THE 7TH INTERNATIONAL MIST MEETING IN MUMBAI

July 10th, 2025, 12:30-17:50
Taj Mahal Hotel, Mumbai, India

Language: English

President:
Yoshihisa Kotani
Wakakusa Daiichi Hospital,
Kansai Medical University

Vice president:
Yukihiro Nakagawa
Wakayama medical university
kihoku hospital.

JAPAN MIST president:
Takashi Tomita
Aomori prefectural central hospital.

Program & Abstract

7th International MIST headquarter
Japan MIST office: mist-secretary@umin.ac.jp
SMISS AP office: mf225@jp-connect.com

General Information

Date & Time
Thursday, July 10th 2025. 12:30- 17:50

Venue
Taj Mahal Hotel Mumbai, Hall C

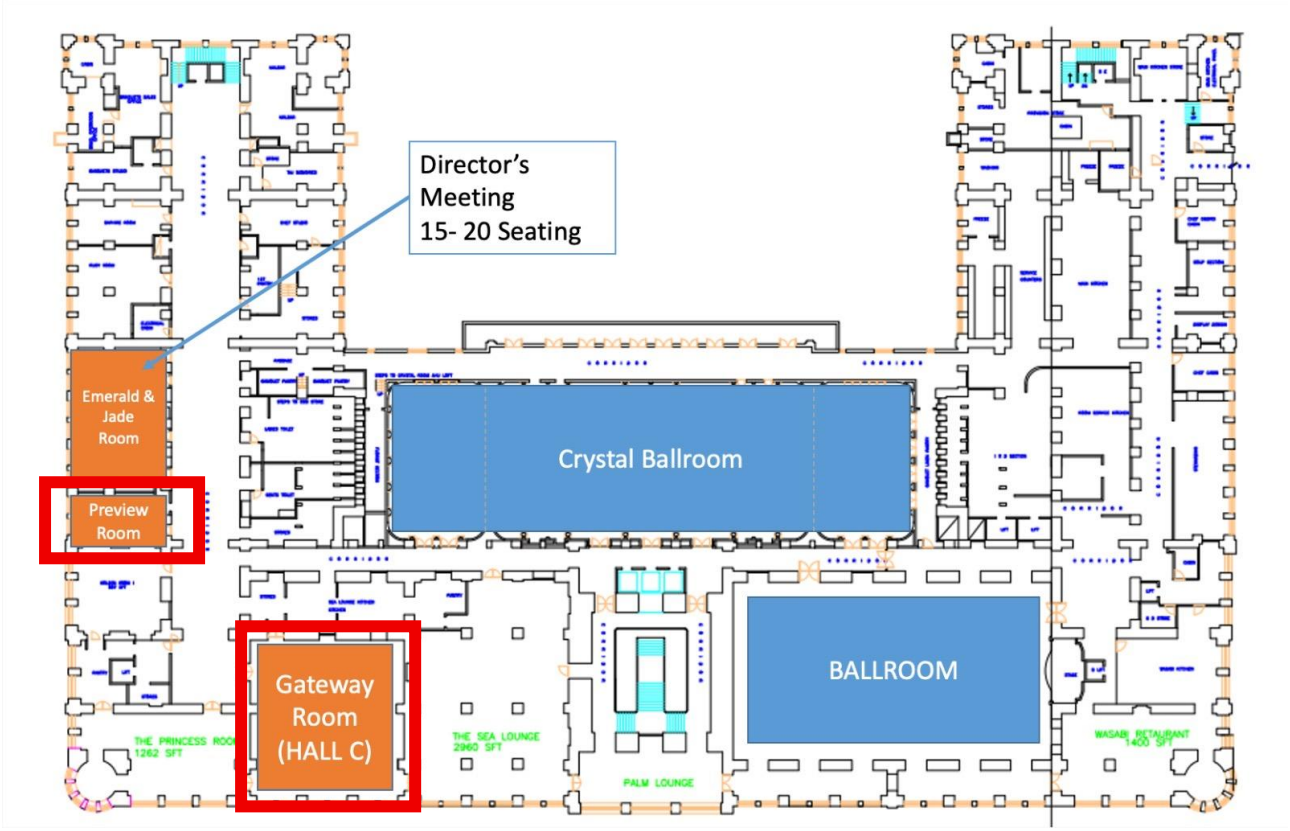
Official Language
English

Dress Code
Island Casual
No jackets or ties are required both during the sessions.

Registration
Registration fee is free and open to all.

Lunch & Welcome reception (SMISS AP)
Compimentary meals will be served at the luncheon seminar.
You can also join the SMISS AP welcome reception on same day at 7 p.m.

Presentation
- Presentation Preview is imperative for every presenter.
- Speaker ready room is designated for uploading the presentations.
- Presenters should come to Speaker ready room at least 30 minutes prior to the scheduled presentation time for presentation preview.
- Presenters will need to bring USB for their presentation.
- If you are a presenter using your own laptop, please make sure you have brought the AC adapter of your laptop. If your AC adapter does not match this power voltage, you will have to bring a voltage inverter with you.
- Do not run over your allotted time.
- The session moderators will facilitate the discussion.
- If you exceed more than one minute of allotted presentation time, the moderator will automatically stop your presentation.
- Presenters will have to operate their slides by themselves during the presentation.
- When presenting, please speak slowly and clearly so as to make your presentation better understood.
- Be sure to come early to your session. You, or one of your co-authors, MUST be present during the start of the session.


Director's
Meeting
15- 20 Seating
Emerald &
Jade
Room
Preview
Room
Crystal Ballroom
Gateway
Room
(HALL C)
BALLROOM
THE PRINCESS ROOM
1262 SFT
THE SEA LOUNGE
2960 SFT
PALM LOUNGE
WASABI RETAURANT
1400 SFT

Agenda

12:30-13:00

Luncheon seminar

Moderator: Takashi Tomita (Japan)

LS **"You Can Teach an Old Dog New Tricks: Evolving Skills in Minimally Invasive Spine Surgery"**

Kartik Kailash (India)

13:00-13:05

Opening Remarks

Yoshihisa Kotani (Japan)

13:05-14:00

Session 1, Endoscopy

(10 minutes presentation and 15 minutes whole discussion)

Moderators: Jacob Oh (Singapore), Kartik Kailash (India)

S1 **"Clinical outcomes of unilateral biportal endoscopy in lumbar disc herniation and degenerative lumbar canal stenosis– A retrospective observational study"**

Chandrashekhar Vijay Gaike (India)

S2 **"Microendoscopic Lumbar Interbody Fusion (MELIF)"**

Yukihiro Nakagawa (Japan)

S3 **"Alignment Correction in Double Cages Biportal Endo-LIF"**

Jwo-Luen Pao (Taiwan)

