohiro Kawamura, MD, PhD; Yusuke Sato, MD; Yuki Onishi, MD; Yuta Nakayama, MD; Hideki Nakamoto, MD, PhD; Kosei Nagata, MD; Hiroyuki Nakarai, MD; Sakae Tanaka, MD, PhD; Yasushi Oshima, MD, PhD

Hypothesis
Carefully selected elderly patients showed outcomes comparable to younger patients following adult spinal deformity surgery.

Design
A retrospective study.

Introduction
The safety and efficacy of spinal deformity surgery in the elderly patients have not been established. This study aims to compare outcomes of adult spinal deformity surgery in patients aged 80 and older with those aged 65 and younger.

Methods
Patients who underwent fusion surgery involving ≥5 spinal levels for spinal deformity between 2017 and 2023 at two institutions were included. Revision surgeries following previous fusions ≥4 levels were excluded. Patients were divided into two groups: elderly (≥80 years) and younger (50–65 years). Background factors, surgical details (fusion level, duration, blood loss), pre- and one-year post-operative radiographic parameters (PI, LL, PT, SVA), and patient-reported outcome measures (PROs: NRS for back and leg pain, ODI, EQ-5D), satisfaction at two years, 30-day complications, and rates of proximal junctional failure (PJF), rod breakage, and reoperation within two years.

Results
Forty-four elderly patients and 29 younger patients were included. The study included 44 elderly and. Significant differences were found in smoking history (0% vs. 9%, p=0.04), ASA classification (2.4 vs. 2.0, p=0.001), and osteoporosis treatment history (82% vs. 34%, p<0.001). Surgical extent and operative time were similar, but blood loss was lower in the elderly group (883 vs. 1355 mL, p=0.005). Preoperative PI-LL (46° vs. 32°, p=0.007), PT (36° vs. 28°, p=0.002), and SVA (147 vs. 92 mm, p<0.001) were significantly worse in the elderly group. Postoperatively, PI-LL was similar (19° vs. 10°, p=0.11), but PT (29° vs. 23°, p=0.005) and SVA (84 vs. 53 mm, p=0.03) remained higher in the elderly group. Only leg pain was significantly worse preoperatively in the elderly group (4.7 vs. 2.7, p=0.02), but all PROs and satisfaction at two years showed no significant differences. PJF was more frequent in the elderly group (31% vs. 10%, p=0.04), while rod breakage (5% vs. 3%, p=0.72) and reoperation rates (21% vs. 13%, p=0.44) were similar.

Conclusion
Despite more severe preoperative deformity and higher PJF risk, patients aged 80 and above achieved comparable surgical outcomes and satisfaction to younger patients. Careful patient selection and thorough preoperative counseling are essential for safe and effective surgical intervention in this population.

E-POINT PRESENTATION ABSTRACTS

292. Muscle Rearrangement as a Novel Cause of Motor Weakness After Spinal Realignment Surgery: A Hypothesis Based on Psoas Muscle Overstretching

Moon-Soo Han, MD

Moon-Soo Han, MD

Hypothesis

To explore alternative causes of motor weakness beyond direct nerve or muscle injury, it was hypothesized that changes in spinal alignment might indirectly contribute to hip flexion weakness by altering the anatomical orientation and function of the psoas muscle.

Design

Retrospective observational cohort study.

Introduction

This study aimed to investigate whether postoperative rearrangement of the psoas muscle is associated with hip flexion weakness in patients who underwent posterior-only spinal realignment surgery (SRS). It was hypothesized that changes in spinal alignment might indirectly contribute to hip flexion weakness by altering the anatomical orientation and function of the psoas muscle.

Methods

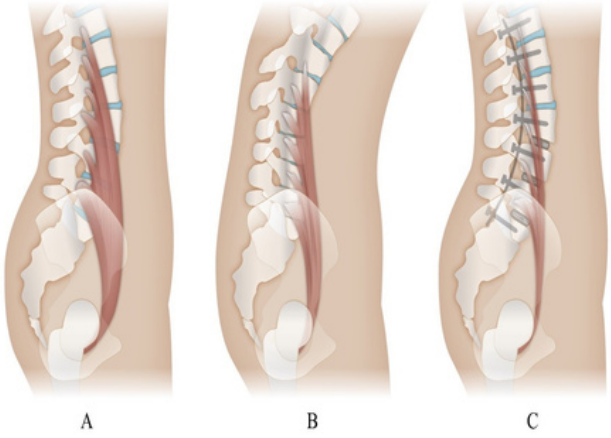
A total of 101 patients who underwent posterior-only SRS between 2012 and 2022 were retrospectively reviewed. Patients without evidence of intraoperative nerve injury, as confirmed by intraoperative neurophysiological monitoring, and without postoperative nerve injury, as confirmed by electromyography or nerve conduction velocity studies were included. Radiographic parameters were measured to assess psoas muscle orientation, using two novel reference lines: the vertical line (VL) and the diagonal line (DL). Cross-sectional areas (CSAs) of the psoas muscle were evaluated on axial magnetic resonance imaging at the L4–L5 disc level. Group comparisons were conducted to assess differences in radiological parameters and CSAs between patients with and without hip flexion weakness.

Results

Hip flexion weakness was observed in 14 patients (13.9%) and recovered in all cases with a median recovery time of 55.2 days. Postoperatively, VL and DL measurements increased significantly, while the psoas muscle CSA decreased. Changes in VL, DL, and CSAs were significantly greater in the hip flexion weakness group. Correlation analysis revealed significant negative associations between VL/DL changes and CSA reduction. In multivariate regression, only VL changes remained an independent predictor of postoperative CSA reduction.

Conclusion

This study demonstrates that postoperative hip flexion weakness can occur after SRS, even without direct nerve or muscle injury. The findings suggest that spinal alignment changes alone might mechanically rearrange of the psoas muscle, contributing to transient hip flexion weakness.



Conceptual illustration of the psoas muscle

293. Long-term Clinical Benefits of Age-Adjusted Sagittal Correction in Adult Spinal Deformity Surgery: Results from Patient Grouping Using a Hierarchical Cluster Analysis

Se-Jun Park, MD, PhD; *HyunJun Kim, MD*; Dong-Ho Kang, MD; Jin-Sung Park, MD, PhD; Chong-Suh Lee, MD, PhD

Hypothesis

This study hypothesizes that hierarchical clustering based on multiple age-adjusted sagittal parameters (PI–LL, PT, TPA, and SVA) can distinguish distinct alignment profiles, and that one of these clusters will show better long-term clinical and mechanical outcomes in adult spinal deformity surgery.

Design

Retrospective cohort study using hierarchical cluster analysis.

Introduction

Age-adjusted sagittal alignment is an essential concept in ASD surgery. Previous studies have primarily focused on single parameters such as PI–LL. This study aimed to classify patients using hierarchical clustering based on offsets from multiple age-adjusted parameters (PI–LL, PT, TPA, and SVA) to identify alignment profiles associated with optimal long-term outcomes.

Methods
We retrospectively reviewed 386 ASD patients who underwent ≥5-level fusion including the sacrum or pelvis with ≥2-year follow-up. Patients were grouped using hierarchical clustering based on the offsets between postoperative alignment and age-adjusted targets for PI–LL, PT, TPA, and SVA. Clinical outcomes (ODI, SRS-22r), incidence of mechanical complications (PJK/F), and sagittal radiographic parameters were compared across clusters.

Results
Three clusters were identified: cluster A (n = 72), cluster B (n = 211), and cluster C (n = 103), each demonstrating undercorrection-, matched-, and overcorrection-like profiles, respectively, although the alignment patterns did not fully align with conventional PI–LL-based age-adjusted targets. Cluster C showed the highest PJK/F rate (37.9%), followed by clusters B (27.5%) and A (20.9%) (P = 0.046). However, post hoc analysis revealed no statistically significant difference in PJK/F incidence between clusters A and B. Cluster B demonstrated significantly better clinical outcomes than clusters A and C in terms of ODI and SRS-22r (P < 0.05).

Conclusion
Hierarchical cluster analysis effectively stratified ASD patients based on postoperative sagittal parameter offsets, identifying a balanced alignment (cluster B) that optimizes clinical outcomes and minimizes mechanical complications. The results suggest a practical and nuanced approach to sagittal alignment correction in ASD surgery, emphasizing the integration of multiple parameters for improved patient outcomes.

294. Unveiling the Impact of Reciprocal Changes in Thoracic Kyphosis After Staged Corrective Surgery in Adult Deformity

Yuan-Shun Lo, MD, PhD; Erh-Ti Ernest Lin, MD; Yi-Hsun Huang, MD; Hung-Lun Hsieh, MD; Hsien-Te Chen, MD, PhD

Hypothesis
This study aimed to evaluate whether compensatory changes in the unfused thoracic spine after staged corrective surgery and long fusion extending from the lower thoracic spine to the pelvis have a favorable or unfavorable impact on global spinopelvic alignment. It hypothesizes that changes in the unfused thoracic spine will significantly influence sagittal alignment, which was analyzed using stratified patient groups.

Design
Retrospective cohort study.

Introduction
Reciprocal changes (RCs) in unfused spinal segments can significantly affect the global alignment after corrective surgery. Identifying radiographic thresholds for guiding surgical strategies is critical for optimizing the outcomes.

Methods
Ninety-eight ASD patients who underwent staged surgeries, including lateral lumbar interbody fusion (LLIF) and posterior spinal fusion (PSF), were analyzed. According to the final follow-up image, the patients were classified into balanced (BG) and imbalanced (IG) groups, with IG further stratified into proximal junctional kyphosis/failure (IG-PJK/PJF) and non-PJK/PJF (IG-NPJK/PJF). Radiographic and clinical data were collected preoperatively, postoperatively, and at 2-year follow-up.

Results
The IG exhibited greater RCs in thoracic kyphosis (TK) and PI-LL mismatch from postoperative to follow-up than the BG (P = .030, P = .008). Significant predictors included Age >65.5 y/o (AUC: .672) and Post-PT >17.5° (AUC: .852) for imbalance and Post-TK >34.5° (AUC: .755) for IG-PJK/PJF. IG-PJK/PJF showed poorer ODI scores than BG and IG-NPJK/PJF(P = .021 and P = .022, respectively). IG-PJK/PJF showed poorer total SRS-22 scores than IG-NPJK/PJF (P = .021).

Conclusion
Increased RCs in TK was associated with adverse outcomes. Extending the upper instrumented vertebra (UIV) to the upper thoracic spine and addressing excessive TK (>34.5°) may improve alignment and reduce complications. Radiographic thresholds can provide actionable guidance in surgical planning.

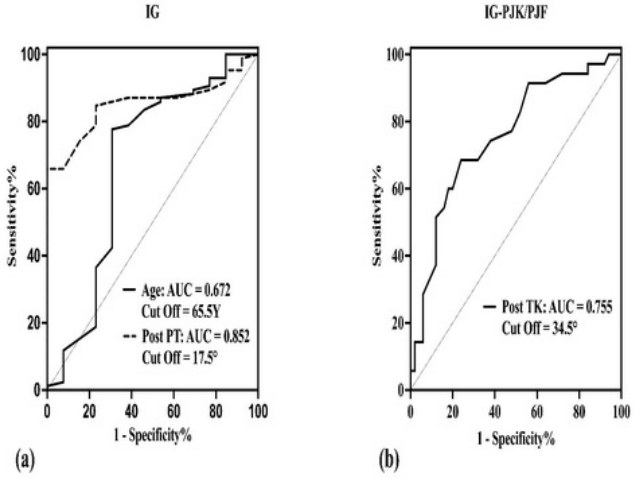


Figure 5. Preoperative and postoperative discriminative value for IG and IG-PJK/PJF based on receiver operating characteristic curve. (IG, imbalanced group; IG-PJK/PJF, imbalanced group with proximal junctional kyphosis/failure).

E-POINT PRESENTATION ABSTRACTS

295. Are Spinal Deformities Associated with Clinical Severity of Parkinson's Disease? – A Retrospective Single-Centre Analysis

Harsh Patel, MBBS, MS; Saumyajit Basu, MS(Orth), DNB(Orth), FRCSEd; Ayon Ghosh, MS; Vikas Hanasoge, MBBS, MS; Shubham Kumar M, MS; Ajay VM, MS; Dipanshu Maheshwari, MBBS, MS; Dhrumilkumar Patel, MBBS, MS; Dhruv Patel, MS

Hypothesis
Spinal deformities correlate with clinical severity in Parkinson's Disease.

Design
Retrospective Cross-sectional Observational Study.

Introduction
Postural deformities are common disabling complications in Parkinson's Disease (PD), significantly affecting quality of life. However, there is a notable gap in the literature, particularly regarding radiological alignment parameters, their clinical correlations, and osteoporosis in the Indian population.

Methods
A retrospective analysis was conducted on 82 patients diagnosed with Idiopathic PD (Hoehn & Yahr stages 1–4), fulfilling the UK Brain Bank criteria, from 2005 to 2025. Patients with atypical/secondary PD or prior spinal surgery were excluded. Radiological assessments included lumbar lordosis (LL), thoracic kyphosis (TK), cervical lordosis (CL), sagittal and coronal vertical axes (SVA, CVA), pelvic parameters (pelvic incidence [PI], pelvic tilt [PT], sacral slope [SS]), and coronal Cobb angle (CA). Bone mineral density (BMD) was evaluated via DEXA scans. Clinical severity was assessed using H&Y staging and MDS-UPDRS Part III scores.

Results
The mean age was 68.7 years, with an average H&Y stage of 2.39 and MDS-UPDRS-III score of 39.1. Radiological analysis revealed significantly increased SVA, CVA, and PT, with reduced LL, SS, and BMD values ($p < 0.05$). No significant differences were observed in PI or CL compared to normative data. Scoliosis was present in 39 patients (47.5%), predominantly lumbar (76.9%) and left-sided, with a mean Cobb angle of 36.1°. Female patients exhibited higher PI, PT, and lower BMD than males. SVA showed moderate correlation with H&Y stage ($r = 0.55$) and MDS-UPDRS III ($r = 0.44$). CVA showed some correlation ($r = 0.26, 0.33$ respectively); other parameters had minimal associations. Patients with scoliosis had significantly higher CVA, PI, and PT, along with unexpectedly better BMD than non-scoliosis counterparts, despite similar age and disease severity.

Conclusion
Significant global malalignment was observed in PD patients, with SVA and CVA most prominently affected. SVA demonstrated a moderate correlation with clinical severity, suggesting its potential as a surrogate marker. Scoliosis, pelvic malrotation (PI, PT), and coronal imbalance (CVA) were more prevalent in the scoliosis subgroup. Interestingly, osteoporosis was more common in the non-scoliosis group—a finding warranting further investigation.

297. Does Surgeon-Directed Bone Cement Augmentation at the UIV and UIV+1 Prevent Proximal Junctional Fracture? A Retrospective Analysis Based on Bone Mineral Density and Prior Fracture Status

Seon-Jin Yoon, MD, PhD; Yongjung J. Kim, MD

Hypothesis
Prophylactic bone cement augmentation (CA) at the upper instrumented vertebra (UIV) and UIV+1 reduces the incidence of proximal junctional fracture (PJF), particularly in patients with low bone mineral density (BMD), and may also offer benefits in normal BMD patients with a history of vertebral fractures.

Design
Retrospective analysis.

Introduction
PJF is a common mechanical complication after long-segment posterior spinal fusion, especially in elderly patients or those with poor bone quality. While CA at the UIV and UIV+1 has been suggested as a preventive measure, its effectiveness across different BMD categories remains unclear.

Methods
We retrospectively reviewed patients aged ≥40 years who underwent long-segment posterior spinal fusion (≥5 vertebrae) by a single surgeon at Seoul Bumin Hospital between December 2020 and June 2024. Inclusion criteria required the UIV to be between T9 and L2. Patients without pre- and postoperative whole-body EOS or whole-spine radiographs, missing electronic medical records, prior surgeries involving ≥4 fused levels, or no postoperative follow-up imaging were excluded. CA at UIV and UIV+1 was performed at the discretion of the operating surgeon. Patients were stratified according to FRAX-cross checked BMD and augmentation status. Radiographic alignment parameters and incidence of PJF were assessed.

Results

Cement augmentation (CA) at UIV and UIV+1 was associated with a lower incidence of proximal junctional fracture (PJF) across all BMD groups—osteoporotic (12.5% vs. 20.0%), osteopenic (11.6% vs. 13.8%), and normal BMD (0% vs. 7.1%). Despite this trend, logistic regression identified only preoperative PI–LL mismatch (OR 1.04, P = 0.033) and postoperative PJA (OR 1.13, P = 0.025) as statistically significant predictors of PJF.

Conclusion

While surgeon-directed CA appears to reduce PJF incidence in all BMD categories, it did not reach statistical significance as an independent factor. Instead, malalignment parameters such as preoperative PI–LL and postoperative PJA were the key determinants of PJF risk.

