Session 10 | Adult Spinal Deformity & Miscellaneous Abstracts

Papers are listed in presentation order

Paper #149. Which Complications Impact Satisfaction Among Patients with Adult Spinal Deformity (ASD)?

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Hypothesis
Neurological complications result in lower satisfaction compared to those that are mechanical or treatable in nature.

Design
Multicenter, prospective cohort

Introduction
Surgical management of ASD has a well-cited complication profile. Of note, a subset of patients who experience a perioperative complication still express post-surgical satisfaction. This study strives to identify the characteristics of complications that influence levels of satisfaction.

Methods
Data was obtained from a multicenter cohort of patients with ASD, who developed postoperative complications within two years of follow-up. Satisfaction was determined by the SRS-22 satisfaction subscore. Demographic and spinopelvic parameters at baseline and two years were recorded. Complication-related variables included latency, frequency, subcategory, and severity (high = major/requiring reoperation and low = minor). The associations between the variables were evaluated with multiple linear regression. Post hoc analysis was conducted of the complication profiles significantly related to satisfaction (p-value < 0.05).

Results
Of the initial 795 patients meeting inclusion criteria, 533 (67.0 %) had at least one complication. The demographic, spinopelvic, and satisfaction parameters are shown in Table 1. On regression, patients with implant-related ($\beta = 0.39$, $p = 0.006$) and infection-related ($\beta = 0.42$, $p = 0.017$) complications were associated with greater satisfaction at two years. Complication frequency was negatively associated with satisfaction at two years ($\beta = -0.14$, $p = 0.018$). Among patients who had an infectious complication, those who developed sepsis were more likely to have worse satisfaction at two years ($\beta = -1.66$, $p = 0.047$). The subcategory of neurologic or implant-related complication was not associated with satisfaction at two years.

Conclusion
Greater complication frequency, likely due to the cumulative effect of multiple complications on recovery, yields poor long-term satisfaction. Patients with implant-related or infectious complications tended to have better long-term satisfaction compared to patients with other categories of complications. Likely, sustaining an adverse event with a permanent deficit yields poorer satisfaction, when compared with recoverable adverse events.

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Table 1.

	All complications (n = 533)	Surgical neurologic complications only (n = 109)	Implant-related complications only (n=120)	Infectious complications only (n=63)
Age	62.0 ± 12.7 (range 19.8 – 86.6)	62.5 ± 11.7 (range 24.0 – 82.1)	60.6 ± 11.6 (range 20.0 – 79.0)	62.0 ± 11.9 (range 30.2 – 84.3)
Female (%)	417 (78.2)	83 (76.1)	89 (74.1)	52 (82.5)
BMI	28.4 ± 5.8	29.5 ± 6.1	29.0 ± 6.0	30.7 ± 6.7
CCI	2.0 ± 1.8	2.4 ± 0.6	2.0 ± 1.7	2.1 ± 1.7
ASA score	2.5 ± 0.6	2.4 ± 0.6	2.4 ± 0.6	2.5 ± 0.6
Osteoporosis (%)	100 (18.8)	22 (20.2)	17 (14.2)	12 (19.0)
Depression at baseline	130 (24.3)	24 (22.0)	38 (31.7)	11 (17.5)
Depression at two years	75 (14.1)	14 (12.8)	22 (18.3)	4 (6.3)
PI-LL at baseline	19.6 ± 21.4	17.6 ± 20.3	22.9 ± 24.6	25.0 ± 19.9
SVA at baseline (mm)	79.1 ± 73.2	69.9 ± 72.5	91.1 ± 82.2	99.2 ± 76.8
PI-LL at two-years	5.5 ± 15.6	5.3 ± 16.4	10.1 ± 16.8	8.5 ± 12.3
SVA at two-years (mm)	38.8 ± 55.4	46.7 ± 57.9	55.8 ± 53.9	49.1 ± 62.5
Satisfaction				
SRS-22 satisfaction at baseline	2.7 ± 1.0	2.7 ± 1.1	2.8 ± 1.1	2.8 ± 0.9
SRS-22 satisfaction at two years	4.1 ± 1.0	3.9 ± 1.0	4.1 ± 1.0	4.2 ± 0.9

Complication categories		Neurologic complications		Implant-related complications		Infectious complications	
Adverse Event (%)	228 (42.3)	Peroneal nerve palsy (%)	0 (0)	Rod breakage (%)	56 (46.7)	Deep infection (%)	20 (31.7)
Cardiopulmonary (%)	88 (16.5)	Epidural hematoma (%)	1 (0.9)	Screw breakage (%)	16 (13.3)	Clostridium difficile infection (%)	1 (1.6)
Gastrointestinal (%)	56 (10.5)	Femoral neuralgia (%)	2 (1.8)	Screw loose (%)	11 (9.2)	Superficial infection (%)	11 (17.5)
Implant (%)	120 (22.5)	Motor deficit (%)	37 (33.9)	Painful Implant (%)	11 (9.2)	Sepsis (%)	7 (11.1)
Infection (%)	63 (11.8)	Nerve root injury (%)	1 (1.8)	Prominence (%)	8 (6.7)	Pneumonia (%)	10 (15.9)
Neurologic (%)	132 (24.8)	Radiculopathy (%)	52 (47.7)	Interbody dislocation (%)	5 (4.2)	Urinary tract infection (%)	23 (36.5)
Operative (%)	133 (25.0)	Myelopathy (%)	7 (6.4)	Screw medial breach (%)	9 (7.5)	Other infection (%)	5 (7.9)
Radiographic (%)	142 (26.6)	Bowel or bladder deficit (%)	4 (3.7)	Screw vascular impingement (%)	0 (0)		
Renal (%)	8 (1.5)	Sensory deficit (%)	14 (12.8)	Loose dislocation (%)	12 (10)		
Wound (%)	23 (4.3)			Rod dislocation (%)	2 (1.7)		
				Screw nerve impingement (%)	3 (2.5)		