S4 **"Comparison of Early Clinical and Radiological Outcomes Between Total Percutaneous Posterolateral Trans-Kambin Lumbar Interbody Fusion (KLIF) and Minimally Invasive Transforaminal Lumbar Interbody Fusion (MIS-TLIF)"**

Niraj Vasavada (India)

Agenda

14:00-14:55

Session2, MIS innovative

(10 minutes presentation and 15 minutes whole discussion)

Moderators: John Choi (Australia), Niraj Vasavada (India)

S5 **"Prone Lateral Surgery: Tips, Tricks and applications"**

Reuben Soh (Singapore)

S6 **"Feasibility of indirect decompression and when direct decompression is necessary?"**

Worawat Limthongkul (Thailand)

S7 **"Minimally Invasive Surgical Management of Spinal Dural Arteriovenous Fistulas"**

Mitchell Hansen (Australia)

S8 **"Percutaneous Vertebral Body Stenting in AO DGOU OF3 and OF4 fractures"**

Kim Soon Oh (Malaysia)

14:55-15:20

Break Time

15:20-16:00

Free paper 1

(5 minutes presentation and 3 minutes Q&A)

Moderators: Worawat Limthongkul (Thailand), Yukihiro Nakagawa (Japan)

FP1-1 **"Prospective study to compare the outcomes ACDF vs posterior endoscopic cervical foraminotomy in surgical management of compressive unilateral cervical radiculopathy"**

Shubham Kadam (India)

FP1-2 **"Early reoperation within 30 days after microendoscopic laminectomy does not affect patient satisfaction and outcomes"**

Yuta Urabe (Japan)

FP1-3 **"Navigation-assisted unilateral biportal endoscopic extra foraminal lumbar inter body fusion (UBE/BESS-ELIF)"**

Kenyu Ito (Japan)

Agenda

FP1-4 **"Prospective comparative study TO assess the clinico-radiological adequacy of cord decompression after navigated vs non-navigated laminectomy in cervical spondylotic myelopathy"**

Shubham Kadam (India)

FP1-5 **"ERAS Protocols in MIS surgery– narrative review & suggestion for a protocol for Indians"**

Devesh Dholakia (India)

16:00-16:40

Free paper 2

(5 minutes presentation and 3 minutes Q&A)

Moderators: Wongthawat Liawrungrueang (Thailand), Reuben Soh (Singapore)

FP2-1 **"Managing lumbar adjacent segment disease (ASD) using minimally invasive techniques (MIS): An analysis of posterior surgical techniques"**

Meet Shah (India)

FP2-2 **"Integration and application of Artificial intelligence and Surface Topography in scoliosis screening"**

Rohan Shanker Tiwari (India)

FP2-3 **"Are We Compromising Biology/Fusion for Hardware. Helping you to make the right biologic choices"**

Devesh Dholakia (India)

FP2-4 **"The thoracic kyphosis with little degeneration can be improved by correcting the lumbar alignment"**

Masanari Ogino (Japan)

FP2-5 **"Revisiting the Efficacy of Staged- Surgeries in Adult Spinal Deformity: A Comparative Analysis with Single-Stage Surgery"**

Koki Kawashima (Japan)

Agenda

16:40-16:50

Break Time

16:50-17:45

Session3, MIS Innovative 2

(10 minutes presentation and 15 minutes whole discussion)

Moderators: Wenjian Wu (China), Masato Tanaka (Japan)

S9 **"Application of OLIF51 for adult spinal deformity. Advantage and Pitfall"**
Yoshihisa Kotani (Japan)

S10 **"Technique of anterior lumbar interbody fusion and lumbar disc replacement"**
Philip Cheung (Hong Kong)

S11 **"Feasibility of short segment cMIS fusion for adult degenerative scoliosis"**
Wenjian Wu (China)

S12 **"Utility and surgical tips of minimally invasive PSO for adult spinal deformity"**
Masayuki Ishihara (Japan)

17:45-

Closing Remarks

Yukihiro Nakagawa (Japan)

Abstract

Luncheon Seminar

LS ***"You Can Teach an Old Dog New Tricks: Evolving Skills in Minimally Invasive Spine Surgery"***

Karthik Kailash
Prof and Head of Spine Surgery Sri Ramachandra University
President MISSAB India
Founder President Chennai Ortho Spine Society India

The adage "You can't teach an old dog new tricks" suggests that adaptability wanes with age. However, in the realm of minimally invasive spine surgery (MISS) and endoscopic spine surgery (ESS), seasoned practitioners are not only adopting new methods—they're thriving with them. From embracing endoscopic visualization to mastering novel instrumentation and surgical navigation, experienced spine surgeons are proving that lifelong learning is both possible and essential. This document explores the intersection of experience and innovation, illustrating how structured training, emerging technologies, and professional curiosity enable surgeons to remain leaders in their field regardless of age.

"You Can't Teach an Old Dog New Tricks—Can You? Rethinking Skill Acquisition in Minimally Invasive and Endoscopic Spine Surgery"

The adage "You can't teach an old dog new tricks" has long implied limitations in adaptability with age or experience. Yet, the evolution of minimally invasive spine surgery (MISS) and endoscopic spine surgery (ESS) challenges this notion, offering a compelling counter-narrative within the surgical community. As these techniques demand new hand-eye coordination, instrumentation familiarity, and visualization strategies, seasoned spine surgeons—often trained in traditional open procedures—are increasingly mastering these modern approaches. This abstract explores the transformative potential of adopting MISS and ESS techniques later in one's surgical career, drawing on case examples and training paradigms that support lifelong learning. Technological advancements, immersive simulation, and structured proctorship have become catalysts for skill acquisition, even for those with decades of conventional practice. Rather than being impediments, age and experience often enrich the learning process, enabling more nuanced decision-making and refined technique integration. This discussion reframes the surgical learning curve, reinforcing that professional growth is not bounded by age but fueled by curiosity, adaptability, and access to the right tools. In spine surgery, the future belongs not just to the young, but to the willing.

Abstracts

Symposium

S1 ***"Clinical outcomes of unilateral biportal endoscopy in lumbar disc herniation and degenerative lumbar canal stenosis– A retrospective observational study"***

Chandrashekhar Vijay Gaike
Consultant Endoscopic and minimal Access Spine Surgeon
Associate Professor (Orthopedics),
M.G.M. Medical college and Hospital
Chhatrapati Sambhajinagar- Maharashtra, India

Context:
Unilateral biportal endoscopy(UBE) is a rapidly growing surgical method that uses the arthroscopic system for the treatment of various spinal disorders.

Aim:
This study is aimed to assess the clinical outcomes in patients operated with UBE for lumbar disc herniation (LDH) and degenerative lumbar canal stenosis(DLCS) at our centre.

Materials and methods:
The subjects consisted of 50 patients within age 40-70years, who underwent Unilateral biportal endoscopy for LDH and DLCS, and were analysed retrospectively. Outcomes of the patients were assessed with operation time, hospital stay, complications, visual analogue scale (VAS) for back and leg pain, and the Oswestry disability index (ODI).