298. The Effectiveness of Patient-Specific Pre-Bent Rods in Achieving Target Alignment in Adult Spinal Deformity Surgery: A Meta-Analysis

Chang-Hyun Lee, MD, PhD; Seung-Jae Hyun, MD, PhD

Hypothesis

Patient-specific pre-bent rods may effectively achieve the targeted spinal alignment.

Design

Meta-Analysis.

Introduction

Although surgical techniques for adult spinal deformity (ASD) have advanced, sub-optimal radiographic outcomes still occur with rates reported up to 23%. To improve alignment precision, patient-specific pre-bent rods (PSRs) have been developed to facilitate deformity correction by translating preoperative plans into precise intraoperative corrections. However, the effectiveness of PSRs in achieving targeted alignment remains uncertain. This study aims to evaluate the accuracy of PSRs in achieving the planned alignment and meeting Schwab criteria.

Methods

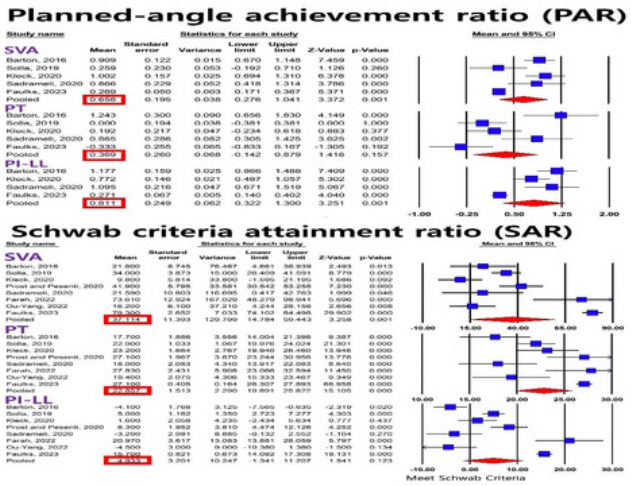
A systematic search was conducted to identify studies assessing spinopelvic alignment using PSRs in ASD surgery. Studies involving adolescent idiopathic scoliosis, neuromuscular diseases, cervical deformities, or non patient-specific rods were excluded. Outcome measures included the planned-angle achievement ratio (PAR) and the Schwab criteria attainment Ratio (SAR) at final follow-up, focusing on pelvic incidence minus lumbar lordosis (PI–LL), sagittal vertical axis (SVA), and pelvic tilt (PT).

Results

We searched core databases and identified 288 studies. Nine studies with 340 patients were finally included and analyzed. For the PAR, ASD surgery using PSRs achieved 65.8% (95% CI, 27.6%–104.1%) for SVA, 36.9% (95% CI, –14.2%–87.9%) for PT, and 81.1% (95% CI, 32.2%–130.0%) for PI–LL. For the SAR, spinopelvic parameters at final follow-up were as follows: the mean SVA was 37.11 mm (95% CI, 14.78–59.44), indicating that 59.94% of patients met the Schwab criterion for SVA (<40mm). The mean PT was 22.86° (95% CI, 19.89–25.82), corresponding to a SAR (<20°) of 2.95%. The mean PI–LL mismatch was 4.93° (95% CI, –1.34–11.21), with 94.33% of patients meeting the Schwab criterion (<10°). Regarding complications, the summary estimates were 11.6% for rod fracture, 11.9% for surgical site infection, and 14.9% for reoperation.

Conclusion

ASD surgery using PSRs achieved high PAR and SAR for PI–LL, with LL as the surgeon's direct correction target. However, both SVA and PT, which are compensated by changes in LL, often failed to reach their target values. These may need to improve planning softwares to predict compensatory changes following LL correction.



Forest plots of planned-angle and Schwab criteria attainment ratio.

299. Can Long-Term Corrective Cast and Brace Treatment Avoid Growth-Friendly Surgery in Early-Onset Scoliosis? – Indications and Limitations

Ryo Sugawara, MD, PhD; Hideaki Watanabe, MD, PhD; Naoya Taki, MD, PhD; Saki Onuma, MD; Ichiro Kikkawa, MD, PhD; Katsushi Takeshita, MD, PhD

Hypothesis
Alternatively repetitive cast and brace treatment (ARCBT) extending into the school-age years can avoid growth-friendly surgery (GFS) in patients with early-onset scoliosis (EOS).

Design
Retrospective observational study.

Introduction
At our institution, we aim to avoid GFS in patients with EOS by extending ARCBT into the school-age years whenever possible, completing treatment with final fusion (FF) alone. This study evaluated the feasibility and limitations of this strategy.

Methods
We retrospectively reviewed 24 patients with EOS who underwent at least two cycles of ARCBT and were followed until triradiate cartilage closure, a commonly accepted threshold for FF. Cobb angle, treatment status at the time of triradiate cartilage closure, and subsequent outcomes were analyzed.

Results
The cohort included 7 idiopathic scoliosis (IS), 7 syndromic scoliosis (SS), and 10 neuromuscular scoliosis (NMS) cases (10 males, 14 females). Mean age at initial presentation was 4.8 ± 2.3 years. Casting began at 5.6 ± 2.4 years, with initial Cobb angle improving from 47.2 ± 9.6° to 24.7 ± 6.9° (47.4% correction). Patients underwent an average of 7.2 casts during treatment. Mean follow-up was 6.8 ± 2.4 years to triradiate cartilage closure and 11.8 ± 4.2 years to final follow-up. Four patients required surgery before triradiate closure due to curve progression: GFS in 2 SS and early FF in 1 SS and 1 NMS. Their mean Cobb angle improved from 98.0 ± 14.6° to 49.0 ± 5.1°, though progression occurred in both GFS cases. Among 20 patients who reached triradiate closure without surgery, mean Cobb angles were IS: 53.7 ± 16.6°, SS: 77.8 ± 28.8°, NMS: 66.9 ± 22.1°, with no statistically significant differences among groups. FF was later performed in 10 (IS: 5, SS: 2, NMS: 3), with correction from 77.4 ± 11.8° to 35.4 ± 15.3°, maintained at final follow-up. The remaining 10 (IS: 2, SS: 2, NMS: 6) remained non-surgical, with final Cobb angle of 70.4 ± 32.2°. In five cases with curves >70°, surgery was not performed due to severe disease progression (n=3) or parental refusal (n=2).

Conclusion
All IS patients avoided GFS with extended conservative treatment. Some SS and NMS patients also reached FF without GFS, while others may have had suboptimal outcomes due to delayed surgery. Careful patient selection and timely intervention are key to optimizing this strategy.

301. Automatic Assessment of the Proximal Femur Maturity Index in Full Spine Radiographs Using a Deep Learning-Trained Model

Hiroyuki Nakarai, MD; Kosei Nagata, MD; So Kato, MD, PhD; Yuki Taniguchi, MD, PhD; Sakae Tanaka, MD, PhD

Hypothesis
The novel deep learning model will accurately assess skeletal maturity using the Proximal Femur Maturity Index (PFMI) on full spine radiographs with a high degree of precision.

Design
Retrospective study.

Introduction
Although skeletal maturity is commonly evaluated using the Risser grade, the PFMI has the advantage of assessing peak height velocity during Risser 0 without requiring an additional hand radiograph. However, the use of multiple classification systems can be time-consuming, and the learning curve associated with a new classification system may deter surgeons from adopting it. A deep learning model may provide a fast and accurate method for assessing skeletal maturity.

Methods
A dataset of anterior-posterior full spine radiographs was extracted from a single academic center. The database included preoperative, in-brace, and postoperative radiographs. Patients with syndromic or neuromuscular scoliosis were excluded. The images were split into training and testing sets in an 80:20 proportional split. We manually annotated the region of interest (ROI) with a square shape, including the hip joint, greater trochanter, and triradiate cartilage on both sides, and classified them using the PFMI (Figure). The model was trained using a convolutional neural network based on the EfficientNet B3 architecture with pretrained weights, implemented with the PyTorch framework. After tuning the training algorithm, model performance metrics were calculated on the test set, including accuracy, positive predictive value (precision), recall, and F1 score (the harmonic mean of precision and recall).

Results
The final database included 256 images with 512 hips. Forty-one hips (8.0%) were excluded from the training phase as the landmarks were obscured by braces or the hips were not fully included in the radiographs. The model demonstrated an overall accuracy of 0.734, a precision of 0.781, a recall of 0.734, and an F1 score of 0.733. Although the F1 score exceeded 0.8 for Grades 1 and 6, it ranged from 0.44 to 0.72 for Grades 2–5.

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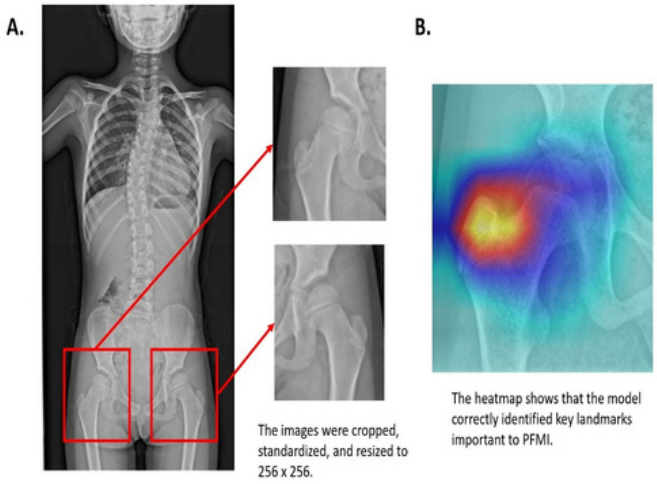
Conclusion
A trained deep learning model demonstrated moderate performance in assessing skeletal maturity using the PFMI in full spine radiographs, with balanced precision and recall. This model may assist in clinical decision-making for scoliosis treatment.



303. Impact of Thoracic Curve Deviation on Postoperative Alignment in Selective Lumbar Fusion for Lenke 5 Adolescent Idiopathic Scoliosis

Kentaro Kai, MD; Yusuke Hori, MD, PhD; Takashi Namikawa, MD, PhD; Masaki Kawamura, MD; Akira Matsumura, MD, PhD

Hypothesis
Thoracic curve deviations significantly impact postoperative alignment in patients with Lenke 5 adolescent idiopathic scoliosis (AIS) undergoing selective lumbar fusion (SLF).

Design
Single-center retrospective cohort study.

Introduction
In Lenke 5 AIS, primary lumbar curves are accompanied by non-structural thoracic curves, which can sometimes deviate from the midline. This study aimed to elucidate the impact of these deviations on the postoperative outcomes of SLF.

Methods
The study included 84 patients (78 females, average age 16.7 ± 3.4 years) with left convex lumbar curves who underwent SLF with a minimum of two year of follow-up. Patients were classified based on the C7 plumb line (C7PL) relative to the thoracic curve apex into two groups: those with the C7PL intersecting the pedicles of the apex vertebra (N group) and those with the pedicles positioned to the right of the C7PL (P group) (see Figure). ANCOVA was used to compare changes in radiographic parameters and SRS-22 scores between the groups.

Results
Patients were divided into the P group (38 patients) and the N group (46 patients). The P group demonstrated less improvement in lumbar curve magnitude (preoperative/postoperative/latest follow-up = P: 45/13/18°, N: 45/10/14°, p=0.02) and LAVT (P: 38/12/17 mm, N: 46/12/16 mm, p = 0.04). Improvement in L4 tilt was comparable between groups (P: 18/5/6°, N: 21/5/6°, p=0.57). Thoracic curves were significantly more pronounced in the P group both preoperatively and at latest follow-up (34/23/23° vs. 23/12/13°, p < 0.01), as was UIV tilt (16/5/9° vs. 14/4/4°, p < 0.01). SRS-22 scores showed slightly less improvement in the P group (4.0/4.2 vs. 4.0/4.5, p=0.02).

Conclusion
Lenke 5 patients, where the thoracic curve deviates from the C7 plumb line (P group), exhibit residual thoracic curvature and a rightward shift in the instrumented segment post-SLF. These findings imply that adjustments in the extent of fixation might be considered to optimize clinical outcomes.

304. Prone Lateral Anterior Column Realignment (ACR) for Adult Spinal Deformity Correction: A Complementary Classification to the ACR Classification

Yu-Cheng Yeh, MD; Yung-Hsueh Hu, MD; Tsung-Ting Tsai, MD, PhD; Po-Liang Lai, MD

Hypothesis
The anterior column realignment (ACR) technique could be safely applied in prone lateral adult spinal deformity (ASD) surgery.

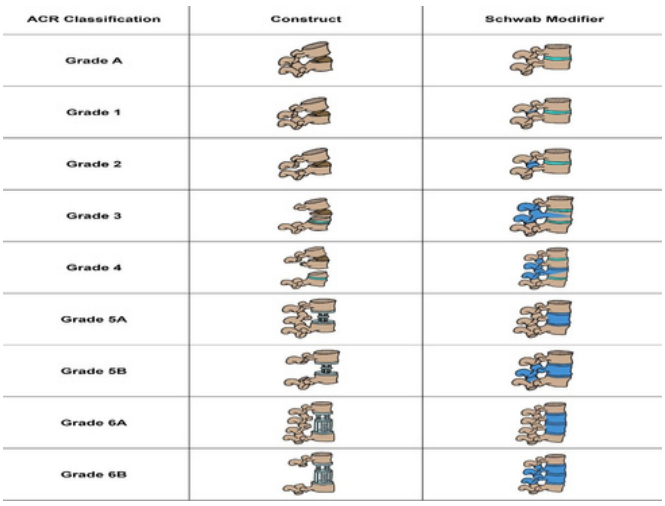
Design
Retrospective cohort study

Introduction
ACR is a minimally invasive technique offering comparable radiologic outcomes with reduced blood loss and less tissue dissections. However, repositioning from lateral to prone position is often required for posterior instrumentation and additional posterior osteotomy. This study introduces a prone lateral ACR technique that enables both anterior and posterior procedures in a single prone position, thereby minimizing repositioning and enhancing surgical efficiency.

Methods
We retrospectively reviewed patients who underwent prone lateral ACR surgery from June 2021 to June 2023, excluding those without at least 24 months of follow-up. Procedures were classified based on Uribe et al., with our proposed modification for high-grade ACR: Grade 5 denoting single-level corpectomy and Grade 6 for multi-level corpectomy, each subdivided into Modifier A or B (with or without posterior osteotomy). We compared pre- and postoperative (1-year) radiographic parameters, Visual Analog Scale (VAS) scores, and Oswestry Disability Index (ODI).

Results
A total of 30 patients (mean age 61.7 years) underwent prone lateral ACR via antepsoas (43%) or retropleural (57%) approaches from T11 to L4–5. The mean follow-up was 30.5 months, with an average of 5.1 ± 2.0 fused levels. Overall, the mean correction angle was 39.1° ± 13.3°, accompanied by significant improvements in local Cobb angles, VAS, and ODI (all $p < 0.001$). Among the 24 high-grade ACRs, mean corrections were 34.9° ± 11.3° for 5A (n=18), 49.5° ± 11.2° for 5B (n=4), 59.0° for 6A (n=1), and 72.0° for 6B (n=1). Five patients (16.7%) experienced transient psoas weakness, resolving within six weeks. Four patients developed junctional problems and one had pseudoarthrosis requiring revision.

Conclusion
Prone lateral ACR demonstrates promising clinical and radiographic outcomes in ASD, offering substantial deformity correction without the need for intraoperative patient flipping. Our modified ACR grading system provides a structured approach to high-grade ACR and correlates with the extent of achievable deformity correction. Further long-term studies are warranted to validate these results and refine surgical indications for ASD patients.



The modified ACR classification

305. Activation of S1PR2 in Vascular Endothelial Cells of Blood-Spinal Cord Barrier Aggravates Distraction Spinal Cord Injury after Spinal Deformity

Yeqiu Xu, MD; Weishi Liang, MD; Yong Hai, MD, PhD

Hypothesis
In spinal deformity correction surgery, mechanical distractive stress activates the S1PR2 receptor in vascular endothelial cells of the blood-spinal cord barrier. This activation induces endothelial cytoskeletal contraction and pyroptosis, thereby disrupting BSCB integrity. Consequently, these processes exacerbate neuroinflammation and neuronal apoptosis. Targeted inhibition of S1PR2 blocks this pathway, attenuating distraction spinal cord injury and promoting neurological functional recovery.

Design
1) whether mechanical stress in DSCI selectively activates S1PR2 in spinal cord barrier (BSCB) endothelial cells, thereby disrupting barrier integrity through specific signaling pathways; 2) if this S1PR2-driven BSCB disruption causally exacerbates neuroinflammation and apoptosis in DSCI; and 3) whether targeted S1PR2 inhibition can protect the BSCB and consequently reduce neurological deficits in DSCI.

Introduction
Distractive spinal cord injury (DSCI) is a serious neurological complication after orthopedic surgery for spinal deformity. The destruction of blood spinal cord barrier is the first barrier of DSCI, but its injury mechanism is still unclear, and there is a lack of therapeutic interventions. In this study, we used simulated spinal stretch surgery in rats and cultured blood spinal cord endothelial cells to perform mechanical stretch to reveal a new mechanism of blood-spinal cord barrier disruption caused by mechanical stretch.