Statistical analysis:
Mean and SD were calculated for quantitative variables and proportions were calculated for categorical variables. Paired t-test was applied to check the significance difference between pre and post-treatment. P- Value of <0.05 was considered statistically significant.

Results:
The average operative time for the procedure was 70 – 90 minutes. The average hospital stay was two days. The VAS score for back pain, leg pain and ODI scores had significantly reduced at the six month follow up period. In patients with DLCS, all the patients could walk comfortably to over two kilometre at six months follow-up. Recurrence of symptoms was seen in one patient of LDH. However, no intra operative or post operative complication was noted. No surgical site infection was encountered.

Conclusion:
UBE for the treatment of degenerative lumbar diseases is a safe, effective and ergonomically comfortable surgical technique under the clear and wide endoscopic view. Segmental stability could be preserved since it allowed over-the-top decompression easily without the removal of the spinous process & spinous ligaments. However, large scale comparative studies will be needed to assess the difference in clinical outcomes and infection rates with other procedures.

S2 ***"Microendoscopic Lumbar Interbody Fusion (MELIF)"***

Yukihiro Nakagawa
Professor,
Department of Orthopaedic Surgery, Wakayama Medical University Kihoku Hospital
Wakayama, Japan,

TLIF was first described by Harm et al. in 1982. Since then, TLIF has evolved into a more minimally invasive procedure, known as MIS TLIF, and more recently, it has progressed to Endoscopic TLIF. Spinal endoscopy is categorized into the full endoscopic system and the endoscopy-assisted system. This time, we will introduce microendoscopic lumbar interbody fusion (MELIF), which utilizes the microendoscopic system, one of the endoscopy-assisted procedures. MELIF has distinct characteristics that set it apart from other endoscopic procedures. MELIF use a tubular retractor with spinal endoscopy. This technique involves cage insertion via enlarged Kambin's triangle, so there is no possibility of serious complications like those seen in lateral procedures. Additionally, this procedure can be completed in a single position and, indirect decompression effects can be expected. Therefore, the surgical indication is generally limited to cases that do not require direct decompression. However, direct decompression is also possible if necessary. MELIF allows for the placement of a boomerang-shaped expandable cage in the anterior position, which is advantageous for restoring lumbar lordosis. Additionally, it can be easily applied to multi-level fusion surgeries. Therefore, it is the optimal approach not only for primary surgeries but also for spinal fusion in patients who have previously undergone decompression surgery. A potential issue is that achieving adequate discectomy and endplate preparation can be challenging. However, there are no concerns regarding bone fusion. Additionally, since the procedure is performed using the trans Kambin approach, there is a concern for exiting nerve injury. However, by monitoring the nerve roots with MEP (motor evoked potentials), we can prevent such injuries before they occur. As a result, to date, we have not encountered any cases of exiting nerve root injury. In this presentation, we will explain the MELIF surgical technique step by step. Moreover, we will present actual cases to discuss the advantages and disadvantages of MELIF, as well as its future prospects.

S3 ***"Alignment Correction in Double Cages Biportal Endo-LIF"***

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

Biportal endoscopic lumbar interbody fusion (biportal endo-LIF) is a novel minimally invasive spine fusion technique performed via two minor skin incisions. The surgical wounds are about 2.5 cm for a one-segment fusion and 4 cm for a two-segment fusion. With the hydrostatic pressure of the saline and high-resolution endoscope, we can perform very delicate surgery in a crystal clear and magnified surgical field with almost no bleeding. Adequate neural decompression can be safely accomplished with a low risk of dural or nerve root injury. The diameter of the endoscope is only 6 mm, so we can advance it into the disc space to visualize radical resection of the degenerative disc and cartilage endplate while preserving the bony endplate. The sturdy endplate reduces the incidence of cage subsidence and provides robust initial stability. Our double-cage technique uses two interbody fusion cages to effectively increase the cage footprint and a large amount of bone graft to promote fusion. Reduction of the spondylolisthesis can also be achieved using the modern pedicle screws system.

From 2019 to 2024, we performed more than 350 biportal endo-LIF cases. The clinical data, including ODI, JOA, and VAS scores, showed significant improvement with a very low incidence of complications. In our computed tomography (CT) study 1 year after the surgery, the successful fusion rate was as high as 93.3%, with a cage subsidence rate of only 5.5%

Biportal endo-LIF is a safe, effective, and revolutionary MIS solution for spinal fusion. Its advantages include magnificent surgical fields, direct decompression, minimum blood loss, radical discectomy and endplate preparation under direct visual, bone grafts and cage insertion under direct visual, excellent treatment results with a fantastic fusion rate, and few complications.

This presentation will demonstrate how we use the double-cage biportal endo-LIF technique to correct the sagittal and coronal plane malalignment, focusing on pre-operative planning, intra-operative adjustment, and unique surgical techniques for sequential insertion of the double cages.

S4 ***"Comparison of Early Clinical and Radiological Outcomes Between Total Percutaneous Posterolateral Trans-Kambin Lumbar Interbody Fusion (KLIF) and Minimally Invasive Transforaminal Lumbar Interbody Fusion (MIS-TLIF)"***

Niraj Vasavada
MBBS, MS (ortho) (University first)
Fellowship in Minimally Invasive & Endoscopic spine surgery
Senior Consultant Spine Surgeon, Zydus Hospitals, Ahmedabad
Ass. Vice President, Spine Association of Gujarat, Faculty Member, SMISS-AP, Faculty, AO spine (SIN), Ex EC Member, MISSAB, Committee Member, ASSI
India

A**im:** To compare early (3-month) clinical and radiological outcomes between percutaneous posterolateral trans-Kambin lumbar interbody fusion (KLIF) and minimally invasive transforaminal lumbar interbody fusion (MIS-TLIF).

Materials and Methods: We prospectively evaluated all patients who underwent KLIF or MIS-TLIF between April 2024 and August 2024. The cohort included patients with symptomatic Schizas grade B and C lumbar canal stenosis with instability, degenerative deformity, or lytic listhesis who had failed adequate conservative management. Radiological parameters assessed included pre- and post-operative disc height, foraminal height, segmental lordosis, and global lumbar lordosis, with each fusion level analyzed individually in multi-level procedures. Clinical parameters included pre- and post-operative Visual Analog Scale (VAS) scores for back and leg pain at 2 hours, 4 hours, 15 days, 1 month, and 3 months, as well as Oswestry Disability Index (ODI) scores at 15 days, 1 month, and 3 months. Subgroup comparisons were performed for single-level versus multi-level fusions. All patients followed a standardized mobilization protocol starting 4 hours post-surgery. Additional intra-operative metrics, such as estimated blood loss and surgical duration, and any adverse events were recorded. A 3-month timeframe was chosen to assess early outcomes.

Statistical Analysis: Categorical variables were analyzed using the chi-squared test. Continuous variables were assessed using Student's t-test for parametric data and the Mann-Whitney U test for non-parametric data. Data normality was evaluated through skewness, kurtosis, and the Shapiro-Wilk test. Statistical analysis was performed using JASP 0.18 (University of Amsterdam).

Results: Forty-five patients (median age: 62 years; 26 females, 19 males) underwent surgery: 20 patients (16 females, 4 males) underwent KLIF (45 levels), while 25 patients (15 females, 10 males) underwent MIS-TLIF (31 levels). There was no significant difference in age ($p = 0.557$), although the KLIF group had a significantly higher proportion of females ($p = 0.036$). Intra-operative parameters, including estimated blood loss ($p = 0.870$), mobilization time post-surgery ($p = 0.557$), and surgical duration ($p = 0.772$), were comparable between groups. No significant differences were observed in VAS scores for back or leg pain at any time point ($p = 0.533$, 0.333, 0.198, 0.544, and 0.188, respectively) or ODI scores at 15 days, 1 month, and 3 months ($p = 0.468$, 0.076, and 0.298). Radiological parameters, including changes in disc height, foraminal height, segmental lordosis, and global lordosis, were also comparable ($p = 0.453$, 0.400, 0.464, and 0.568). No significant intra-operative or early post-operative adverse even was recorded in either groups.

Conclusion: Early post-surgical outcomes for KLIF were comparable to those of MIS-TLIF in terms of clinical and radiological parameters, with both techniques demonstrating safety. Longer follow-up and larger sample sizes are required to validate these early findings.

S5 ***"Prone Lateral Surgery: Tips, Tricks and applications"***

Reuben Soh
Singapore General Hospital
Singapore

Prone lateral spine surgery combines the benefits of the lateral approach with the stability of the prone position, offering an innovative solution for spinal deformity correction and degenerative disc disease. Benefits over the traditional lateral surgery would be that the patient is positioned prone, allowing for improved lordosis restoration, reduced operative time, and enhanced surgical outcomes.

One of the main benefits include simultaneous access for posterior instrumentation without repositioning. It is particularly useful in treating conditions such as adjacent segment disease, revision surgery and degenerative scoliosis where both anterior column support and posterior fixation are required.

It is important to recognise that gravity is the main force that is working against the surgeon. This places risk of anterior longitudinal ligament injury, which can occur due to retractor migration. This talk will address tips to prevent retractor movement

In conclusion, prone lateral spine surgery represents a significant advancement in lateral access minimally invasive surgery and offers a versatile and effective option for complex spinal pathologies.

S6 ***"Feasibility of indirect decompression and when direct decompression is necessary?"***

Worawat Limthongkul
Associate Professor of Orthopaedics,
Department of Orthopaedics, Faculty of Medicine, Chulalongkorn University
Director of Center of Excellence in Biomechanics and Innovative Spine Surgery,
Chulalongkorn University
Bangkok, Thailand

The Oblique Lumbar Interbody Fusion (OLIF) technique is increasingly recognized as an effective minimally invasive option for treating various spinal pathologies, particularly degenerative disc disease. One of the distinctive features of OLIF is the ability to achieve indirect decompression of neural structures through restoration of vertebral alignment and disc height, without direct manipulation of the nerve roots. This abstract aims to explore the feasibility of indirect decompression in OLIF surgery and identify scenarios where direct decompression may still be necessary.

Indirect decompression during OLIF is primarily achieved by inserting interbody cages, which restore disc height and indirectly widen the neural foramina, thus reducing nerve root compression. This approach offers several advantages, including preservation of nerve structures, reduced surgical morbidity, and quicker recovery times when compared to traditional direct decompression techniques. For many patients with mild to moderate degenerative spinal conditions or foraminal stenosis, indirect decompression through OLIF can effectively relieve symptoms such as radiculopathy and lower back pain. The technique's minimally invasive nature further contributes to reduced blood loss, shorter hospital stays, and faster rehabilitation.

However, while indirect decompression is highly effective in certain cases, there are clinical situations where direct decompression remains necessary. In cases of severe central canal stenosis, significant nerve root impingement, or large herniated discs, the direct removal of tissue or bone may be required to achieve optimal decompression and symptom relief. Furthermore, patients with significant degenerative changes or complex spinal deformities may not benefit fully from indirect decompression alone, necessitating a more aggressive approach with direct decompression techniques.

The decision between indirect and direct decompression in OLIF surgery is influenced by various factors, including the severity of the spinal pathology, the presence of spinal instability, and the specific anatomical characteristics of the patient. In cases where indirect decompression is inadequate, the surgeon may need to consider additional procedures, such as posterior decompression or laminectomy, to address more complex neural compression.

In conclusion, indirect decompression via OLIF surgery is a feasible and effective approach for many patients with spinal degenerative conditions. However, careful patient selection is crucial, and direct decompression may be necessary in cases with more advanced or complex spinal pathologies. A tailored, patient-specific approach is key to optimizing outcomes in OLIF surgery.

S7 ***"Minimally Invasive Surgical Management of Spinal Dural Arteriovenous Fistulas"***

Mitchell Hansen
A/Professor
BSc MBBS Grad Dip Sc PhD FRACS
Conjoint Associate Professor, School of Medicine and Public Health, University of Newcastle
Director of Neurosurgery, Newcastle Private Hospital
Neurosurgeon and Spine surgeon
Australia

Objective:

Spinal dural arteriovenous fistulas (SDAVFs) are rare vascular malformations that constitute a significant cause of myelopathy. Traditional open surgical approaches for the treatment of SDAVFs can be associated with considerable morbidity. The advent of minimally invasive spine surgery (MISS) techniques, including the use of tubular retractors, has the potential to reduce surgical morbidity while allowing for effective lesion obliteration. This study outlines the treatment of SDAVFs using a minimally invasive approach with tubular retractors.

Methods:

The minimally invasive approach involved a foraminotomy using tubular retractors, followed by microsurgical dissection and obliteration of the fistula.

Conclusion:

The use of tubular retractors for the surgical treatment of SDAVFs is a safe and effective minimally invasive technique that allows for direct visualization and obliteration of the fistula with minimal disruption of surrounding tissues. This approach is associated with high rates of fistula closure, significant improvement in neurological function, and a low complication profile. Minimal invasive surgery with tubular retractors could be considered a viable alternative to traditional open surgery for the management of SDAVFs. Further prospective studies are warranted to validate these results and potentially establish new standards of care for SDAVF treatment.