Methods
The mechanistic studies utilized the established cell and rat models, employing methodologies including: RNA-seq, Histopathological analysis, Western blotting, qPCR.

Results
Mechanical distraction can activate S1PR2 in endothelial cells, leading to deubiquitination of VDAC1 and pyroptosis of endothelial cells, resulting in the destruction of blood-spinal cord barrier.

Conclusion
Elucidating S1PR2-driven BSCB disruption will provide mechanistic insights into DSCI pathology and accelerate development of targeted neuroprotective therapies for spinal deformity surgery.

306. Predictive Factors for Postoperative OutcomesofCervical Spondylotic Myelopathy in Individuals with Cerebral Palsy

Yoon Ha, MD, PhD; *SooHeon Kim, MD*

Hypothesis
This study aimed to identify factors influencing postoperative outcomes of cervical spondylotic myelopathy (CSM) in individuals with cerebral palsy (CP).

Design
Retrospective cohort study.

Introduction
Research on the postoperative predictors of CSM in the CP population is lacking. Owing to their clinical characteristics, such as the complexity of the deformity and involuntary neck movements, we anticipate that they may exhibit different patterns compared with general predictors. Therefore, in this study, we aimed to identify the predictors of long-term prognosis after surgery for CSM in individuals with CP.

Methods
Data from admitted individuals were retrospectively reviewed. Individuals whose modified Barthel index score, assessed at least 6 months after surgery, declined by 1 or more grades compared to their preoperative score were classified into the poor outcome (PO) group. Multivariate logistic regression analysis was performed to assess risk factors for poor postoperative outcomes.

Results
Of the 73 participants, 15 were in the PO group and 58 in the non-PO group. Duration (OR 1.99, 95% CI 1.25-3.65, P = .01), signal change grade 2 (OR 10.44, 95% CI 1.32-118.01, P = .034), and spinal cord compression ratio, M2 (OR 0.85, 95% CI, 0.73 0.96, P = .02) on preoperative MRI were identified as significant factors associated with the risk of poor postoperative outcomes. Based on the receiver operating characteristic curve analysis, the cutoff values for duration and cord compression metric were determined as 2 years (AUC = 0.689, 95% CI 0.532-0.845) and 76.2% (AUC = 0.841, 95% CI 0.696-0.987), respectively.

Conclusion
This study identified key predictors of poor postoperative outcomes in individuals with CP undergoing surgery for CSM. Symptom duration exceeding 2 years, signal change grade 2, and spinal cord compression ratio below 76.2% on preoperative MRI were found to be predictors of poor outcome. These results underscore the importanceofearly intervention and detailed preoperative radiological assessment to improve surgical outcomes in this population.

307. Impact of Enhanced Recovery After Surgery (ERAS) Protocol on Postoperative Pain and Clinical Recovery in Adult Spinal Deformity Surgery

Yu-Cheng Yao, MD; Jing-Yang Liou, MD, PhD; Hsin-Yi Wang, MD; Po-Hsin Chou, MD, PhD; Hsi-Hsien Lin, MD; Shih-Tien Wang, MD; Chien-Lin Liu, MD

Hypothesis
This study aimed to evaluate the effects of an Enhanced Recovery After Surgery (ERAS) protocol on perioperative outcomes and postoperative analgesic efficacy in patients undergoing Adult Spinal Deformity (ASD) correction surgery.

Design
Prospective cohort study conducted between March 2021 and December 2024.

Introduction
While ERAS protocols have demonstrated benefits in accelerating recovery and ensuring patient safety for ASD correction, their impact on postoperative pain and comprehensive clinical outcomes remains underexplored.

Methods
Seventy-seven ASD patients who underwent posterior-only correction surgery at a single institution were included. Demographic characteristics, radiographic parameters, and surgical data were recorded. Patients receiving the ERAS protocol were prospectively enrolled in the ERAS group (n=40), while those without ERAS were retrospectively identified from institutional databases as controls (non-ERAS group, n=37). Primary outcomes included surgical time, estimated blood loss (EBL), postoperative nausea and vomiting (PONV) incidence, total morphine sulfate equivalent (MSE) consumption, and visual analog scale (VAS) pain scores. Secondary outcomes encompassed perioperative recovery milestones: time to ambulation, oral intake initiation, Foley catheter removal, drainage tube removal, and length of stay (LOS).

Results
The ERAS group demonstrated significantly shorter operative times (359 ± 80 vs. 433 ± 143 minutes, p=0.008) and reduced MSE consumption (18.8 ± 20.4 vs. 77.7 ± 51.0 mg, p<0.001) compared to controls. Fewer ERAS patients required patient-controlled analgesia (45% vs. 70.3%). The protocol group achieved an average of 1 day earlier functional recovery, with reduced time to ambulation, oral intake initiation, and catheter removal. Mean VAS scores were consistently lower in the ERAS group at postoperative day 1(1.9 ± 1.1 vs. 4 ± 1.2, p<0.001), day 2 (2.0 ± 1.1 vs. 3.4 ± 0.8, p<0.001), and day (2.1 ± 1.2 vs. 3.2 ± 0.8, p<0.001).

Conclusion
Implementation of an ERAS protocol for ASD correction surgery significantly improves perioperative recovery trajectories, enhances postoperative pain control, and optimizes overall recovery quality. These findings support the standardized adoption of ERAS principles in adult spinal deformity surgery.

310. Comparison of Hook and Vertebroplasty for the Prevention of Proximal Junctional Failure: Hook May Be the Preferable Option

Jae Hwan Cho, MD, PhD; *Sung Tan Cho, MD, PhD*; Chang Ju Hwang, MD, PhD; Sehan Park, MD

Hypothesis
Prophylactic vertebroplasty (VP) or hook fixation at the uppermost instrumented vertebra (UIV) reduces the incidence of proximal junctional failure (PJF) in patients undergoing long-segment fusion for degenerative sagittal imbalance (DSI), compared to no proximal junctional intervention.

Design
Retrospective cohort study.

Introduction
Proximal junctional failure is a severe and increasingly recognized complication following long-segment fusion for DSI , associated with substantial morbidity and compromised functional outcomes. The pathogenesis of PJF is multifactorial, involving mechanical, biological, and patient-specific factors. Adjunctive strategies aimed at reinforcing the proximal junction, such as VP and hook fixation at the uppermost instrumented vertebra, have been proposed to mitigate PJF risk. However, comparative data on their clinical effectiveness in preventing PJF remain limited.

Methods
Surgical procedures included long-segment posterior spinal fusion from T9/T10 to the pelvis. Proximal junctional interventions were performed at the discretion of the attending surgeon and consisted of either VP or hook fixation applied at the UIV. Patient demographics, surgical variables, and radiographic outcomes were compared across the three groups. Multivariate logistic regression analysis was conducted to identify independent risk factors for PJF.

Results
The overall incidence of PJF was significantly lower in the intervention group (vertebroplasty or hook) compared to the control group (5.9% vs. 21.1%, p=0.009). Among the intervention subgroups, hook fixation demonstrated a numerically lower PJF rate (4.3%) compared to vertebroplasty (9.5%), although this difference was not statistically significant (p=0.544). Multivariate analysis revealed that hook fixation exerted the strongest protective effect against PJF (OR 0.036, p=0.0148), followed by vertebroplasty (OR 0.077, p=0.0334). The incidence of PJK did not significantly differ across groups (p=0.640).

Conclusion
Both vertebroplasty and hook fixation effectively reduced PJF incidence following long-segment fusion for DSI, with hook fixation demonstrating a trend toward superior efficacy. These findings highlight the importance of optimizing proximal construct dynamics and suggest that hook fixation may be a preferable adjunctive strategy for mitigating PJF risk.

311. Coronal Balance in Degenerative Spinal Deformity Patients Receiving Minimally Invasive Lateral Surgery

Kai Wang, MD

Hypothesis
This study aimed to evaluate preoperative coronal balance and its influence on surgical outcomes with lateral minimally invasive surgery (MIS).

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Design
Retrospective study.

Introduction
In degenerative spinal deformity (DSD), sagittal imbalance (SI) has been extensively described, whereas coronal imbalance (CI) has been given little attention.

Methods
Patients were grouped according to pre and postoperative coronal balance and the type of coronal balance. Radiographic data included coronal vertical axis (CVA), coronal Cobb angle, fractional curve take-off, and spinopelvic parameters. Coronal imbalance (CI) was considered if the C7 plumb line (C7PL) was >3 cm lateral to the central sacral vertical line (CSVL). Clinical outcomes were evaluated using the Visual Analog Scale (VAS) and Oswestry Disability Index (ODI).

Results
A total of 127 DSD patients were included in this study. The CI prevalence was 32.3% pre-operatively, 14.17% immediately postoperatively, and 15.75% at the last follow-up. CI at follow-up was more prevalent in patients with preoperative CI (0.005), especially in Qiu Type C patients ($p < 0.001$). Patients with follow-up CI demonstrated a significantly greater preoperative average fractional curve take-off ($p=0.037$) and follow-up fractional curve take-off ($p < 0.001$). There was no correlation between coronal balance and the ODI or VAS.

Conclusion
This study determined that patients with preoperative CI may be at greater risk of follow-up CI after lateral MIS, especially those with Qiu Type C. The average fractional curve take-off (AFC-TO) is a preoperative radiographic variables predicts the risk of postoperative CI. Insufficient correction of the fractional curve in lateral MIS may also lead to follow-up CI. The CI and fractional curve patterns should be evaluated during surgical planning.

312. Gravity Line - Hip Axis Offset as a Guide for Global Alignment to Prevent Recurrent Proximal Junctional failure

Sungjae An, MD; Jae-Koo Lee, MD; Seung-Jae Hyun, MD, PhD

Hypothesis
Postoperative GL-HA offset is a substantial risk factor for mechanical failure following ASD correction surgery for recurrent PJK/F. The ultimate goal of spinal compensation and pathologic complications such as PJF or rod Fx is to put GL-HA offset within its tolerance range.

Design
A retrospective case-control study with a minumum 2-year F/U.

Introduction
Recurrent PJK/F is especially concerning with the need for fusion extension and sometimes irreversible neurologic deficits. The GL has distinct value in representing global sagittal balance. The purpose of this study is to assess postoperative GL-HA offset as a critical risk factor for recurrent PJK/F. To the of our knowledge, this is the first study to demonstrate the relationship between GL-HA offset and recurrent PJK/F following ASD correction surgery.

Methods
Consecutive ASD patients who underwent revision surgery for initial PJK/F at a single academic center were retrospectively reviewed. Patients were divided into non-recurrent PJK/F group and recurrent PJK/F group. Demographics, operative details, spinopelvic and global alignment parameter, and SRS-22 score were evaluated. These variables were analyzed for differences and correlations with recurrent PJK/F.

Results
Thirty-two patients without recurrent PJK/F and 28 patients with recurrent PJK/F were included. Two groups showed no significant differences in baseline demographics, operative characteristics, or pre- and post-operative SRS-22 scores. Importantly, using a cutoff of -52.6 mm from logistic regression, there were considerable differences and correlations with recurrent PJK/F in the postoperative GL-HA offset, leading to an odds ratio of 7.0 (95% CI: 1.94-25.25, $P = .003$).

Conclusion
Postoperative GL-HA offset is a substantial risk factor for recurrent PJK/F in ASD patients following revision surgery. Overcorrection with GL-HA offset less than -5cm is associated with recurrent PJK/F. The instrumented spine put GL near HA even at the expense of proximal junction and rod breakage.

E-POINT PRESENTATION ABSTRACTS

A representative case with recurrent PJF. A, PJF state after L1 to pelvis fusion, with GL-HA offset -71mm. B, One month after T10 fusion extension surgery, with GL-HA offset -89mm. Postoperative GL-HA offset falls below -50mm, indicating overcorrection. C, Fracture of UIV and rod Fx occurred postoperatively. MF occurred despite the clinically acceptable range of PO C7SVA, and MF brought the GL close to HA.

313. Does Hi-PoAD Technique Work for Congenital Scoliosis: A Single Centre Case Series

Bhavuk Garg, MS; *Akashdeep S. Bali, MBBS, MS*

Hypothesis

The Hi-PoAD technique enables significant deformity correction in selected cases of congenital scoliosis with lower complication rates compared to traditional 3-column osteotomy procedures, while maintaining long-term radiological and clinical outcomes.

Design

Retrospective.

Introduction

To evaluate the efficacy of the Hi-PoAD technique in treating select cases of congenital scoliosis.

Methods

We conducted a retrospective review of 38 patients with congenital scoliosis who underwent posterior single-stage surgery using the Hi-PoAD technique, with a minimum follow-up of 2 years. This technique involves high-density pedicle screws, Ponte osteotomies, asymmetric rod contouring, and direct vertebral rotation. All cases were performed between 2016 and 2022 at a single centre by a senior spine surgeon. Surgical data was collected, and improvements in radiologic and clinical parameters were assessed post-surgery, at 1,2 years, and the final follow-up, focusing on deformity correction, coronal balance, and clinical outcomes.

Results

The average follow-up duration was 4.78 years (range 2–8 years). The average coronal Cobb angle improved significantly, decreasing from 76.6±19.9 to 37.5±17 ($p < 0.001$). Apical vertebral rotation (AVR) reduced from 2.31± 0.57 to 1.23± 0.43 ($p <0.001$), and C7PL/CSVL distances reduced from 3.42±2.84 cm to 1.16± 0.9 cm ($p < 0.001$). We also compared neurological injury incidence in our study compared to our previous study with 3-column osteotomy (VCR) and with the current literature, which was significantly lower with similar results. Two early post-operative wound infections were observed, one deep and one superficial, both of which resolved with debridement and implant retention; one neuromonitoring drop was seen while doing the correction. No mechanical complications like junctional kyphosis, deformity progression, or non-union were noted at the final follow-up.

Conclusion

The Hi-PoAD technique proves to be a promising alternative for the treatment of selected cases of congenital scoliosis with similar efficacy and more safety . By distributing forces across multiple vertebral levels via pedicle screws, it reduces the risk of screw cut-out and enhances deformity correction

314. High Early Reoperation Rate in Short Fusion Constructs Across the Thoracolumbar Junction with UIV at L1

Hyun Jun Jang, MD; Jaemin Kim, MD; Dongkyu Kim, MD; Kyung Hyun Kim, MD, PhD

Hypothesis

Fusion constructs that cross the thoracolumbar junction with the upper instrumented vertebra (UIV) at L1 are associated with a high rate of early mechanical failure and revision surgery.

Design

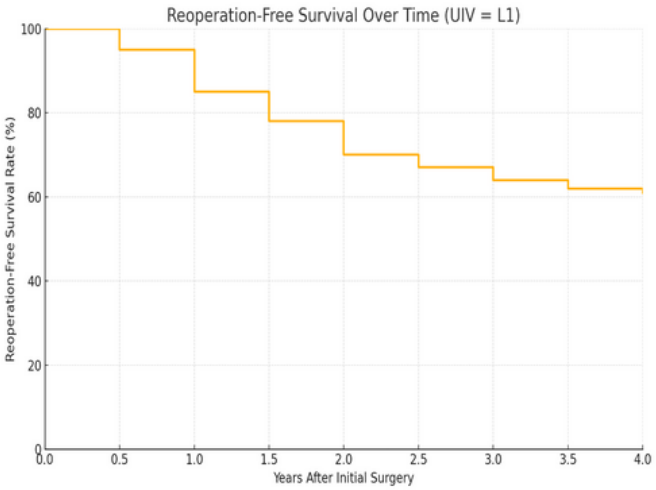
Retrospective observational cohort study.

Introduction
The thoracolumbar junction (TLJ) is a transitional zone in the spine known for its biomechanical vulnerability. Although previous studies have suggested that selecting UIV at or near the TLJ may increase the risk of proximal junctional kyphosis (PJK) or failure (PJF), the actual timing and frequency of such complications when UIV is placed at L1 remain unclear. This study aims to evaluate how often and how early revision surgery is required when L1 is selected as the UIV in posterior fusion constructs extending to the sacropelvic region.

Methods
We retrospectively reviewed all patients who underwent posterior spinal fusion from 2011 to 2024 at a single tertiary academic center. Patients with UIV at L1 and the lower instrumented vertebra (LIV) at S1, S2, alar, or iliac levels were included. Demographics (age, sex, BMI, BMD), surgical approach, and radiologic parameters (PI, LL, PI–LL mismatch, C7–SVA) were analyzed. Reoperation was defined as a subsequent surgery involving instrumentation extension due to mechanical complications (fusion, SPO, TLIF, PLIF, or screw-related revision). Early reoperation was defined as occurring within one year of the index surgery.

Results
A total of 52 patients met inclusion criteria. Among them, 20 patients (38.5%) underwent reoperation involving proximal extension of the fusion construct. Early reoperation (within 1 year) occurred in 10 patients (19.2%). The mean time to reoperation was 682 days (median 429 days). The cumulative reoperation rate reached approximately 20% by 1 year and nearly 39% by 4 years.