S8 ***"Percutaneous Vertebral Body Stenting in AO DGOU OF3 and OF4 fractures"***

Kim-Soon Oh
Consultant Orthopaedic & Spine Surgeon
Island Hospital, Penang
Adjunct Clinical Professor
M Kandiah Faculty of Medicine & Health Sciences, UTAR Hospital
Kampar, Malaysia

Myriad techniques have been described to manage osteoporotic vertebral fractures. To address the disadvantages and complications of conventional vertebral augmentation, vertebral body stenting (VBS) incorporates a cobalt-chromium expandable stent that (1) creates a cavity thus reduces filling pressures and diminishes the possibility of cement leakages (2) resists the loss of height correction seen with balloon kyphoplasty (3) tamps the intra-corporeal cancellous bone to the periphery, strengthening the fragile cortices (4) prevents cement overfilling which may compromise endplate vascularity and (5) avoids large mismatches in stiffness relative to the adjacent level. We looked at our retrospective observational audit on 64 adult elderly patients who suffered 86 levels of osteoporotic vertebral lumbar and thoracic fractures of AO-DGOU-OF 3 and 4 severities between Dec 2019 and Nov 2024. We chose acute fractures of three weeks or less and stented these lesions. All patients had spine T-scores equal to or worse than -2.5. We excluded multiple contiguous lesions exceeding two levels in number, infections and malignancies. We tabulated the parameters of pain relief via the Oswestry Disability Index (ODI), vertebral body height correction and the presence of any complications. Three patients defaulted follow-up.

Results:
Fifty seven patients experienced pain relief within one week (ODI < 20, binomial test $p < 0.0003$) not requiring further NSAIDs or opiates. Vertebral height restoration was 3.7mm +/- 2.1 anteriorly and 2.2 mm +/- 1.7 centrally (Mann Whitney U test $p > 0.72$). Eleven stents leaked anteriorly and laterally without any clinically significance. Two stents failed to deploy and one migrated to the pedicle-corpus line. None developed adjacent segment fracture. By 4 weeks, all had returned to their pre-morbid level of physical activity and comfort. The widespread adoption of VBS is stymied by the apparent lack of full vertebral height restoration and by unsatisfactory stent deployment in situations of mixed sclerotic-lytic bone injury, improper stent placement and unsuitable selection of cases where chronicity had caused early malunion. There is a lack of published consensus on insertional angle and trajectory, and on the actual amount of cement sufficient for each different level. By recognizing possible pitfalls in technique and case selection, percutaneous vertebral body stenting in our series has been adequate in treating AO-DGOU OF3 and selected OF4 fractures.

S9 ***"Application of OLIF51 for adult spinal deformity. Advantage and Pitfall"***

Yoshihisa Kotani
Department of Orthopedic Surgery, Wakakusa Daiichi Hospital,
Kansai Medical University
Osaka Japan

The introduction of OLIF51 for ASD aims at achieving an ideal lumbosacral correction as well as minimizing surgical invasiveness.

We retrospectively analyzed 133 patients with the minimum follow-up period of one year comparing L5/S1 TLIF and OLIF51. The OLIF51 significantly decreased the operation time and estimated blood loss compared to 51 TLIF. The follow-up PI-LL mismatch was decreased from 9.1 degree (51TLIF) to 2.7 degrees (OLIF51) significantly. The follow-up LLL and segmental 51 lordosis were significantly better in OLIF51. There were no neurovascular injuries and PJK decreased from 14% to 6% (51TLIF vs OLIF51).

According to the complication survey of our ten-year experience, there were 1.6% of vascular injury, 0.5% of ileus, and 0% of retrograde ejaculation and visceral damage. Three cases of vascular damage were all micro-hole injury of left CIV, repaired by Tachosil sheet without the support of vascular surgeon. These complication rates were significantly lower than the data reported in systematic review of 5728 ALIFs by Feeley, 2022.The study reported 3.1% of vascular injury, 2% of retrograde ejaculation, 5% of ileus, and 0.37% of visceral damage.

The circumferential MIS correction with OLIF51 serve as an effective surgical modality which can be applied to many cases of adult spinal deformity with minimum complication rates.

S10 ***"Technique of anterior lumbar interbody fusion and lumbar disc replacement"***

Philip Cheung
813 Medical Centre
Hong Kong

S11 ***"Feasibility of short segment cMIS fusion for adult degenerative scoliosis"***

Wenjian Wu, Qiang Zhang, Yazhou Lin, Zhe Chen, Peng Cao, Jianru Qiu, Yu Liang
Department of Orthopedic,
Shanghai Ruijin Hospital, Shanghai Jiaotong University School of Medicine
Shanghai, China

The surgical management of adult degenerative scoliosis (ADS) has traditionally emphasized long-segment fusion to ensure spinal stability and alignment. However, the advent of short-segment fusion techniques has introduced potential advantages such as preserved spinal mobility, reduced operative trauma, making it a viable option for certain deformities. Despite these benefits, concerns persist regarding the efficacy of short-segment fusion in achieving adequate deformity correction, preventing deformity progression, and minimizing junctional complications.

This study presents a retrospective analysis of 23 ADS patients who underwent staged circumferential minimally invasive (cMIS) short fusion. All patients were followed for a minimum of two years. We evaluated surgical procedures, radiographic parameters, and the Oswestry Disability Index (ODI) pre- and post-surgery. Significant improvements were observed in Cobb angle, sagittal vertical axis (SVA), pelvic incidence (PI) minus lumbar lordosis (LL), and ODI, which were maintained at follow-up. Proximal junctional kyphosis occurred in 3 cases (13.0%), none of which required re-operation.

Our findings suggest that for carefully selected cases, short cMIS fusion can effectively correct deformities and improve quality of life in ADS patients. We recommend staged MIS surgery to optimize the fixation range and reduce postoperative complications. This approach not only enhances surgical outcomes but also aligns with the goals of minimizing patient morbidity and maximizing functional recovery. Further studies are warranted to refine patient selection criteria and to assess long-term outcomes of this surgical strategy.

S12 ***"Utility and surgical tips of minimally invasive PSO for adult spinal deformity"***

Masayuki Ishihara,
Masaaki Paku, Takashi Adachi, Yoichi Tani, Koki Kawashima, Shinichirou Taniguchi, Takanori Saito
Dept. of Orthop. Surg, Kansai Medial Univ.
Osaka, Japan

(Introduction)
While three column osteotomy (3CO) for adult spinal deformity (ASD) has a strong corrective force, the invasiveness of the surgery has been a problem. We have also perfomed MIS-PSO to reduce the surgical invasiveness of PSO. In this study, we will introduce the usefulness of this technique and the tips of the surgical technique.

(Subjects and Methods)
This study included 9 patients with ASD (3 males and 6 females, average age 73.5 years) who underwent MIS-PSO by the same surgeon.

(Surgical technique)
After inserting a PPS guide wire, a 2-level PCO, laminectomy and pedicle island were created using a midline mini-open approach, and after drilling into the vertebral body using the air drill, the cancellous bone was thoroughly removed using a shaver and chisel to create an egg-shell shape, and finally the cortical bone was removed in a wedge shape using the air drill. After ensuring sufficient flexibility, the PPS was inserted, and then the optimal contour rod was inserted and installed. The items examined were spinal disorders, blood loss, operative time, number of fixed vertebrae, osteotomized vertebrae, operation stage, various parameters, local lordotic angle, and complications.

(Results)
The original spinal disorders was iatrogenic kyphosis in 7 cases, spontaneous bone fusion in 3 cases due to malalignment, blood loss 465 ml, operative time 245 minutes. Four cases were operated on in two stages, and five cases were operated on in one stage. The local lordosis improved from -3° to 28.5°, LL from 10° to 46°, PT from 32° to 19°, and PI-LL from 35° to 4°. The ODI also improved significantly after surgery. (Discussion/ Conclusion) There are two common methods for performing 3CO: the egg shell method and the chisel method. In the case of the chisel method, the amount of bleeding increases when the vertebral side wall is exposed and when the bone is cut with the chisel, but in this technique, vertebral exposure is not performed except for the bone cutting area, and since lateral dissection is also not performed, a reduction in the amount of bleeding is achieved. This technique also makes 3CO less invasive, and further dissemination is expected.

Abstracts

Free Paper

FP1-1 ***"Prospective study to compare the outcomes ACDF vs posterior endoscopic cervical foraminotomy in surgical management of compressive unilateral cervical radiculopathy"***

Shubham Kadam
India

Introduction-

Unilateral cervical radiculopathy results due to the compression of a soft or hard disc on the cervical root. ACDF is the gold standard of cervical fusion surgeries. Posterior endoscopic cervical foraminotomy (PECF) is emerging as a minimally invasive approach to unilateral cervical radiculopathy nor responding to medical management.

Material and Methods-

Patients with compressive unilateral cervical radiculopathy treated with both ACDF and PECF were included in the study. Pre op and post op VAS, ODI scores, Macnab scores and return to work in days after surgery was used to compare the functional outcomes between the two groups.

Results –

64 patients were included in the outcome analysis. Both the techniques showed comparable improvement in VAS and ODI scores in post operative follow up period. Macnab score was significantly better for PECF group suggestive better patients' satisfaction with endoscopic approach. Return to work after surgery was significantly early with the PECF group at 10.5 days compared to 22.76 days in ACDF patients.

Conclusion-

Both ACDF and posterior endoscopic cervical foraminotomy can result in good clinical outcomes in patients of compressive unilateral cervical radiculopathy. Use of endoscopic cervical foraminotomy can result in better patients' satisfaction and early return to work.

FP1-2 ***"Early reoperation within 30 days after microendoscopic laminectomy does not affect patient satisfaction and outcomes"***

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Background and Purpose:
Microendscopic laminectomy (MEL), one of the MIST procedure, is widely used for lumbar spinal stenosis. However, some patients may require early reoperation due to postoperative complications. The purpose of this study is to evaluate whether reoperation following complications within 30 days after MEL impacts postoperative outcomes and patient satisfaction.

Methods:
This study included 1,682 patients who underwent MEL for lumbar spinal stenosis between 2017 and 2022, with more than one year of follow-up. Among them, 44 patients (1.9%) required reoperation within 30 days after MEL due to complications (reoperation group), while the remaining patients did not require reoperation (non-reoperation group). Propensity score matching (1:3) was applied to match for age, sex, and BMI. Preoperative and one-year postoperative assessments of Numeric Rating Scale (NRS) for back and leg pain, Oswestry Disability Index (ODI), and postoperative satisfaction (7-point Likert Scale) were compared between the two groups.

Results:
Among the 44 reoperation cases, the most common reason for reoperation was hematoma, followed by insufficient decompression, dural injury, postoperative infection, and retained drains. At the one-year follow-up, 34 reoperation patients (77.2%) and 102 non-reoperation patients were available for comparison. Preoperative NRS and ODI scores were not significantly different between the groups. Postoperative NRS scores for back and leg pain were 3.7/2.7 in the reoperation group and 2.8/2.6 in the non-reoperation group, with no significant difference between the two groups. The postoperative ODI score was 37.1 in the reoperation group and 32.8 in the non-reoperation group, also with no significant difference. Regarding satisfaction, 70.1% (24/34) of the reoperation group and 72.6% (74/102) of the non-reoperation group were satisfied with their treatment, showing no significant difference.

Discussion:
Although complications are inevitable in MEL, appropriate management can lead to similar postoperative outcomes and patient satisfaction as those observed in patients without complications.

FP1-3 ***"Navigation-assisted unilateral biportal endoscopic extra foraminal lumbar inter body fusion (UBE/BESS-ELIF)"***

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[Purpose]
In recent years, with the development of endoscopes, extraforaminal lumbar interbody fusion (ELIF) has become possible via extraforaminal approach such as Kambin's triangle. ELIF enables indirect decompression and lumbar interbody fusion without direct visualization of the dura, which is anticipated to lower the risk of dural injury and bleeding. Since 2023, ELIF has been conducted using a unilateral biportal endoscope (UBE/BESS) in our institute. We also report the application of UBE/BESS-ELIF in combination with navigation (NV).

[Method]
A UBE is inserted through the skin incision for percutaneous pedicle screw (PPS). The superior articular process is partially resected, but the inferior articular process is left intact to avoid exposure of the dura. The extraforaminal disc is accessed, and a cage is inserted at 45 degrees, guided by the axial image of NV. In cases where the intervertebral disc area is large, such as L5/S, two cages are inserted. For bone grafting, the resected superior articular process and artificial bone are transplanted. The remaining facet joint is decorticated and bone grafted.

[Results]
A total of 20 cases were analyzed (8 females and 12 males), with an average age of 57 years (range: 40-88). Eighteen cases involved a single-level procedure (L2/3: 1 case, L3/4: 1 case, L4/5: 10 cases, L5/S: 6 cases), while 2 cases involved a two-level procedure (L4-S). The average blood loss was 33.7 ml (range: 10-130 ml). The mean operative time was 188.1 minutes (range: 128-299 minutes) for non-L5/S cases and 200.0 minutes (range: 133-242 minutes) for L5/S cases. During the follow-up period, complications included one case of vertebral body fracture due to a fall and one case of cage subsidence.

[Discussion]
UBE/BESS-ELIF allows for the insertion of a large lordotic cage by resecting the superior articular process, and bone grafts are not harvested from other sites. The procedure was also performed without any exiting nerve root damage. Since this procedure is performed using water irrigation through a PPS skin incision, we anticipate a lower infection rate.

[Conclusion]
Indirect decompression using UBE/BESS-ELIF was performed without major complications. This procedure is minimally invasive and can also be applied at the L5/S level. Additionally, NV not only reduced radiation exposure for the surgeon but also facilitated the insertion of the cage in the optimal position.