Conclusion
Fusion constructs ending at L1 showed high rates of mechanical failure and reoperation. Avoiding L1 as the UIV may reduce the need for future extension surgeries.



Reoperation-free survival curve for patients with UIV at L1. The rate steadily declines over time, with approximately 70% remaining reoperation-free at 2 years and 61% at 4 years postoperatively. This highlights the risk of delayed mechanical failure even after initial surgical success.

316. Is Spina Bifida Occulta a Risk Factor for the Progression of Adolescent Idiopathic Scoliosis?

Akiko Misawa, MD, PhD; Michio Hongo, MD, PhD; Daisuke Kudo, MD, PhD; Naohisa Miyakoshi, MD, PhD

Hypothesis
Spina bifida occulta (SBO) increases the risk of curve progression in adolescent idiopathic scoliosis (AIS).

Design
Retrospective observational study.

Introduction
Since musculoskeletal screening was introduced in 2016, more patients have visited orthopedic surgeons before scoliosis was detected by Moiré screening, enabling earlier intervention. In addition to bone maturity and growth rate, which are measured via X-ray, we explored other indicators of curve progression. Previously, we reported an association between spina bifida occulta (SBO) and scoliosis progression. The aim of this study is to determine whether SBO is a risk factor for progression using data collected after musculoskeletal screening began.

Methods
Of the 386 new patients who visited our scoliosis clinic between January 2017 and March 2022, 234 patients (206 girls and 28 boys) met the inclusion criteria of having idiopathic scoliosis with a Cobb angle of at least 10° and no neurological abnormalities. Patients with congenital, syndromic, or early-onset scoliosis were excluded. SBO was evaluated using plain radiographs. Patients were classified into SBO and non-SBO groups. We compared the following between the two groups: age at initial visit, Cobb angle, Risser classification, bracing, and surgical treatment. In surgical cases, CT and MRI scans confirmed the absence of congenital spinal cord or canal abnormalities.

Results
SBO was identified in 85 out of 234 patients (32.2%). The SBO group was significantly younger at presentation (12.5 vs. 12.9 years; $p = 0.02$). Initial Cobb angles were similar (25.9° vs. 26.2°; n.s.). The SBO group had a higher percentage of Risser 0–3 cases ($p = 0.001$), which suggests skeletal immaturity. Bracing and surgery were more frequent in the SBO group (60.0% and 15.2%, respectively; $p = 0.004$ and $p = 0.033$, respectively).

Conclusion
Due to the younger average age at initial presentation and the higher proportion of Risser 0-3 cases in the SBO group, the risk of progression is considered high. SBO may also indicate insufficient bone maturation. Additionally, the significantly higher rates of bracing treatment and surgery suggest that SBO is a risk factor for progression in idiopathic scoliosis. Some SBO cases exhibit leg length discrepancy. Since pelvic tilt is present before the growth spurt, early intervention is recommended to mitigate the risk of curve progression.

317. Characteristics of Sagittal Spinopelvic Alignment in Adolescent Idiopathic Scoliosis with Lenke Type 1 Following Posterior Spinal Surgery

Tinnakorn Pluemvitayaporn, MD

Hypothesis
To evaluate sagittal spinopelvic alignment parameters following posterior spinal surgery in adolescent idiopathic scoliosis (AIS) patients with Lenke type 1.

Design
A prospective cohort study.

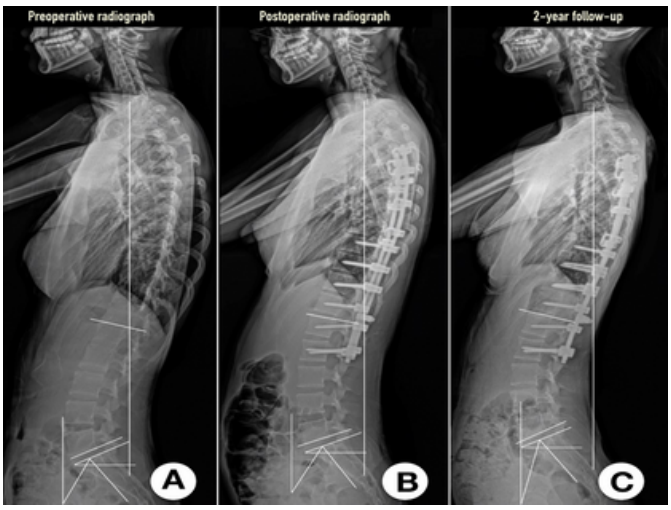
Introduction
In posterior spinal surgery for AIS patients, particularly in Lenke type 1, the lowest instrumented vertebra (LIV) is typically positioned at or above the L3 vertebra. Consequently, the segments from L4 to S1 are preserved and should remain unaffected by alterations in sagittal spinopelvic parameters. However, after the correction of spinal curvature, subsequent changes in overall spinal alignment are expected to occur. To our knowledge, no studies have investigated the effects of posterior surgical correction, specifically regarding its impact on sagittal spinopelvic alignment and whether significant changes in these parameters occur during the postoperative period.

Methods
Between 2021 and 2025, AIS patients with Lenke type 1 who underwent posterior spinal surgery were recruited for this study. Preoperative and postoperative 36-inch whole spine radiographs were analyzed, measuring sagittal spinopelvic parameters such as sagittal vertical axis (SVA), thoracic kyphosis (TK), lumbar lordosis (LL), pelvic incidence (PI), sacral slope (SS), and pelvic tilt (PT). Demographic data including sex, age, body mass index (BMI), Lenke subclassification, and major coronal Cobb angle were also collected for analysis.

Results
A total of 168 AIS patients with Lenke type 1, with a mean age of 14.2 ± 2.9 years, were enrolled in this study. The mean follow-up duration was 26.8 months.Significant changes were noted in PI and LL after surgery. PI decreased from 48.5° to 43.9° ($p = 0.02$) but partially returned to 47.4° at final follow-up. LL decreased from 53° to 46° ($p = 0.003$) and then increased to 54.9° ($p < 0.001$) at final follow-up. Other parameters, PT, SS, TK, and SVA, showed no significant changes.

Conclusion
The sagittal spinopelvic parameters characteristic of AIS patients with Lenke type 1 who underwent posterior spinal surgery were notably influenced by PI and LL during the early postoperative phase, with both parameters demonstrating spontaneous correction at the final follow-up. Other sagittal spinopelvic parameters remained stable, indicating the preservation of global sagittal alignment.

E-POINT PRESENTATION ABSTRACTS



Sagittal spinopelvic parameters: pre- (A), postoperative (B), final follow-up (C).

318. Changes in Pelvic Incidence Following Spino-Pelvic Fixation for Adult Spinal Deformity: A Three-Dimensional Evaluation Using CT

Hiroyuki Sekimoto, MD; Masayuki Ohashi, MD, PhD; Tatsuo Makino, MD; Hideki Tashi, MD; Yohei Shibuya, MD; Masayuki Sato, MD; Tsuyoshi Arabiki, MD; Mio Kubota, MD, PhD; Hiroyuki Kawashima, MD, PhD

Hypothesis

preoperative CT-measured PI can help predict postoperative PI.

Design

Retrospective study.

Introduction

Although pelvic incidence (PI) is a patient-specific parameter frequently used to predict ideal sagittal spinal alignment for adult spinal deformity (ASD) surgery, recent evidence suggests that PI could change with age, positioning, and corrective spinal surgery. However, the impact of clinically significant measurement errors on the accuracy of postoperative PI changes measured on standing radiographs remains unclear. This study aimed to assess postoperative PI changes using supine CT, and accurately predict the postoperative PI in ASD surgery.

Methods

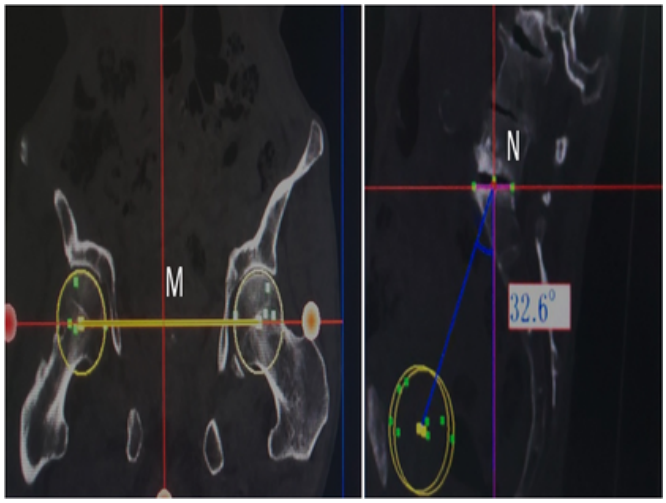
Fifty-seven consecutive patients who underwent thoraco-lumbo-pelvic fixation with sacral alar-iliac (SAI) screws for ASD were included (45 women, mean age: 65.9 years, mean levels fused: 9.6). Preoperatively and 1 week postoperatively, PI was measured on standing and supine radiographs and supine CT scans. Three-dimensional PI measurements were performed using a software generated 3D bone model reconstructed CT data.

Results

PI on standing radiographs significantly decreased from 51.0˚ ± 10.6˚ preoperatively to 47.9˚ ± 10.8˚ postoperatively (mean difference 3.0˚, 95% CI: 1.0–5.0˚, $p < 0.01$). Preoperative supine radiograph PI was significantly lower compared than preoperative standing PI ($p < 0.01$); however, it did not differ significantly from postoperative standing PI ($p = 0.27$). On CT, PI significantly decreased from 47.6˚ ± 8.8˚ preoperatively to 46.8˚ ± 9.1˚ postoperatively (mean difference, 0.85˚; 95% CI: 0.3–1.4˚; $p < 0.01$). A significant preoperative difference in PI was observed between standing radiographs and CT ($p < 0.01$), but not after surgery (mean difference 1.1˚, 95% CI: 0.2–2.4˚, $p = 0.11$).

Conclusion

Although statistically significant PI changes were observed on both standing radiographs and supine CT, the CT-measured changes were clinically insignificant (smaller than the reported measurement error of approximately 2°). Therefore, preoperative CT-measured PI can help predict postoperative PI. Furthermore, considering PI changes between standing and supine imaging pre- and postoperative, postoperative PI changes may primarily reflect positional change from the standing to the supine/prone position.



3D measurement of PI using CT

E-POINT PRESENTATION ABSTRACTS

319. Fusion Status of Allogenic Bone Graft in Adult Spinal Deformity Surgery: An Evaluation Using Computed Tomography

Masayuki Miyagi, MD, PhD; *Gen Inoue, MD, PhD*; Akiyoshi Kuroda, MD, PhD; Yuji Yokozeki, MD, PhD; Toshiyuki Nakazawa, MD, PhD; Takayuki Imura, MD; Yoshihide Tanaka, MD; Yusuke Mimura, MD; Shun Nokariya, MD; Masashi Takaso, MD, PhD

Hypothesis
We hypothesized allogenic bone graft, which is prepared in accordance with Japanese guideline, is effective to achieve posterior spinal fusion in adult spinal deformity (ASD) surgery.

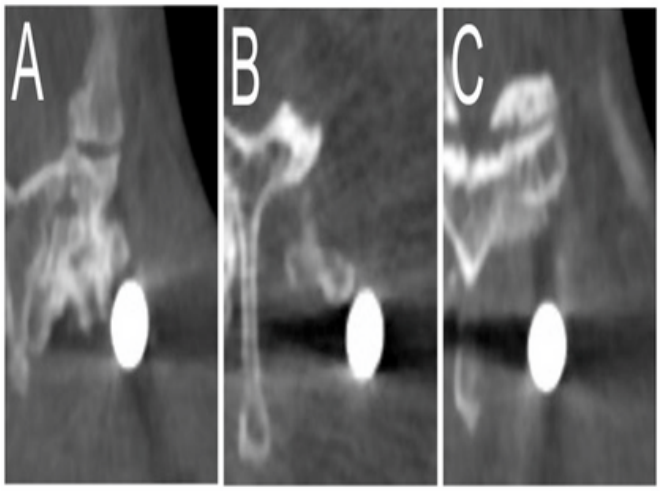
Design
Retrospective study.

Introduction
Allograft bone is one of the major options of bone grafting in spinal fusion surgery. However, it has been reported to account for over 6-8% of all bone grafts in Japan, and there have been almost no reports on the detailed fusion morphology of allograft banked bone used in ASD surgery. In this study, we investigated in detail how the morphological changes of grafted allograft occur on the lamina using computed tomography (CT) after posterior spinal fusion surgery in ASD.

Methods
The participants were 40 ASD patients (mean age; 69.9 years) with total 389 vertebral laminae who had undergone spinal fusion surgery in which allogeneic femoral heads were granulated and transplanted onto the vertebral laminae. Plain CT scans were performed preoperatively, 1 week and 1 year postoperatively to measure and compare the cross-sectional area and CT values of the grafted bone in axial section on the T9-L2 vertebral laminae. We classified the grafted bone morphology into three groups; A: grafted bone was incorporated into lamina, B: grafted bone was separated from lamina without any contact, and C: grafted bone was completely or partially absorbed. T-test and $\chi 2$ test were used for statistics, and p value<0.05 was defined as a significant difference.

Results
The cross-sectional area of grafted bone was 406.2±174.2 mm2 just after surgery and decreased significantly to 286.3±142.8 mm2 at 1 year postoperatively. Conversely, CT values were increased into 588.8 ± 257.6 HU 1 year postoperatively compared with preoperative 430.6 ± 246.7 HU. At postoperative 1 year, morphologic classification was A: 72.0%, B: 16.5%, and C: 21.4%, respectively. There were no significant differences in age and sex among the three groups. However, the cross-sectional area of grafted bone just after surgery in group C was significantly smaller than that in the other groups.

Conclusion
These findings suggest that allograft bone is one of the effective options for ASD surgery, but certain amount of bone transplantation is mandatory to achieve the definite fusion in posterior spina fusion of ASD patients.



320. Posterior Tethering for Scoliosis Induction in Growing Lee-Sung Pigs

Wen-Chan Yu, BS; Chi-Yu Yang, PhD; Lin Tsung, MS; Chun-Hsiang Hou, MS; Chi-Kuang Feng, MD

Hypothesis
Posterior tethering can induce scoliosis in the growing Lee-Sung pigs.

Design
Interventional study.

Introduction
The etiology of adolescent idiopathic scoliosis (AIS) remains unclear and suggested multifactorial. Due to the biomechanical similarities to human spines, we anticipated Lee-Sung pigs would be a suitable animal model for studying the etiology of AIS. We aimed to verify relative anterior spinal overgrowth (RASO), which indicates the unmatched growth velocity in sagittal plane can develop scoliosis, on Lee-Sung minipigs.

Methods

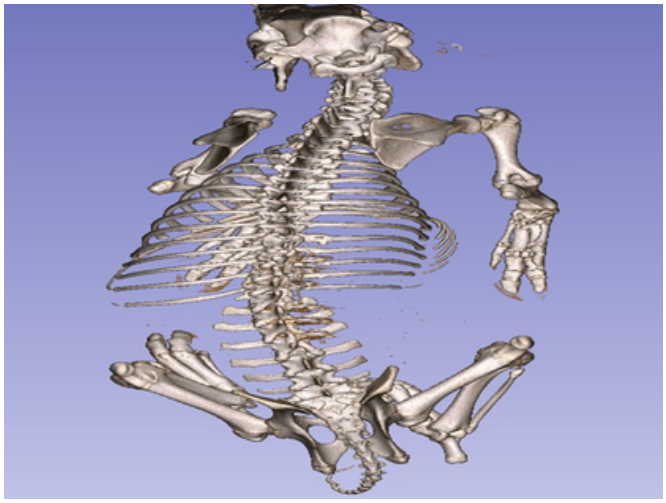
Growing, healthy Lee-Sung pigs were assigned to intervention and control groups. In the intervention group, the pigs' spines underwent posterior tethering using self-developed implants. These implants comprised a pedicle screw-rod complex, a cable as the tether, and an adaptor to connect them. Where pedicle screws were not applicable, hooks were used instead. The primary endpoint was the presence of scoliosis observed six months post-operatively. Spinal morphology and implant condition were monitored using post-operative medical images.

Results

Six Lee-Sung pigs were enrolled in this study at the age of 2 months old. LS-014 and 015 were enrolled first, and one year later, LS-044, 045, 046 and 047 were also enrolled. LS-014, 046, and 047 were assigned into control group. First, LS-015 underwent posterior tethering at 5 months of age. We observed a loosened screw and tether, and no scoliosis was evident on the 7-month post-operative X-ray . Second, LS-045 underwent posterior tethering at 2 months of age and the pedicle screws were replaced by hooks. The asymmetrical ribs level, ribs hyperostosis, and a Cobb angle of 8.4 degree were observed under anesthesia. Finally, LS-044 underwent the surgical which had identical protocol to LS-045. However, the implant was broken intra-operatively and the tether ruptured. We conducted a secondary operation for LS-044 at 7 months of age. For the implant used in this operation, the hooks were replaced by pedicle screws, cable was replaced by a PET cord with 100N tension. Two months after the operation, a Cobb angle of 25 degree was observed under anesthesia. No scoliosis was observed in the 3 pigs in control group.