FP1-4 ***"PROSPECTIVE COMPARATIVE STUDY TO ASSESS THE CLINICO-RADIOLOGICAL ADEQUACY OF CORD DECOMPRESSION AFTER NAVIGATED VS NON-NAVIGATED LAMINECTOMY IN CERVICAL SPONDYLOTIC MYELOPATHY"***

Shubham Kadam
India

Introduction-
Cervical laminectomy has traditionally been performed non navigated. Use of navigation has been used and studied mainly for accuracy in pedical screw a. Navigation based approach is likely to improve the accuracy of bony decompression while avoiding facetal breaches. Use of navigation for laminectomy is emerging technique to improve outcome in decompression surgeries.

Study Design and Material, Methods-
Cervical Spondylotic Myelopathy treated with Navigated and Non-Navigated laminectomy was included in the study and the data was compared prospectively. Preop and Postop MRI and CT scans were used to assess radiological adequacy of cord decompression with parameters like Total Area (TA), Mean Cord Compression (MCC), and Mean Spinal Cord Compression (MSCC) using Surgimap software, while mJOA and VAS score were used to assess functional outcome. Also to determine usefulness of Navigated cervical laminectomy various parameters like blood loss, operative time, facetal breach were compared.

Result-
Total 75 patients were included in the analysis. Both navigated and non-navigated procedures showed consistent improvements, with mean VAS scores decreasing from 6.16 to 3.41 and from 5.2 to 2.86, respectively. The mean pre operative mJOA improved from 12.96 to 15.09 post-operatively in Navigated laminectomy, as indicated by a P-value of 0.0001 and from 12.59 pre-operatively to 14.86 post-operatively, with a P-value of 0.0003. Both navigated and non-navigated surgeries showed significantly increased Total Area (TA) post-surgery ("<0.0001"), with no significant difference between the two. Mean Cord Compression (MCC) percentages decreased significantly ("<0.0001") in Navigated approach as compared to non-navigated one. Also, Mean Spinal Cord Compression (MSCC) percentages decreased significantly overall (P-value 0.008), primarily in navigated surgeries. Non-navigated surgeries had longer operative times (144.51 minutes) than navigated (136 minutes), with a significant difference (P-value 0.002). Navigated procedures had a lower incidence of facetal Breach (1 cases) compared to non-navigated (5 cases), with a significant difference (P-value 0.01). Navigated procedures due to limited lateral bony dissection showed lesser mean blood loss of 263.7 ml compared to non-navigated procedures having a mean of 340.9 ml.

Conclusion-
Navigated surgical approach resulted in significant improvements in Functional and Clinico-radiological parameters post-surgery as compared to non-navigated approach. Use of Navigation exhibited lower rates of complications, better patients' satisfaction, and lesser chances of future instabilities, mainly because of limited bony excision.

Keywords-

Cervical spondylotic myelopathy, Navigation, Laminectomy,

FP1-5 ***"ERAS Protocols in MIS surgery– narrative review & suggestion for a protocol for Indians"***

Devesh Dholakia, Nandini Dholakia
India

Study Design:
Review various methods to optimise anaesthesia and analgesia for MIS surgery

Objective:
To inform surgeons and anaesthesiologists of methods to provide optimal anaesthesia and pain control for minimally invasive spine surgery with an emphasis on perioperative planning.

Summary of background Data:
Minimally invasive surgery has ushered a new era of spine surgery by minimizing the undue iatrogenic injury, recovery time, and blood loss, among other complications, of traditional open procedures. Has our preop intraop and postoperative recovery pathways changed to optimize patient care in minimally invasive spine surgery.
In addition to the incisional pain, trauma to deeper tissues, such as ligaments, muscles, intervertebral discs, and periosteum are reasons for significant pain. The increasing number of minimally invasive surgeries and the need for improved and rapid return of the patient of func tionality have brought the ERAS protocols

Method:
I looked at the current body of literature supporting various pain treatments in the context of perioperative pain management for spine surgery. . I built a protocol which could be used in Indian context.

Result:
In the review we will discuss perioperative opioid management, non opiod medications, behavioral interventions, ketamine and lidocaine infusions and regional and neuraxial techniques for patients going for MIS surgery. It is important to understand and implement multimodal analgesic therapy starting preoperatively. This continues into the perioperative period and postoperative management

Conclusion:
The anesthetist and spine surgeon should collaborate for optimal preoperative, perioperative and postoperative anesthesia and analgesic protocol for best possible pain relief and rapid return to normal function which is the aim of MIS surgery.

FP2-1 ***"Managing lumbar adjacent segment disease (ASD) using minimally invasive techniques (MIS): An analysis of posterior surgical techniques"***

Meet Shah
India

Study Design:
A descriptive study.

Objective:
To manage lumbar ASD effectively using MIS techniques.

Introduction and background:
Lumbar ASD is a well-established phenomenon after spinal fusion surgery. The benefits of MIS are well known. The literature available for managing lumbar ASD using MIS techniques is scant.

Material and methods:
This study describes various step by step techniques of managing ASD using MIS techniques in patients who had undergone open or MIS spinal fusion. The surgical techniques were based on the duration of ASD since primary surgery, fusion status of operative level and technical difficulties. Patients treated for ASD from January 2008 to December 2023 were taken into consideration.

Results:
Eight cases were operated with the described techniques out of which 4 were males and 4 were female (sex ratio: 1:1). 75% of patients were above 70 years of age. (Mean age: 68.5 years).
Patients operated using the described techniques achieved complete resolution of the pre-operative symptoms and none of them had to be converted to open surgery. One patient died after 6 months due to septicaemia.

Conclusion:
There is no literature describing various techniques of managing ASD using posterior MIS techniques. The authors offer innovative successful MIS techniques of managing ASD in the lumbar spine.

Keywords:
Adjacent segment disease (ASD), Minimally invasive surgery (MIS), spinal fusion, tubular decompression, techniques

FP2-2 ***"Integration and application of Artificial intelligence and Surface Topography in scoliosis screening"***

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Background/Purpose

Traditional scoliosis diagnosis typically relies on radiographic imaging, which involves exposure to ionizing radiation, posing potential health risks with repeated use. However, recent advancements in 3D surface topography, such as the application of Microsoft Kinect V2.0, offer a promising radiation-free alternative. The Kinect V2.0 captures highly detailed 3D images of the body's surface using time-of-flight technology.

By integrating this technology with artificial intelligence (AI) and machine learning (ML), diagnostic accuracy can be significantly improved. Automated detection of anatomical landmarks and precise calculation of spinal metrics can enhance the efficiency of scoliosis assessments. This study explores the synergy of AI and 3D surface topography to deliver a cost-effective, efficient, and radiation-free approach to scoliosis assessment, with an emphasis on minimizing radiation exposure.

Design/Methodology

This study involved 25 participants recruited from a specialized orthopaedic hospital. The Kinect V2.0 sensor was used to capture 3D surface topography of the participants' backs, with data processed to measure key spinal metrics such as thoracic kyphosis, lumbar lordosis, and Cobb angles.