Conclusion

Posterior tethering can induce scoliosis in the growing Lee-Sung pigs. The implant design and intervention age may be the factors for successful scoliosis induction.



Two months after the operation, scoliosis was observed under anesthesia.

321. Comparisons Of Health-Related Quality Of Life (HRQOL) Between Adolescents and Young Adults with Surgical Treatment For Idiopathic Scoliosis : 2-Year Follow Up

Hung Ho Yen, MD; Shu-Hua Yang, MD; Chih-Wei Chen, MD; Ming-Hsiao Hu, MD

Hypothesis

We hypothesize that adolescent idiopathic scoliosis (AIS) patients and young adult idiopathic scoliosis (AdIS) patients undergoing surgical correction and fusion would demonstrate comparable health-related quality of life (HRQOL) outcomes both preoperatively and postoperatively.

Design

Retrospective, comparative, single-center cohort study.

Introduction

Adolescent idiopathic scoliosis (AIS) is a common spinal deformity, and surgical correction during adolescence usually results in good deformity correction and improved quality of life. However, some patients postpone surgery until adulthood due to personal or socioeconomic factors. This study compares health-related quality of life (HRQOL) outcomes between those treated in adolescence and early adulthood.

Methods
Patients undergoing posterior spinal deformity correction by a single surgeon from 2014 to 2023 were reviewed and divided into AIS (<18 years) and AdIS (18–30 years) groups. Inclusion criteria were idiopathic scoliosis diagnosis, age >10 years, and preoperative main coronal curve >50°. Data collected included demographics, surgical details (fused levels, operative time, blood loss), and SRS-22 scores across four domains (function, pain, self-image, mental health) preoperatively and at 2-year follow-up. Radiographic measures included Cobb angle and correction rate.

Results
A total of 72 patients were included, with 42 in the AIS group and 30 in the AdIS group. No significant differences were observed between groups in gender, BMI, number of fused levels, operative time, or intraoperative blood loss. Radiographic outcomes, including pre- and postoperative Cobb angles and correction rate, were comparable. Postoperative SRS-22 scores and satisfaction levels were similarly high. Although no significant differences were found in postoperative SRS-22 domains, the AdIS group showed significantly lower preoperative scores in pain (4.11 vs. 4.35, P=0.044) and function (4.34 vs. 4.6, P=0.048) compared to the AIS group.

Conclusion
This study shows idiopathic scoliosis patients undergoing surgery in adolescence or young adulthood have similar radiographic and HRQOL outcomes if preoperative curves are comparable. Delaying surgery to young adulthood may still yield satisfactory results without rapid curve progression or cardiopulmonary issues. These findings may help guide surgical timing decisions.

325. Interstage Cage Migration in Combined Anterior-Posterior Staged Surgery for Adult Spinal Deformity

Nam-Su Chung, MD; Hee-Woong Chung, MD, PhD; Han Dong Lee, MD, PhD

Hypothesis
1. Cage migration between anterior-posterior (A-P) staged surgery for adult spinal deformity (ASD) may occur because the cage is not secured, even temporarily, during the interval between stages. 2.
2. There may be risk factors for interstage cage migration.
3. Interstage cage migration may affect radiological outcomes.

Design
Retrospective study.

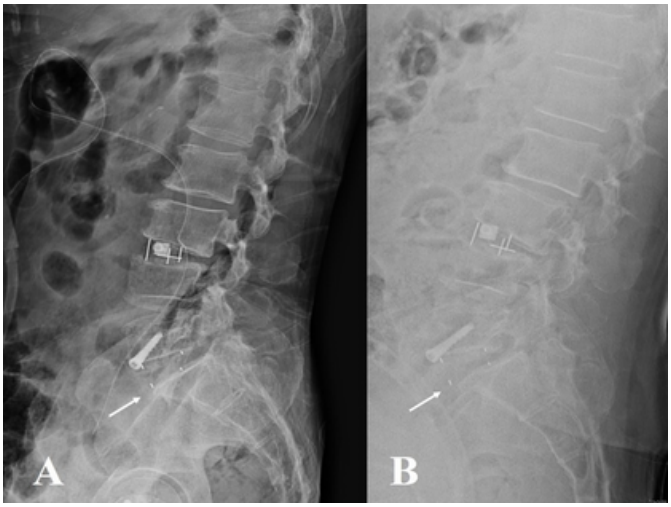
Introduction
Combined A-P staged surgery offers advantages in ASD correction by distributing surgical stress and enabling more effective reconstruction. However, cage migration during the interval between the A-P stages remains a concern.

Methods
This study analyzed 174 operated disc levels in 70 patients with ASD who underwent combined A-P staged surgery. Interstage cage migration was assessed by comparing immediate postoperative radiographs with follow-up radiographs obtained just prior to the second-stage procedure. Risk factors for interstage cage migration and their association with radiological outcomes were also evaluated.

Results
A total of 126 lateral cages (72.4%) and 48 anterior cages (27.6%) were used. For lateral cages, migration > 2 mm was observed in 19 cases (15.1%) and migration > 4 mm in 7 cases (5.6%). Posterior disc height, the performance of anterior column alignment, and cage position not crossing the midline were significantly associated with lateral cage migration > 2 mm. For anterior cages, migration > 2 mm was noted in 8 cases (16.7%) and migration > 4 mm in 4 cases (8.3%). Higher cage lordotic angle and anterior cage position were significantly associated with anterior cage migration > 2 mm. The overall fusion rate was 93.7% (163/174), and cage subsidence was observed in 29 (16.7%) cases. Changes in disc height and disc lordotic angle, as well as fusion grade and cage subsidence, were not significantly associated with interstage cage migration (all P > 0.05).

Conclusion
Interstage cage migration was infrequent and did not adversely affect radiological outcomes. The occurrence of interstage cage migration was more closely related to intraoperative technique including proper cage placement, than to preoperative conditions.

E-POINT PRESENTATION ABSTRACTS



An illustration of interstage cage migration > 5 mm. (A) immediate postoperative radiographs, (B) radiographs obtained just prior to the second-stage surgery

326. Surgical Outcome of Anterior Corpectomy and Fusion in Case of Degenerative Cervical Myelopathy Associated with Kyphosis

Janardhana P. Aithala, MBBS, MS

Hypothesis

The anterior approach to cervical spine can be safely used in 3 levels of cervical myelopathy and helps in better correcting the kyphotic deformity.

Design

Retrospective study of prospectively maintained data base (observational study).

Introduction

Surgical management of degenerative cervical myelopathy associated with kyphotic deformity is challenging and associated with complications in view of multiple level involvement. Anterior approach provides better options to correct the deformity. This study analyses the results of degenerative cervical myelopathy with kyphosis and underwent 3 or more levels decompression and instrumented fusion.

Methods

This is a retrospective study of a prospectively maintained database. 19 patients with kyphosis deformity and K line negative were included in the study and underwent anterior corpectomy (2 or more vertebrae) and plating with either iliac crest graft or cage placement. The clinical improvement of analysed using improvement in Nurick grade, JOA score and complications while radiological parameters analysed included C2-C7 cobb's angle improvement.

Results

A total of 19 patients were available, with mean age of 58.25 years, and male/female sex raio of 14/5. 13 patients were Nurick 4 or above, mean JOA score was 9.86 (SD 2.29). 18 patients underwent 3 level decompression with a corpectomy of 2 vertebrae, while one patient underwent corpectomy of 2 vertebrae and one level discectomy spanning 4 levels. Mean JOA score at 2 year follow up was 12.86, 14(77.7%) patients showed atleast one grade of nurick improvement,3 patients expired in the first 3 months, and 2 patients have worsening of deficits. Complications included worsening of deficits in 2 patients, implant failure in 2 patients and wound infection in one patient. Mean C2-C7 angle improved from 3.6 degrees to 16.8 degrees (P<0.001). The preoperative Nurick grade(P<0.001), walking statusP<0.001) and duration of onset of gait disturbance(P-0.043) are associated with poor recovery.

Conclusion

3 levels of anterior decompression can be safely done in cervical spine and gives better opportunity to correct the deformity in cervical kyphosis due to degenerative disc disease. However neurolgoical recovery and function outcome depend on preoperative severity of myelopathy.

327. Posterior Trans-Intervertebral Osteotomy with Anterior Support for Kyphosis Deformity Secondary to Ankylosing Spondylitis

Zihao Ding, MD; Yong Hai, MD, PhD

Hypothesis

This study aimed to assess the efficacy of a novel spinal osteotomy technique, the posterior trans-intervertebral osteotomy with anterior support, in individuals diagnosed with ankylosing spondylitis. This study utilized computer software to simulate the osteotomy procedure, predict orthopedic outcomes, and assist in preoperative planning.

Design

Patients with ankylosing spondylitis underwent posterior trans-intervertebral osteotomy with anterior support that post-operative follow-up of more than 1 year. Osteotomy was performed using the intervertebral space approach with the cage placed anteriorly in the intervertebral space to improve the correction. Perioperative clinical symptoms, imaging data, and surgical factors were also documented.

Introduction
This study's objective was to provide a comprehensive analysis of the initial encounter with three individuals diagnosed with severe AS who underwent posterior kyphosis correction using posterior trans-intervertebral osteotomy with anterior support (TIOAS). The main goal was to enhance the safety of posterior kyphosis correction procedures. Posterior TIOAS has exhibited positive efficacy and outcomes as a versatile surgical approach for addressing severe and rigid spinal deformities.

Methods
The patients with AS who were qualified for this study were consecutively enrolled from February 2021 to August 2025. All patients included underwent surgery by the same surgeon and followed up for more than 1 year.

Results
Patients who underwent posterior trans-intervertebral osteotomy with anterior support achieved good clinical results with favorable correction rates and minimal estimated blood loss. The average preoperative, postoperative and follow-up Cobb angles were 90.5° (range: 86–96°) , 43.5° (range: 34–52°) and 46.25°(range: 37–55°), respectively.

Conclusion
Posterior trans-intervertebral osteotomy with an anterior support procedure was performed through the intervertebral space and subsequent implantation of a cage within the transpedicular space, effectively addressing the constraints associated with the conventional trans-intervertebral osteotomy method. Our preliminary findings indicate that posterior trans-intervertebral osteotomy with anterior support is potentially more secure than the conventional method for correcting ankylosing spondylitis kyphosis.

327. Posterior Trans-Intervertebral Osteotomy with Anterior Support for Kyphosis Deformity Secondary to Ankylosing Spondylitis

Yanrui Yang, MD; Yingsong Wang, MD; Li Zhang, MD; Zhi Zhao, MD; Tao Li, MD; Zhiyue Shi, MD; Zhaoquan Zhang, MD; Zhibo Song, MD

Hypothesis
Age, BMI, and physical activity level (PA) are potential risk factors for the severity of adolescent idiopathic scoliosis (AIS), with possible interactive effects when co-existing to exacerbate spinal deformity progression.

Design
This observational cross-sectional study was approved by the Research Ethics Committee of the Second Affiliated Hospital of Kunming Medical University.

Introduction
This study aimed to determine the physical activity levels of adolescents with idiopathic scoliosis (AIS) identified through school scoliosis screening (SSS), and to investigate the influence of age, BMI, and physical activity (PAQ-CN) on scoliosis severity, as well as the interaction effects between these risk factors.

Methods
AIS patients were identified during SSS conducted in Pu'er City, Yunnan Province, from June to December 2024. Besides the Adams forward bend test, the Angle of Trunk Rotation (ATR) was measured. The Physical Activity Questionnaire for Chinese Children (PAQ-CN) was used to assess physical activity levels. BMI was stratified according to standards established by the US Centers for Disease Control and Prevention (CDC). Multivariate analysis of variance (MANOVA) was employed to examine differences in ATR across age, BMI, and PAQ level groups, as well as their interaction effects. Post-hoc multiple comparisons were performed for significant findings.

Results
190 patients suspected of scoliosis were recruited from SSS. AIS patients predominantly exhibited low PAQ levels. PAQ level itself did not significantly affect ATR magnitude, but a significant gender difference was observed (females exhibited lower PA levels than males） Compared to other age and BMI subgroups, AIS patients aged 16-18 years and classified as underweight exhibited significantly larger ATR values. An interaction effect between BMI and age on the progression of scoliosis was also observed.

Conclusion
AIS patients in high-altitude regions demonstrated low physical activity (PA) levels; however, PA did not significantly influence axial trunk rotation (ATR) magnitude. Both age and BMI were identified as independent risk factors for scoliosis severity. Critically, BMI and age synergistically drove AIS rotational deformity progression through significant interaction effects, rather than exerting isolated impacts. This validates that maintaining healthy weight is central to spinal protection across all adolescent stages.

E-POINT PRESENTATION ABSTRACTS

330. Does Under Correction of Sagittal Alignment Bring Inferior Clinical Outcomes in Corrective Surgery for Adult Spinal Deformity in the Elderly?

Masanari Takami, MD; Shunji Tsutsui, MD; Keiji Nagata, MD; Yuyu Ishimoto, MD; Masatoshi Teraguchi, MD; Ryuichiro Nakanishi, MD; Hiroshi Iwasaki, MD; Hiroshi Yamada, MD

Hypothesis
"Pelvic incidence (PI)-lumbar lordosis (LL) mismatch <10°" was proposed as a formula in the SRS-Schwab classification for corrective fusion surgery for adult spinal deformity (ASD). However, this formula may not necessarily be appropriate as a goal for ASD in the elderly because it was derived from studies conducted on relatively young patients. An epidemiological study showed that PI-LL shifts to +10° in people above 70 years.

Design
A retrospective study.

Introduction
This study aimed to compare the outcomes of corrective fusion for ASD in older people using two different sagittal correction goals: the conventional formula of "PI-LL mismatch <10°" and an under-correction strategy based on the range of 10°≤PI-LL≤20°.

Methods
A total of 102 consecutive patients (11 male and 91 female patients; mean age, 72.0 years) older than 65 years of age with scoliosis >20° or LL <20° who had undergone long-segment fusion from the lower thoracic spine to the pelvis for ASD and had been followed-up for a minimum of 2 years at our institution since March 2013 were included in this retrospective study. After excluding patients with PI-LL ≤-10° on postoperative standing radiographs, the remaining patients were divided into two groups: 31 patients with 10°≤PI-LL≤20° (U group) and 63 patients with -10°<PI-LL<10° (M group). Radiological and clinical outcomes were compared between the groups.

Results
The incidence of proximal junctional kyphosis and mechanical failure was not significantly different between groups (p=0.659 and 1.000, respectively). After excluding patients who underwent reoperation due to mechanical failure, there were no differences in the Oswestry Disability Index (ODI) and each domain of the Visual Analog Scale score, Scoliosis Research Society-22r patient questionnaire (SRS-22r), or the short form 36 health survey questionnaire (SF-36) at the final observation between the U group (n=27) and M group (n=57). In addition, the non-inferiority and equivalence of the U group to the M group were demonstrated in all domains of the SRS-22r and ODI. Furthermore, the superiority of the U group was demonstrated by the functional domain of SRS-22r.

Conclusion
For the sagittal correction goal in corrective fusion surgery for ASD in older people, strict adherence to "PI-LL mismatch <10°" is not necessary, and "PI-LL ≤20°" may be acceptable.

333. Efficacy of Schroth Exercises in Management of Adolescent Idiopathic Scoliosis Within Asia

Grace H. Chua, MBBS; June M. Quek, Physiotherapist; You Heng Ou Yang, FRCS; Chay You Ang, FRCS; Lei Jiang, FRCS; Karine C. Sia, Physiotherapist; Yong Hao Pua, Physiotherapist; Jun Xiang Ng, Physiotherapist; Reuben CC Soh, MBBS, FRCS

Hypothesis
This study hypothesis that there is no difference in Cobb angle, Angle of Trunk Rotation (ATR) and SRS-22 (Scoliosis Research Society-22 patient questionnaire) scores before and after undergoing Schroth exercises.

Design
A retrospective study was conducted on a prospectively collected database of Adolescent Idiopathic Scoliosis (AIS) patients seen at a single tertiary hospital in Singapore from 2022 to 2025.

Introduction
The Schroth method in management of AIS consists of sensorimotor, postural and breathing exercises aimed at recalibrating normal postural alignment, postural control and spinal stability, often undertaken supplementary to bracing. This study was conducted to investigate the efficacy of Schroth exercises in absence of bracing in the management of AIS within a school screening programme.

Methods
Inclusion criteria were patients diagnosed with AIS, 10 to 18 years old, and participated in supervised Schroth exercises with physiotherapists with no other ongoing or prior interventions such as bracing/surgery. Only patients completing a minimum of four sessions of Schroth exercises, typically monthly, were included. Reasons for exclusion were not achieving the minimum frequency of Schroth exercises, concurrent bracing or lacking follow-up data. Cobb angle, ATR and SRS-22 scores before and after Schroth exercises were compared.

Results

A total of 50 AIS patients were included in the study (70.0% females, mean age 13.60±1.42 years, BMI 18.27±3.66, Risser 2.6±1.2). They attended 5.5±0.5 sessions of Schroth exercises across 6.2±4.2 months. Improvements in thoracic ATR (p=0.028, CI [0.09, 1.57], Cohen's d=0.32) and lumbar ATR (p=0.042, CI [0.03, 1.53], Cohen's d=0.30) were statistically significant, but change in Cobb angle was not significant (p=0.396, CI [-1.41, 0.57], Cohen's d=0.12). Improvement in quality of life was also represented by a significant improvement in SRS-22 scores (p=0.001, CI [-0.23, -0.06], Cohen's d=0.65). Analysis of patients who defaulted on physiotherapy showed that school and examinations played a major role in compliance to the sessions.

Conclusion

Schroth exercises are effective in improving ATR and SRS-22 scores, while effective in maintaining Cobb angle. The improvement in ATR and SRS-22 scores provides evidence that Schroth exercises should be considered in patients with slightly more mature spines, in addition to standardised treatment.

	Schroth (mean ± SD)		*p*-value	CI	Cohen's d effect size
	Initial	Latest			
Cobb angle	25.00 ± 5.84	24.64 ± 6.46	0.396	[-1.41, 0.57]	0.12
ATR-T	5.55 ± 3.36	5.00 ± 3.68	0.028	[0.09, 1.57]	0.32
ATR-L	5.26 ± 2.48	4.54 ± 3.05	0.042	[0.03, 1.53]	0.30
SRS-22	4.16 ± 0.29	4.32 ± 0.31	0.001	[-0.23, -0.06]	0.65

Outcomes before and after Schroth exercises

334. Using Uppermost Instrumented Vertebral Vertical Line as the Surgical Strategy to Determine the Lowest Instrumented Vertebral Level in Atypical Major Proximal Thoracic Curve in Adolescent Scoliosis Patients

Chih-Wei Chen, MD; Shu-Hua Yang, MD

Hypothesis

Using UIVPL may save some more fusion segments and have acceptable surgical outcomes.

Design

Retrospective cases analysis.

Introduction

Lenke classification is the currently most widely used classification for adolescent idiopathic scoliosis (AIS). However, there are still some unclassifiable curve patterns, such as the major curve located in the proximal thoracic (PT) area. Therefore, only a few articles focus on the surgical strategies for these patients. Here, we propose the "Uppermost instrumented vertebra plumb line" (UIVPL) to determine the lowest instrumented vertebra (LIV) and its surgical outcomes.

Methods

From September 2006 to November 2023, 6 patients with major PT curves received surgery at our institute. Their medical records and images were analysis retrospectively. All of them underwent posterior correction and fusion surgery with pedicle screw construct and followed up at least for 1 year. Two of them have Lenke type 2-like curves, but with a larger proximal curve, which was treated with the same principle using the central sacral vertical line (CSVL) to determine the LIV. The other four have only structural curves at the proximal thoracic region. We use the UVIPL to determine the LIV, which was the first vertebra bisected by this line. The associated demographic and radiograph data were recorded.

Results

Our patients included 4 females and 2 males, the average age was 17.5 years old with a major PT curve size of 58.0°. The immediate curve size after surgery was 30.6° with a correction rate of 43.7%. Coronal balance either improved or remained stable after surgery. The correction remained stable at last follow-up (average 3.6 years with MT curves at 30.4° and correction rate of 46.2%). Only two patients have C7 plumb line (C7PL)-CSVL distance greater than 2 cm in the final follow-up. The LIV determined by UIVPL is either the same or higher than that determined by CSVL (0~5 levels).

Conclusion

Currently, there is still no consensus on the LIV choice for the major PT curve. Using UIVPL may save some more fusion segments and have acceptable surgical outcomes. However, there are only a few patients in our study, which needs more cases to draw a more persuasive conclusion.

E-POINT PRESENTATION ABSTRACTS

335. Application of Dindo-Clavien Complication Grading System to Adult Spinal Deformity Surgery for Uniform Assessment of Perioperative Complications

Shunji Tsutsui, MD; Masanari Takami, MD; Yuyu Ishimoto, MD; Keiji Nagata, MD; Masatoshi Teraguchi, MD; Ryuichiro Nakanishi, MD; Hiroshi Iwasaki, MD; Hiroshi Yamada, MD

Hypothesis

Although adult spinal deformity (ASD) surgery has been historically associated with substantial incidence of perioperative complications, there is a lack of a uniform classification system to categorize complications. The Dindo-Clavien (DC) complication grading system could be applicable to ASD surgery.

Design

Retrospective single-center study.

Introduction

Less invasive procedures, such as lateral interbody fusion, have become common in surgery for ASD. However, the rate of perioperative complications remains high, especially in older patients. Nonetheless, there is a lack of a uniform classification system to categorize complications. The DC system was originally developed for general surgery, and has been recently introduced to spinal surgery. This study aimed to validate DC system in ASD surgery with major invasiveness and high complexity.

Methods

We performed a retrospective study of 96 patients aged ≥65 years who underwent long spinopelvic fusion using lateral interbody fusion. Perioperative complications were analyzed using DC classification based on 5 grades according to the severity and type of intervention required to treat complications. We assessed patient characteristics (age, sex, body mass index, frailty, American Society of Anesthesiologists physical status, pelvic incidence), operative time, intraoperative estimated blood loss, days from surgery to independent ambulation, and length of hospital stay.

Results

There were complications in 76 patients (79.2%): grade Ⅰ (any deviation from the normal postoperative course) =32, Ⅱ (pharmacological treatment) =28, Ⅲ (surgical, endoscopic or radiological intervention): a (without general anesthesia) =12; b (under general anesthesia) =3, and Ⅳa (ICU management, single organ dysfunction) =1. Although none of the preoperative patient characteristics and surgical data had association with DC grade, days from surgery to independent ambulation and length of hospital stay were significantly associated with DC grade. In addition, there was no significant difference in any of the factors other than the days to independent ambulation and length of hospital stay between the patients with minor (≤ grade Ⅱ) and major (≥ grade Ⅲ) complications.

Conclusion

The DC classification is thus suggested to be appropriate in application in ASD surgery.

Grade	Definition (type and severity of intervention to treat complication)
Ⅰ	Any deviation from the normal postoperative course without need for pharmacological treatment or surgical, endoscopic and radiological intervention
Ⅱ	requiring Pharmacological treatment
Ⅲ	requiring Surgical, Endoscopic, or Radiological intervention
a	general anesthesia Not required
b	general anesthesia required
Ⅳ	Life-threatening complication requiring ICU management
a	single organ dysfunction
b	multi organ dysfunction
Ⅴ	Death

Dindo-Clavien classification

336. The Hsu-lace: A Novel Technique to Prevent Proximal Junction Failure

Jennyfer Paulla Galdino Chaves, MD; Stone Sima, MD; Bhisham Singh, MBBS, FRCSA, MS, FRCS; Ashish Diwan, PhD; *Brian Hsu, MD*

Hypothesis

The use of the Hsu-lace technique for artificial interspinous soft stabilization in thoraco-lumbar-pelvic reconstruction for Adult Spine Deformity (ASD) reduces the incidence of proximal junctional kyphosis (PJK), proximal junctional failure (PJF), and the need for extension of fusion compared to conventional instrumentation without soft stabilization.

Design

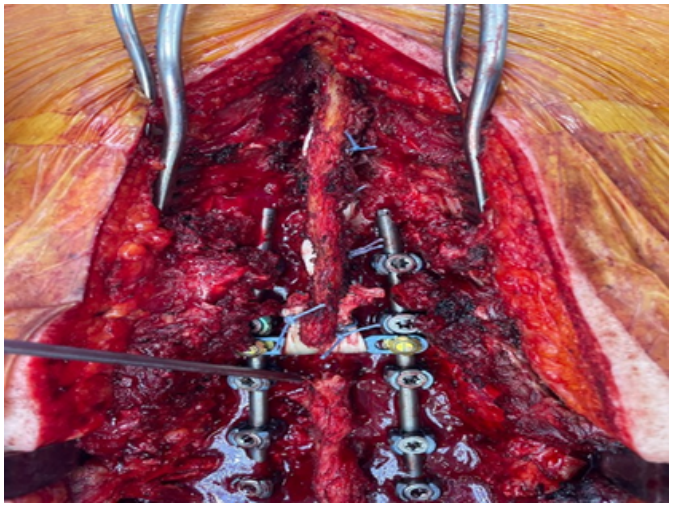
A retrospective review.

Introduction
Proximal junctional kyphosis (PJK) and proximal junctional failure (PJF) remain significant complications following thoraco-lumbar-pelvic reconstruction in Adult Spine Deformity (ASD) surgery. This retrospective study evaluates the efficacy of the Hsu-lace technique —an artificial interspinous Nylon and Tendon soft stabilization method—designed to create a "soft landing" at the proximal junction with the aim of reducing PJK, PJF, and the need for reoperation or extension of fusion.

Methods
A retrospective review was conducted on 53 consecutive patients who underwent thoraco-lumbar-pelvic fusion for ASD between 2019 and 2023. Patients were divided into two groups based on the type of artificial interspinous stabilization used: Nile-Life Health Care (Nile-LHC; n=27) or Tendon/Ausbio-APM (n=26). Data collected included patient demographics, surgical parameters, incidence and timing of PJK/PJF, reoperation rates, and frequency of fusion extension.

Results
8 patients developed PJK before 6 months and 5 were submitted to extension of fusion. 80% of these patients extended were from the Nile-LHC group. Despite this, we had 3 patients that developed PJK but had no proximal junction failure (PJF).

Conclusion
The Hsu-lace technique appears to be a promising adjunct in ASD surgery by providing proximal soft stabilization that may mitigate the risk of PJF and reduce the need for reoperation. This technique has led to a meaningful change in our surgical practice and may offer a simple yet effective strategy for improving long-term outcomes in complex spinal reconstruction.



Final suture of the Tendon-Ausbio overlapping the crossline with Ethibond 5.0 suture.

337. Restoration of Pelvic Incidence Minus Lower Lumbar Lordosis Significantly Affects Pelvic Tilt

Seung-Jae Hyun, MD, PhD; Youngbae B. Kim, MD, PhD; Yongjung J. Kim, MD

Hypothesis
The most effective way to correct the pelvic retroversion is to restore LLL according to the patient's PI and Roussouly type. Ideal LLL differ according to individual PI and Roussouly Type.

Design
A retrospective analysis.

Introduction
The roles of LLL in relation to individual PI and Roussouly type have yet to be established. This study aimed to determine the optimal LLL and PI-LLL based on individual pelvic and spinal morphology within a normal asymptomatic elderly population.

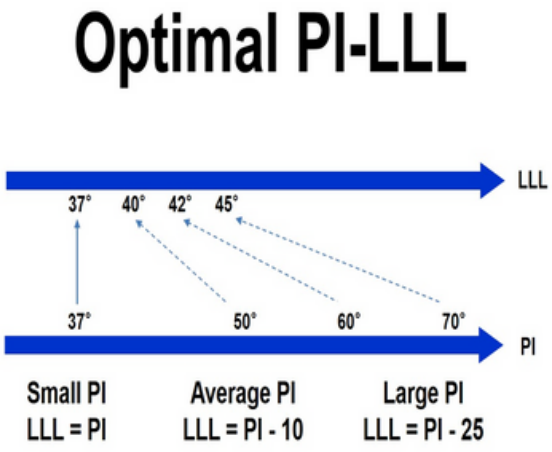
Methods
Whole spine standing radiographs were obtained from asymptomatic elderly volunteers who had not undergone previous spinal surgery. The following parameters were measured: LL from the T12 LEP to the S1 UEP, LLL from the L4 UEP to the S1 UEP, and spinopelvic parameters. Lordosis distribution index (LDI) for the lower lumbar spine were calculated. Pearson correlation and linear regression analyses were performed, and the mean value for each parameter was obtained according to PI subgroup (PI < 40°, 40° ≤ PI < 50°, 50° ≤ PI < 60°, and 60° ≤ PI) and "theoretical" Roussouly type.

Results

Overall, 150 male volunteers were enrolled in the study, with an average age of 64.1 ± 6.4 years. The average LL was −57.5° ± 9.0°, LLL was −39.7° ± 6.8°, and PI was 48.6° ± 8.6°. PT significantly correlated with PI, PI-LL, PI-LLL, and LDI. However, PT was not significantly related to LL. The differences between PI and LL (PI-LL) and between PI and LLL (PI-LLL) were −8.9° ± 8.0° and 9.0° ± 9.3°, respectively. The coefficient of determination (R2) for PI-LLL was highest as 0.554, indicating the accuracy of this method for predicting PT. As PI increased from low (<40°) to high (≥70°), PI-LLL increased from -0.3 to 25.3, while LDI decreased from 74.1% to 61.1%. Similarly, PI-LLL increased from 1.0 to 23.3 as Roussouly types increased, while LDI decreased from 81.0% to 62.6%.

Conclusion

LLL substantially impacts LL in patients with a low PI and Roussouly type 1. The relationship between PI-LLL and PT displayed the highest coefficient of determination in a regression analysis, suggesting that PT is significantly related to LLL according to PI. However, PT was not significantly related to LL. These findings suggest that the most effective way to correct the PT is to restore LLL according to the patient's PI and Roussouly type.



The schematic diagram of normative PI-LLL according to PI.

338. Minimally Invasive Lateral Interbody Fusion with Posterior Instrumentation for Sagittal Alignment Restoration in Adult Lumbar Spinal Deformity: Clinical and Functional Outcomes

Wen-Tien Wu, MD, PhD; Kuang Ting Yeh, MD, PhD

Hypothesis

Lateral interbody fusion, including anterior lumbar interbody fusion (ALIF) and oblique lumbar interbody fusion (OLIF), combined with posterior percutaneous instrumentation effectively restores sagittal alignment and improves functional outcomes in adult spinal deformity patients with reduced surgical morbidity.

Design

Retrospective cohort study.

Introduction

Adult spinal deformity correction traditionally requires extensive open procedures with significant morbidity. Minimally invasive lateral approaches offer potential advantages including reduced blood loss, preserved paraspinal musculature, and shorter recovery time while achieving effective deformity correction.

Methods

From August 2021 to August 2024, 82 patients (24 males, 58 females, mean age 60.9 years) with degenerative scoliosis, spondylolisthesis, or other spinal pathologies underwent lateral ALIF/OLIF with posterior percutaneous instrumentation. Radiographic parameters including pelvic incidence, lumbar lordosis, L4-S1 lordosis, and lordosis distribution index (LDI) were measured. Functional outcomes including Oswestry Disability Index (ODI) and Visual Analog Scale (VAS) for back/leg pain were assessed preoperatively and postoperatively with minimum 12-month follow-up.

Results

Significant improvements were achieved in radiographic parameters: lumbar lordosis improved from 36.1° to 45.2°, L4-S1 lordosis increased from 20.9° to 31.0°, and lordosis distribution index improved from 0.52 to 0.72. All 26 patients with preoperative LDI <0.5 achieved postoperative normalization. Functional outcomes showed substantial improvement: ODI decreased from 52.3±12.8 to 28.6±10.4, back pain VAS reduced from 7.2±1.6 to 3.1±1.8, and leg pain VAS improved from 6.8±2.1 to 2.4±1.5 (all $p<0.001$). Patient satisfaction rate was 89.2%.

Conclusion

Lateral ALIF/OLIF with posterior instrumentation thru minimally invasive approach provides excellent sagittal alignment restoration and functional outcome improvement in adult spinal deformity patients.

340. Grip Strength is Associated with Sagittal Spinopelvic Alignment and Frailty in Elderly Male Patients with Degenerative Lumbar Disease

Taewoo Kim, MD; Yoon Ha, MD, PhD

Hypothesis
In elderly male patients over 75 years of age with degenerative lumbar disease, the weaker the grip strength, the more severe the sagittal spinopelvic alignment imbalance will be.

Design
We performed comprehensive geriatric assessment in a patient aged 75 years and older who were hospitalized for degenerative spinal surgery between March 2015 and June 2017. Of a total 144 patients we enrolled only male patients with degenerative lumbar disease in this retrospective cross-sectional study. Exclusion criteria 1) previous lumbar surgery 2) neurogenic or myogenic disorder 3) severe compression fractures 4) insufficient data. 36 patients participating in this study.

Introduction
Sarcopenia is defined as an age-associated decline in skeletal muscle mass and strength, measuring grip strength is one of the diagnostic methods. In this study, we measured grip strength, sagittal spinopelvic parameters, frailty scale. The main aim was to explore an association between grip strength and the spinopelvic parameters in elderly patients with degenerative lumbar disease. The association of frailty scale and other variables was also analyzed.