Both concurrent and criterion validity were assessed. Concurrent validity was evaluated by comparing Kinect measurements with clinical assessments, while criterion validity involved comparing Kinect data with recent spinal radiographs. The procedure included placing adhesive markers on anatomical landmarks (C7, L1, and bilateral PSIS) and capturing images from various distances to enhance generalizability during machine learning (ML) training and scoliosis classification.

Findings/Results

The Kinect V2.0 provided valid measurements for thoracic kyphosis but demonstrated less consistent correlation for lumbar lordosis when compared to traditional radiographic methods. AI-driven analysis of Kinect data was effective in detecting trunk rotation, which is useful for scoliosis assessment. The Kinect's non-invasive and radiation-free approach offers advantages in cost, portability, and safety. Despite these benefits, the study identifies the need for further refinement of AI algorithms to improve measurement accuracy and clinical reliability

FP2-3 ***"Are We Compromising Biology/Fusion for Hardware . Helping you to make the right biologic choices"***

Devesh Dholakia, Nandini Dholakia
India

Study Design:
Review various bone graft materials available
Objective: help you understand the complex landscape of Bonegrafts materials. Help making the right choice

Background:
Spine Fusions are being done for various conditions - degenerative, revision, infection - in the spine. Fusions are being done from the various MIS approaches – posterior, posterolatreral, transforamianal, trans kabium, lateral, anterolateral, anterior. Patients undergoing fusions often have various risk factors associated – smoking, diabetes, obesity, osteopenia, sarcopenia, radiation, steroids, antirheumatics, chemotherapy.
While there is constant improvements in the fusion techniques to put the hardware from various approaches, the access to bonegraft becomes less and many use various graft material available to them and hoping for fusion New bone formation is the key for successful spinal fusion and heavily depends on the local bone environment and the graft material.

Methods:
I have studied the different types of bone graft products available, level of evidence, variability and cost. The complex landscape of current bone graft products studied include autologous cellular grafts, allografts, synthetics, DBM, cellular based allografts (stem cells), biologics - BMP- 2 & P15 Peptide

Results:
DBM use has limited level of evidence with variable product variability and no safety concerns and minimal cost. On other hand BMP & P15 peptide has Class III PMA FDA approval with level1 evidence. It is of consistent quality in every batch with minimal safety concerns but are costly. Hence the the right choice will depend on whether you are using bone graft products as extenders, enhancers or substitutes.

Conclusion:
Level of evidence required for FDA approval is variable and do not require level! studies in humans. The key factors to look for in any bone graft product are level of evidence, product variability, safety concerns and of course cost.

FP2-4 ***"The thoracic kyphosis with little degeneration can be improved by correcting the lumbar alignment"***

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Purpose:
There are cases where thoracic kyphosis improves due to correction of lumbar alignment. In this study, we investigated changes in thoracic alignment after correction of lumbar alignment.

Subjects and Methods:
This study included 104 patients with ASD who had undergone surgery for lateral access surgery/TLIF or posterior PPS at the lumbosacral spine and had been able to be followed up for at least 2 years. We examined various parameters, the characteristics of the thoracic vertebrae, and TK on supine CT in two groups: patients whose thoracic kyphosis decreased after surgery (Group G) and those whose kyphosis increased (Group P). The characteristics of the thoracic vertebrae were classified into three types: no degeneration (Type N), osteophytes (Type O), and DISH (Type D).

Results:
There was no significant difference in age or gender, but there was a significant difference in preoperative PI-LL between Group G (27.4°) and Group P (33.5°), and a significant difference in postoperative PI-LL between Group G (9.0°) and Group P (14.2°). there was a significant difference in preoperative TK between the G and P groups (32.4 and 18.0, respectively), and TK change (preoperative - postoperative) was 25.2 and -6.6 in the G and P groups, respectively. The kyphosis was significantly improved in the G group. There was no significant difference in vertebral body characteristics. Of the 9 patients with preoperative TK of 45° or more, only 2 patients did not show improvement in thoracic kyphosis after surgery, and their vertebral body characteristics were O and D.

Discussion/Conclusion:
The fact that the postoperative PI-LL was significantly smaller in Group G suggests that good correction of the lumbar spine is important for improving thoracic kyphosis. On the other hand, Group P had a large preoperative PI-LL and a small preoperative TK. This suggests that the thoracic spine is strongly compensated for the strong lumbar lordosis before surgery, and that the increase in thoracic lordosis after surgery is a reciprocal change. In other words, even if the thoracic lordosis before surgery is small or large, if there is little degeneration, it is expected that it will be corrected to a certain extent by natural alignment through sufficient correction of the lumbar spine.

FP2-5 ***"Revisiting the Efficacy of Staged- Surgeries in Adult Spinal Deformity: A Comparative Analysis with Single-Stage Surgery"***

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The main problem with corrective surgery for adult spinal deformity (ASD) is the invasiveness of the surgery, and in recent years, two-stage surgery has become the mainstream approach, taking into account the invasiveness of the surgery. On the other hand, the spread of circumferential minimally invasive surgery (CMIS) using LLIF and PPS has made it possible to reduce the invasiveness of surgery and shorten the time required, so in some cases, surgery is performed in a single stage. In this study, we compared and examined the clinical outcomes of single-stage and two-stage surgery for ASD.

[Subjects and Methods]

This study included patients who had undergone CMIS using LLIF and PPS for ASD after 2022 and who had been able to be followed up for at least one year. The patients were divided into two groups: a group that had undergone one-stage surgery (Group A, 25 patients) and a group that had undergone two-stage surgery (Group B, 52 patients) (Group B, 52 patients) and compared patient background, operation time, blood loss, various parameters, the period of time before patients were able to start walking with a walker, D-dimer levels on the fourth day after posterior surgery, length of hospital stay, and various complications. Results: There were no significant differences in age, gender or any of the parameters, and the operation times were 258 minutes for Group A and 249 minutes for Group B, and the blood loss was 520 ml for Group A and 554 ml for Group B, with no significant differences. The duration of walking with a walker was 4.1 days in Group A and 5.8 days in Group B, and the D-dimer level was 6.7 μg/mL in Group A and 10.1 μg/mL in Group B, and the duration of hospitalization was 13.2 days in Group A and 22.5 days in Group B, showing a significant difference. As complications, there was 1 case of asymptomatic PJK in Group A, 2 cases of cage subsidence, 1 case of cage migration, 1 case of DVT, 2 cases of asymptomatic PJK, 1 case of rod fracture, and 1 case of postponement of surgery due to pneumonia after the first surgery in Group B.

[Discussion/Conclusion]

With the advancement of minimally invasive surgical techniques and the accompanying spread of CMIS, even in stage 1, minimally invasive surgery has become possible, and in the results of this study, many complications specific to stage 2 surgery were observed in Group B. In the future, it is suggested that stage 1 surgery may be more useful in some cases.

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