Methods
An electronic dynamometer was used for measuring grip strength before the surgery. The dominant hand was assessed twice, with the non-dominant hand being assessed in between, and the strongest grip was registered and used for analysis. We also tried to adjust grip strength with BMI. Standing lateral radiographs of the whole spine were taken. We measured C7 sagittal vertical axis (SVA), T1 pelvic angle (PA), pelvic tilt (PT), sacral slope (SS) pelvic incidence (PI), lumbar lordosis (LL). The analysis was performed using the R statistical software.

Results
Average grip strength was 26.47±7.45 kg. Pearson correlation demonstrated that grip strength was related to T1 PA ($r=-.43$, $p<.01$), PT ($r=-.57$, $p<0.001$), PI ($r=-.43$, $p<.01$), PI-LL ($r=-.41$, $p<0.05$). Grip strength adjusted for BMI showed the similar correlation, and it was also associated with frailty scale. Multiple regression analysis confirmed the associations between grip strength and T1 PA, PT, PI and PI-LL ($\beta=-.80$, $p<.01$, $R^2=.49$; $\beta=-.99$, $p<.001$, $R^2=.38$; $\beta=-.88$, $p<0.05$, $R^2=0.24$ and $\beta=-1.11$, $p<.05$, $R^2=.27$, respectively).

Conclusion
Grip strength is a relevant and easy-to-measure parameter associated with sagittal spinopelvic alignment in elderly male patients with lumbar spine degeneration.

341. Femoral and Tibial Length Growths Were Not Predictive of Curve Progression in AIS

Kee Lok Fong, MBBS; Kenny Y. Kwan, MD, FRCS(C); Janus Wong, FRCS

Hypothesis
Curve progression in adolescent idiopathic scoliosis (AIS) patients could be predicted by lower limb long bone growth.

Design
This is a retrospective cohort study. We reviewed existing clinical and radiographic records of patients who had undergone serial EOS x-rays before receiving any treatment, such as bracing or surgery.

Introduction
Predicting curve progression in scoliosis is essential for guiding timely treatment, improving long term patient outcomes. Scoliosis progression is closely linked to height velocity, making the assessment of growth potential important in predicting curve severity. In this context, we explored the role of lower limb long bones as potential predictors.

Methods
Consecutive patients with AIS treated at a tertiary referral centre with at least 2 concurrent x-ray films of the spine and lower limbs were screened for inclusion. Serial concurrent radiographic measurements on EOS whole spine and lower limb films were compared until patient received brace or surgery. Patient sex, chronological age, menarche, body height, Cobb angle, Risser stage, femur length, tibia length, and time elapsed between serial measurements were collected. Patients with congenital scoliosis, lower limb pathologies, syndromal associations, and outliers (more than 2 standard deviations from the mean) were excluded. Spearman correlation was used to investigation potential associations between rates of progression Cobb angle, and femoral and tibial lengths. Statistical significance was set at $p<0.05$.

Results
128 pairs (66 girls, 62 boys) of concurrent radiographic measurements of patient's spine and lower limbs at mean chronological age of 15 +/-2 years were included in analysis. The average annual rate of curve progression was 3 +/-7 degrees, while the annual growth rate femur and tibia length were 11 +/-8 cm and 8 +/-6 cm respectively. The rate of curve progression was not associated with femoral length growth (Spearman rho 0.27, p=0.763) or tibial length growth (Spearman rho -0.022, p=0.808).

Conclusion
Growth of femur and tibia lengths were not statistically associated with rate of curve progression in scoliosis. The findings of this study suggests that limb length growth may not be an accurate marker of spine growth nor predictor of curve progression in AIS.

343. Ten-Year Clinical Outcomes Following Corrective Fusion Surgery for Adult Spinal Deformity: A Retrospective Cohort Study

Hiroshi Taniwaki, MD; Akira Matsumura, MD, PhD; Takashi Namikawa, MD, PhD; Yusuke Hori, MD, PhD; Masaki Kawamura, MD; Hidetomi Terai, MD, PhD

Hypothesis
Corrective fusion surgery for adult spinal deformity (ASD) provides long-term improvements in radiographic alignment and health-related quality of life (HRQOL), and clinical outcomes at 5 years may predict those at 10 years postoperatively.

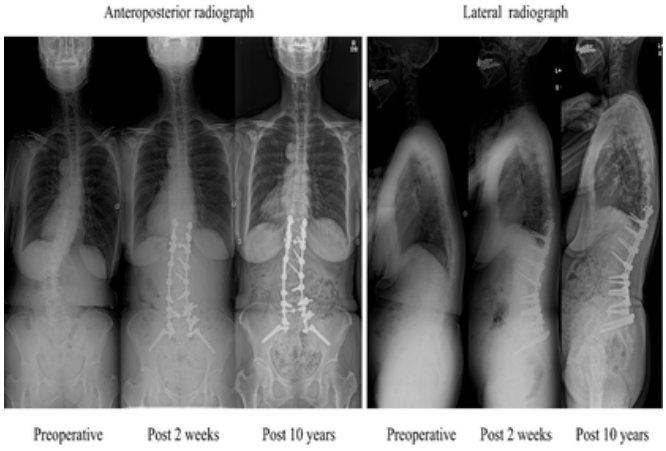
Design
Retrospective cohort study with a minimum 10-year follow-up after corrective fusion surgery for ASD.

Introduction
Recent advances in ASD corrective surgery—such as standardized alignment goals, surgical innovations, and minimally invasive techniques—have significantly improved short- to mid-term outcomes. However, the long-term durability of these improvements remains unclear due to limited 10-year follow-up reports. Additionally, it is unknown whether 5-year outcomes reliably predict long-term results. This study aims to evaluate 10-year outcomes after ASD surgery and assess the correlation between the 5- and 10-year results.

Methods
Of 19 patients who underwent corrective fusion for ASD between May 2009 and May 2013, 15 were followed for over 10 years (mean age: 60.1 years, mean follow-up: 11.6 years, follow-up rate: 78.9%).

Results
Mechanical complications occurred in five cases (PJK: 3, DJK: 2), with one requiring revision surgery. At PO10Y, 11 patients could ambulate independently. Significant improvements were observed in all radiographic parameters postoperatively. However, TK, PI-LL mismatch, and lumbar Cobb angle worsened significantly between preoperative and PO10Y evaluations (p=0.024, 0.025, and 0.038, respectively). HRQOL improved significantly by PO2Y and remained stable through PO10Y. Notably, self-image (p=0.035) and subtotal SRS-22 score (p=0.012) were still significantly better than baseline at PO10Y. Strong correlations were found between PO5Y and PO10Y scores across multiple HRQOL domains.

Conclusion
Corrective fusion surgery for ASD provides sustained improvement in HRQOL and alignment over 10 years. The strong correlation between 5- and 10-year outcomes suggests that mid-term results are predictive of long-term surgical success.



346. Modified Pedicle Subtraction Osteotomy using a Biportal Endoscopic Approach for Osteoporotic Vertebral Collapse

Subin Lim, MD; Min Seok Kang, MD; Sukha Lee, MD, PhD; Tae-Hoon Kim, MD, PhD

Hypothesis
Modified pedicle subtraction osteotomy (mPSO) through a biportal endoscopic (BE) approach provides effective correction of kyphotic deformity and favorable clinical outcomes in patients with osteoporotic vertebral collapse (OVC), while reducing surgical morbidity.

Design
Retrospective case series.

Introduction

Osteoporotic vertebral compression fractures are typically benign but can progress to OVC or nonunion, often accompanied by kyphotic deformity, severe pain, and neurological deficits, making treatment difficult. Several studies have reported that mPSO offers advantages such as reduced blood loss and shorter operative time compared to conventional vertebral corpectomy procedures, while still achieving effective correction of kyphotic deformity and significant pain relief. In this study, we present the surgical technique and preliminary outcomes of BE-mPSO for the treatment of OVC.

Methods

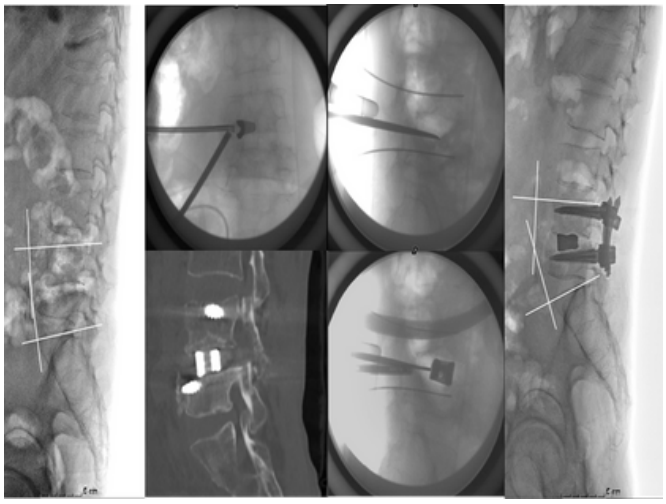
From January 2022 to December 2024, eight patients with OVC underwent BE-mPSO. Under general anesthesia, the patient was positioned prone, and an ipsilateral total facetectomy was performed. After insertion of a guidewire for the vertebral osteotomy, partial pediculectomy and partial vertebrectomy were carried out. Following meticulous endplate preparation, a lordotic interbody cage was inserted into the intervertebral disc. Posterior instrumentation was performed with an emphasis on restoring sagittal alignment as much as possible. The perioperative kyphotic angles, sagittal vertical axis (SVA), neurological status, and complications were recorded. And, perioperative Oswestry Disability Index (ODI) scores and visual analog scale (VAS) scores were compared.

Results

The mean age was 71.4 ± 10.2 years. The mean operative time was 215.3 ± 240.2 min. The mean blood loss was 176.1 ± 24.9 ml. A mean correction of kyphotic angles was 23.2 ± 28.3°. The mean preoperative and postoperative SVA were 55.4 ± 3.8 mm and 27.9 ± 3 mm, respectively. The mean ODI score improved from 58.3 ± 5.1 preoperatively to 26.4 ± 8.5 at last follow-up. The mean VAS score improved from 7.4 ± 1.6 preoperatively to 2.6 ± 0.8 at last follow-up. There was no implant failure in any of the 8 patients. No significant complications were observed.

Conclusion

BE-mPSO may serve as an alternative treatment for OVC, offering kyphotic correction, pain relief, and functional recovery with low blood loss.



Kyphotic deformity was corrected via mPSO.

347. Integrating Oncologic and Spinal Deformity Principles: Current Approaches in the Management of Tumor-Associated Adult Spinal Deformity

Muhammad Abdulhamid, MD; Rieva Ermawan, MD; Bayu S. Jiwandono, MD

Hypothesis

A comprehensive surgical approach that integrates oncologic goals with spinal deformity correction results in better structural stability, neurological outcomes, and patient-reported quality of life in tumor-associated adult spinal deformity (TASD).

Design

Narrative literature review.

Introduction

TASD arises from structural damage due to spinal tumors or their treatment, often resulting in spinal imbalance, pain, and neurologic compromise. Traditional approaches focus on tumor control and stabilization, but recent advances emphasize the importance of restoring alignment to improve long-term function and reduce mechanical complications.

Methods
A literature review was conducted using PubMed and Scopus, targeting studies published from 2019 to 2024 on the surgical management of TASD. Articles were selected based on relevance to combined oncologic and deformity correction strategies, including realignment osteotomies, anterior reconstruction, and use of enabling technologies. Outcomes assessed included spinal alignment, neurological preservation, instrumentation failure, and functional recovery.

Results
Recent studies demonstrate that integrating deformity correction principles—particularly sagittal balance restoration—with oncologic resection improves mechanical durability and reduces revision rates. Techniques such as pedicle subtraction osteotomy, pelvic fixation, and use of 3D-printed implants have enabled more precise reconstruction in complex tumor cases. Multidisciplinary planning, including oncology, radiotherapy, and rehabilitation, further enhances functional outcomes.

Conclusion
Integrated surgical strategies that address both tumor burden and spinal alignment provide superior outcomes in TASD patients. This approach reduces complications, improves function, and aligns with modern expectations for quality of life in oncologic spine care. Continued research is needed to standardize protocols and assess long-term benefits.

348. Changes in Coronal and Sagittal Plane Alignment Following OLIF for the Treatment of Lumbar Degenerative Deformity in Adults

Hao Wu, MD

Hypothesis
We hypothesized that single-level oblique lumbar interbody fusion with percutaneous posterior fixation (OLIF+PPPSF) would significantly correct both coronal and sagittal spinal alignment in degenerative lumbar scoliosis, evidenced by reduced coronal Cobb angles/CVA and improved lumbar lordosis/SVA.

Design
This retrospective cohort study analyzed 64 adults undergoing L1–L5 OLIF+PPPSF (2017–2022). Preoperative, immediate postoperative, and follow-up radiographs assessed coronal (regional/segmental Cobb angles, CVA) and sagittal alignment (lordosis, segmental Cobb, SVA). Clinical outcomes included VAS (back/leg) and ODI scores. Operative metrics (blood loss, time) and complications were recorded. Paired analyses compared pre-/postoperative changes ($p < 0.05$).

Introduction
The major focus of the realignment in lumbar degenerative deformity has been on the sagittal plane. We aimed to emphasis on coronal and sagittal plane in OLIF+PPPSF. This objective of this study was to evaluate the coronal and sagittal correction angle of OLIF surgery for the treatment of single-segement degenerative scoliosis.

Methods
This retrospective analysis included 64 adults undergoing oblique lateral interbody fusion with posterior fixation (OLIF+PF) for degenerative lumbar deformity at XuanWu Hospital (2017–2022). Standing lumbar radiographs were analyzed pre- and postoperatively, assessing regional/segmental coronal/sagittal Cobb angles, global coronal (CVA) and sagittal balance (SVA). Additional data encompassed operative metrics (blood loss, duration), patient-reported outcomes (VAS, ODI), and complications.

Results
All 64 patients exhibited significant radiographic and clinical improvements (p^*、 <0.01). Coronal alignment improved with regional Cobb angle decreasing from 35.1° to 10.5°, segmental Cobb from 6.7° to 2.6°, and CVA from 35.4 mm to 16.8 mm. Sagittal parameters showed lumbar lordosis increasing from 24.4° to 32.1°, segmental Cobb from 6.6° to 8.1°, and SVA decreasing from 92.4 mm to 42 mm. Fractional curves demonstrated significant reductions (regional: 13.1°→5.5°; segmental: 4.9°→2.2°; $p<0.001$). Clinically, VAS-back improved from 4.9 to 0.8, VAS-leg from 3.7 to 1.2, and ODI from 43.5 to 12 ($p<0.0001$). No infections or neurological complications occurred.

Conclusion
It is effective and safe to perform L1-L5 OLIF in adults with degenerative lumbar disease.

349. The Utilization of the Closed Multi-Axial Screw in the Modified Shilla Growth-Guidance Technique for the Treatment of Early Onset Scoliosis: A Preliminary Report

Tinnakorn Pluemvitayaporn, MD

Hypothesis
To introduce a novel growth-guidance technique for EOS surgery, using closed multi-axial screws (CMAS) as an alternative to Shilla trolley screws, and to report on both the clinical and radiographic outcomes associated with this technique.
rew may be limited in certain regions.

E-POINT PRESENTATION ABSTRACTS

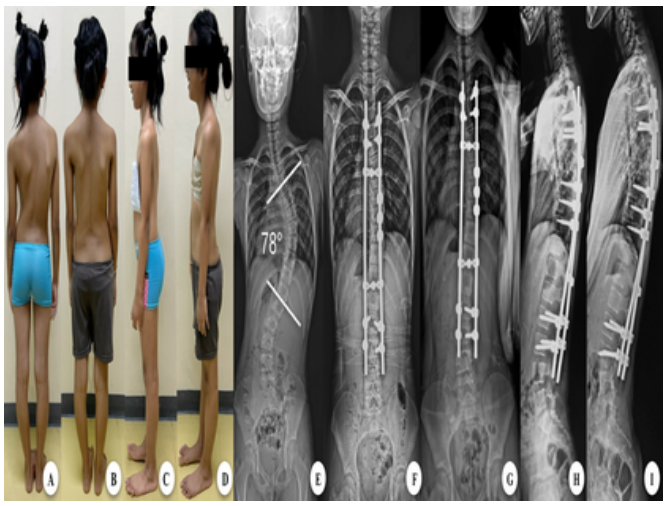
Design
Prospective cohort study.

Introduction
Early onset scoliosis refers to a spinal deformity condition that manifests in children under the age of ten. Surgical treatment aims to halt curve progression and allow spinal growth until maturity. One of the surgical techniques for EOS is the growth-guided technique. The utilization of this technique facilitates the spinal growth to conform with the contoured rod within the Shilla screw without serial operations. However, access to Shilla screw may be limited in certain regions.

Methods
Five patients diagnosed with early-onset scoliosis were conducted between 2021 and 2024. The patients underwent active apex correction (modified Shilla) using closed multi-axial screws (CMAS) instead of Shilla screws for the growth guidance technique. The details of this technique have been thoroughly described. This approach served as an alternative to using Shilla trolley screws at the cephalad and caudad regions of the anchor site. The collected data was analyzed, and the radiographic outcomes, including corrected major Cobb angle and truncal height (C7-S1 distance), were documented and reported.

Results
The average preoperative major coronal Cobb angle of 71.2 degrees was corrected to 19.6 degrees postoperatively and maintained until the final follow-up. Truncal height increased by an average of 22.8%. No patient experienced neurological changes as a result of surgery. Patients were braced for the first three months postoperatively.

Conclusion
The utilization of CMAS instead of a Shilla trolley screw may benefit the growth guidance procedure. The CMAS system is readily accessible and user-friendly, with demonstrated reliable predictive outcomes.



A 7-year-old girl diagnosed with idiopathic EOS presented with a preoperative major coronal Cobb angle of 78 degrees and a preoperative truncal height (C7-S1 distance) of 268 mm (A,C,E). Postoperative general appearance of this patient (B,D). Immediate postoperative whole spine plain radiographs (F,H). At the final follow-up (g,I).

350. Proximal Junction Uninstrumented Bone Fusion as a Feasible Additive Procedure to Delay or Prevent Proximal Junctional Kyphosis/Failure

Seung-Jae Hyun, MD, PhD; *Sungjae An, MD*

Hypothesis
Proximal junction uninstrumented bone fusion (UBF) is an effective preventive measure for proximal junctional kyphosis/failure (PJK/F) following adult spinal deformity (ASD) corrective surgery.

Design
Retrospective matched cohort study.

Introduction
UBF is a long-standing technique since the beginning of the spinal fusion history, first reported on 1911 by Hibbs who performed posterior spinal arthrodesis on three Pott's disease patients. UBF was a powerful measure with the ability to fuse multilevel spine on its own before the era of interbody fusion or instrumentation. Based on this historical insight, we focused on its potential to make gradual transition of stiffness for long construct spinal fusion without any instrumentation at uppermost instrumented vertebra (UIV) +1. Since 2017, we have attempted UBF at UIV+1 by lamina decortication and cranially extending onlay bone graft for ASD surgeries.

E-POINT PRESENTATION ABSTRACTS

Methods

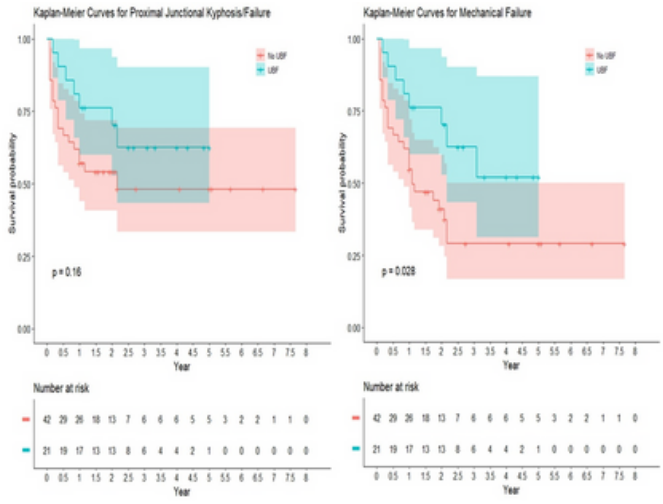
We retrospectively analyzed patients who underwent ASD corrective surgeries incorporating UBF at the proximal junction at a single academic institution. ASD patients were individually matched (1:2) for age, gender, osteoporosis status, and UIV. Demographic, operative, and radiographic parameters were compared, while complication-free periods for PJK/F and any mechanical failure (MF) were separately assessed. A multivariable survival analysis identified significant factors for mechanical complications.

Results

A total of 21 patients in the UBF group and 42 patients in the non-UBF group were enrolled. No significant differences were observed regarding demographic, operative, radiographic parameters, and patient-reported outcome scores. The median time to PJK/F was longer in the UBF group (11.0 vs 3.5 months, P=0.037). In the UBF group, six patients experienced successful bone mass fusion without any MF. The odds ratio of UBF was 0.55 (P=0.28) for PJK/F and 0.35 (P=0.056) for any MF. Kaplan-Meier analysis indicated a significantly extended MF-free period in the UBF group (P=0.028), but not for PJK/F (P=0.16). The Cox proportional hazard model identified proximal junction UBF as a significant protective factor against MF (Hazard ratio 0.35, P=0.017).

Conclusion

Proximal junction UBF in ASD surgeries could be a potentially beneficial strategy to prevent and delay PJK/F.



Kaplan-Meier curves for PJK/F and MF-free survival, stratified by the proximal junction UBF.

PARTNER ORGANIZATIONS

The Asia Pacific Meeting is, as a scientific meeting for the region, by the region, held by the Scoliosis Research Society in conjunction with regional Partner Organizations.

ASSI ASSOCIATION OF SPINE SURGEONS OF INDIA

中国康复医学会脊柱专业委员会 CAS 1991 Chinese Association of Spine

대한척추외과학회 KOREAN SOCIETY OF SPINE SURGERY 1984

Korean Spinal Neurosurgery Society 1987

SPINE SOCIETY MALAYSIA

Philippine Spine Society

SINGAPORE SPINE SOCIETY FOUNDED 2017

SPINE SOCIETY OF AUSTRALIA

SST Spine Society of Thailand Founded 2011

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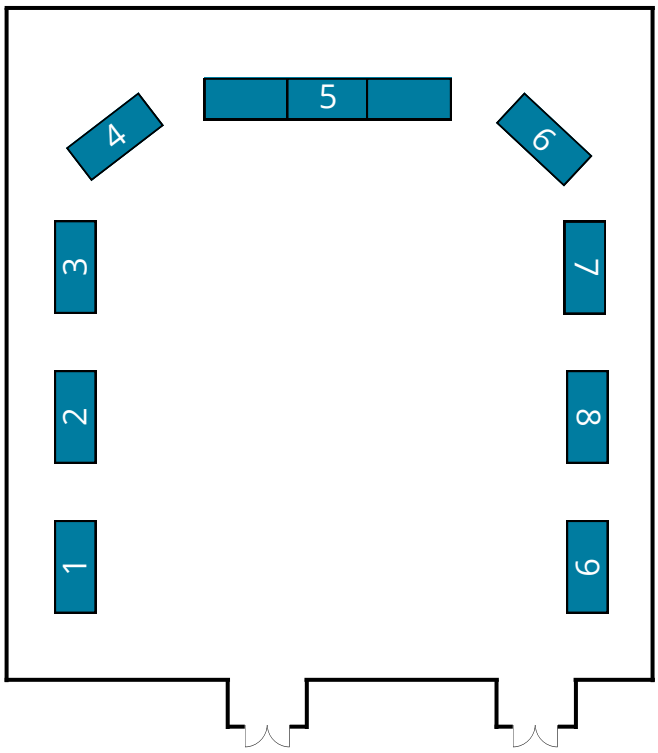
Located in Argos EF, 1F
Exhibit Hall Hours:

Friday, February 6	07:30 - 18:45
Saturday, February 7	07:30 - 16:00

Table	Company
1	Highridge Medical
2	B. Braun Aesculap Japan, Co., Ltd
3	Corentec
4	Medyssey, Co., Ltd.
5	L&K Biomed
6	UpSurgeOn
7	Globus Medical
8	Smile Curve
9	Medtronic



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CORENTEC CO., LTD. is a South Korea–based medical device company specializing in the research, development, and manufacturing of orthopedic implant systems. The company provides a broad portfolio of solutions across joint reconstruction, spine, and orthopedic surgical instruments, supporting a wide range of clinical needs.

With a strong foundation in in-house research and engineering, Corentec focuses on developing implants that emphasize anatomical compatibility, mechanical stability, and long-term clinical performance. The company collaborates closely with clinicians to translate surgical insights into practical, surgeon-driven product designs.

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Guided by a commitment to patient outcomes and surgical excellence, Corentec strives to contribute to the advancement of orthopedic care through innovation, quality, and collaboration.

EXHIBITORS

GLOBUS MEDICAL is a leading global musculoskeletal technology company dedicated to solving unmet clinical needs and changing lives. We innovate with passion, provide world-class education and clinical support, and advance care through our comprehensive spine, orthopedic trauma, and joint reconstruction procedure portfolios, regenerative biologics, and enabling technologies, including our Power Portfolio and Excelsius™ Technology.

HIGHRIDGE MEDICAL is committed to improving spine care by partnering with the surgeon community to drive innovation. The company has a strong portfolio supported by extensive clinical evidence, including solutions for complex spine, motion preservation, minimally invasive surgery, biologics, and enabling technology.

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MEDTRONIC We are redefining spine and cranial surgery through the convergence of data, AI-driven planning, navigation, imaging, robotics, and implants to reduce surgical variability and deliver personalized care. Through the AiBLE™ smart ecosystem, we optimize every phase of care—before, during, and beyond surgery— to achieve more predictable, patient-specific outcomes. Our goal is to set new standards in spine and cranial surgery, so patients can return to fuller, more active lives with confidence.

MEDYSSEY, CO., LTD. Founded in 2003 in South Korea, Medyssey Co., Ltd. is a specialized medical device manufacturer, involving both Implants and Instrumentations dedicated to the 3D printing design, pioneering development, and intricate production of advanced solutions for spinal surgery.

With a strong foundation in clinical science and engineering excellence, Medyssey has continuously pursued innovation aimed at improving spinal fusion outcomes, preserving physiological mobility, and enhancing overall patient quality of life.

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These solutions are developed through close collaboration with spine surgeons and are supported by robust scientific validation, regulatory compliance, and rigorous quality control under ISO 13485 standards.

The company has achieved multiple international regulatory approvals, including U.S. FDA 510(k) clearances, and maintains a global clinical and commercial network spanning over 25 countries and more than 700 surgeons worldwide. With in-house R&D, manufacturing, and quality assurance capabilities, Medyssey continues to expand its role as a trusted global partner in spine care.

Guided by a commitment to medical excellence and sustainable growth, Medyssey strives to advance spinal treatment through thoughtful innovation and deep clinical insight.

EXHIBITORS

SMILE CURVE is a Japan-based MedTech startup developing a radiation-free scoliosis screening and monitoring platform for adolescents. Scoliosis often emerges during growth spurts (ages 10–16); early detection is essential to enable timely bracing and help prevent progression that may otherwise require invasive surgery.

Our solution builds on Japan's unique moiré topography screening approach—an established method recognized for its high sensitivity and its ability to minimize missed cases in school-based screening—while modernizing it with a lightweight portable 3D scanner (approximately 5 kg, sub-second capture, millimeter-level accuracy) and a cloud-based decision-support system for quantitative assessment. Designed for fast, privacy-conscious workflows in schools and clinics, the platform supports longitudinal follow-up and secure, cloud-based sharing of results between hospitals, parents, and patients.
We work closely with spine surgeons and clinical researchers at Keio University, alongside industry partners with deep expertise in 3D measurement technologies. Our mission is simple: make early detection accessible, accurate, and scalable—so more children can receive timely care and keep their smiles.

Across Asia, scoliosis screening programs have expanded in recent years, with new and scaled initiatives emerging around 2020 in countries such as China and others in the region. In this context, SMILE CURVE is actively seeking hospital partners and scoliosis specialists across Asia for joint research and clinical validation—benchmarking performance, refining best-practice workflows, and building evidence for scalable implementation.

UPSURGEON is a surgical simulation company founded in 2017, with the mission of making surgical excellence accessible globally. By offering cutting-edge hyper-realistic simulators and immersive VR/AR experiences, it specializes in fields such as Neurosurgery, Spine Surgery, Plastic Surgery, and others. UpSurgeOn helps professionals enhance their psychomotor skills, improve patient safety, and reduce costs for healthcare providers.

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AUTHOR INDEX

Podium Presentations: 1-72; E-Points: 200-350; ES1: Adolescent Idiopathic Scoliosis: From Natural History to Advanced Treatment; ES2: Adult Spinal Deformity: Optimizing Surgical Strategies and Long-Term Outcomes

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ABOUT SRS

Founded in 1966, the Scoliosis Research Society is an organization of medical professionals and researchers dedicated to improving care for patients with spinal deformities. Over the years, it has grown from a group of 37 orthopaedic surgeons to an international organization of more than 1,700 health care professionals.

Mission Statement

The purpose of the Scoliosis Research Society is to foster the optimal care of all patients with spinal deformities.

Membership

SRS is open to orthopaedic surgeons, neurosurgeons, researchers and allied health professionals who have a practice that focuses on spinal deformity.

Candidate Fellowship (membership) is open to orthopaedic surgeons, neurosurgeons and to researchers in all geographic locations who are willing to commit to a clinical practice which includes at least 20% spinal deformity. Candidate Fellows stay in that category for three- five years, during which time they must demonstrate their interest in spinal deformity and in the goals of the Scoliosis Research Society. Candidate Fellows may serve on SRS committees. After a minimum three years, those who complete all requirements are eligible to apply for Active Fellowship in the Society. Candidate Fellowship does not include the right to vote or hold office.

Active Fellowship (membership) requires the applicant to have fulfilled a minimum three year Candidate Fellowship and have a practice that is 20% or more in spinal deformity. Only Active Fellows may vote and hold elected offices within the Society.

Associate Fellowship (membership) is for distinguished members of the medical profession including nurses, physician assistants, as well as orthopaedic surgeons, neurosurgeons, scientists, engineers and specialists who have made a significant contribution to scoliosis or related spinal deformities who do not wish to assume the full responsibilities of Active Fellowship. Associate Fellows may not vote or hold office, but may serve on committees.

Visit www.srs.org/membership for membership requirement details.

Programs and Activities

SRS is focused primarily on education and research that include the Annual Meeting, the International Meeting on Advanced Spine Techniques (IMAST), Worldwide Conferences, and the Research Education Outreach (REO) Fund which provides grants for spine deformity research, and development of patient education materials.

Website Information

For the latest information on SRS meetings, programs, activities, and membership please visit www.srs.org. The SRS Website Committee works to ensure that the website information is accurate, accessible, and tailored for target audiences. Site content is varied and frequently uses graphics to stimulate ideas and interest. Content categories include information for medical professionals, patients/public, and SRS members. For more information, please visit the SRS website at www.srs.org.

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MEETING OUTLINE

Thursday, February 5, 2026		
17:00-19:30	Registration Open	Argos D Foyer
17:00-19:30	Speaker Ready Room Open	Kusu
Friday, February 6, 2026		
07:00 - 17:30	Registration Open	Argos D Foyer
07:00 - 17:00	Speaker Ready Room Open	Kusu
07:30 - 18:45	Exhibit Hall Open	Argos EF
08:00 - 09:00	Abstract Session 1: Award Nominated Presentations	Argos D
09:00 - 09:30	Exhibit Viewing and Refreshment Break	Argos EF
09:30 - 10:30	Abstract Session 2: Adolescent Idiopathic Scoliosis	Argos D
10:30 - 10:40	Exhibit Viewing	Argos EF
10:40 - 12:35	Education Session 1: Adolescent Idiopathic Scoliosis: From Natural History to Advanced Treatment Strategies	Argos D
12:35 - 12:50	Lunch Pick-Up	Argos EF
12:50 - 13:50	Industry Workshops: 1. DePuy Synthes 2. Globus Medical 3. Medtronic	 Navis A Navis B Argos C
13:50 - 14:20	Exhibit Viewing and Refreshment Break	Argos EF
14:20 - 16:50	Abstract Session 3: “Best of” Session	Argos D
16:50 - 18:45	Welcome Reception, Networking & Exhibit Viewing	Argos EF
Saturday, February 7, 2026		
06:30 - 17:00	Registration Open	Argos D Foyer
07:00 - 16:30	Speaker Ready Room Open	Kusu
07:30 - 16:00	Exhibit Hall Open	Argos EF
07:00 - 07:50	Industry Workshops: 1. Highridge Medical 2. Smile Curve	 Argos C Navis B
08:00 - 09:00	Session 4: Adult Spinal Deformity	Argos D
09:00 - 09:30	Exhibit Viewing and Refreshment Break	Argos EF
09:30 - 10:25	Session 5: Adult & Cervical Deformity, and Kyphosis	Argos D
10:25 - 10:40	Exhibit Viewing	Argos EF
10:40 - 12:35	Education Session 2: Adult Spinal Deformity: Optimizing Surgical Strategies and Long-Term Outcomes	Argos D
12:35 - 12:50	Lunch Pick-Up	Argos EF
12:50 - 13:50	Industry Workshop: 1. ATEC Spine	 Argos C
13:50 - 14:20	Exhibit Viewing and Refreshment Break	Argos EF
14:20 - 15:35	Abstract Session 6: Basic Science, Cervical Deformity, Neuromuscular/Syndromic Deformity & Early Onset Scoliosis	Argos D
15:35 - 15:50	Exhibit Viewing	Argos EF
15:50 - 17:05	Abstract Session 7: Miscellaneous	Argos D