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Paper #150. Perioperative Infection Prophylaxis with Vancomycin is a Significant Risk Factor for Deep Surgical Site Infection in Spine Surgery

Gregory Kazarian, MD; Francis C. Lovecchio, MD; Jung Mok, MD; Yusef Jordan, MD; Mitchell A. Johnson, BS; Takashi Hirase, MD, MPH; *Han Jo Kim, MD*

Hypothesis
We hypothesize that perioperative use of vancomycin for infection prophylaxis increases the risk of infection compared to cefazolin in primary spine surgery.

Design
This study was a single-center multi-surgeon retrospective review of all patients undergoing primary cervicothoracic, thoracolumbar, lumbar, or lumbosacral discectomy, decompression, or fusion surgery from an institutional registry.

Introduction
Perioperative infection prophylaxis with cefazolin is an important preventative measure for infection in spine surgery. However, the relative efficacy of alternative regimens is poorly understood.

Methods
Postoperative infection was defined by the combination of three criteria: irrigation and debridement within 3 months of the index procedure, clinical suspicion for infection, and positive intraoperative cultures. Microbiology records for all infections were reviewed to assess the infectious organism and organism susceptibilities. Univariate and multivariate analyses were performed.

Results
A total of 10,122 patients met the inclusion criteria for this study. The overall incidence of infection was 0.78%, with an incidence of 0.73% in patients who received cefazolin and 2.03% in patients who received vancomycin (OR 2.83, 95% CI 1.35-5.91, p-0.004). Use of IV vancomycin (OR 2.83, 95% CI 1.35-5.91, p=0.006), BMI (MD 1.56, 95% CI 0.32-2.79, p=0.014), presence of a fusion (OR 1.62, 95% CI 1.04-2.52, p=0.033), and operative time (MD 42.04, 95% CI 16.88-67.21, p=0.001) were significant risk factors in the univariate analysis. In the multivariate analysis, only non-cefazolin antibiotics (OR 2.48, 95% CI 1.18-5.22, p=0.017) and BMI (MD 1.56, 95% CI 0.32-2.79, p=0.026) remained significant independent risk factors. Neither IV antibiotic regimen nor topical vancomycin significantly impacted Gram type, organism type, or antibiotic resistance (p>0.05). The most common reason for antibiosis with vancomycin was a penicillin allergy (75.0%).

Conclusion
Perioperative prophylactic antibiosis with IV vancomycin leads to a roughly 2.5-times higher risk of infection compared to IV cefazolin when controlled for other risk factors in primary spine surgery. We recommend the routine use of IV cefazolin for infection prophylaxis, and caution against the elective use of alternative regimens like IV vancomycin unless clinically warranted.

	OR	95% CI Lower bound	95% CI Upper bound	p-Value
Vancomycin	2.48	1.18	5.22	0.017*
IV Steroid Intraoperatively	1.84	0.45	7.53	0.399
IV Steroid Postoperatively	1.22	0.74	2.03	0.442
Topical Vancomycin	1.09	0.68	1.75	0.719
Fusion	1.06	0.62	1.84	0.825
Sex (Male)	0.80	0.51	1.26	0.329
Topical Steroid Intraoperatively	0.60	0.14	2.45	0.473
Location (Lumbar)	0.35	0.12	1.02	0.053
	MD	**95% CI Lower bound**	**95% CI Upper bound**	**p-Value**
BMI	1.56	0.32	2.79	0.026*
OR Duration	42.04	16.88	67.21	0.089
Age	0.27	-3.67	3.11	0.756

Table 1: Multivariate Logistic Regression Assessing Risk Factors for Infection. BMI = body-mass index; OR duration = operating room duration; OR = odds ration; CI = confidence interval; * = indicates statistical significance

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Paper #151. Spine Shape Vs Alignment: Which Determines the Best Outcomes in Adult Spinal Deformity?

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Hypothesis

Alignment and spine shape are important for optimizing outcomes in adult spinal deformity (ASD) patients.

Design

Retrospective analysis of prospective multicenter databases.

Introduction

Overcorrected patients experience more proximal junctional kyphosis (PJK) than those functionally aligned or undercorrected, in ASD surgery. In addition, previous studies identified that PJK patients have a more posteriorly translated spine shape than non-PJK patients. This study analyses combinations of alignment and spine shape with respect to severe PJK, proximal junctional failure (PJF) and health-related quality of life (HRQL) outcomes.

Methods

Patients with fusions to the pelvis and above T11 were included. Linear regression was performed to predict T10PA using age-normative short form-36 physical component scores (PCS) and pelvic incidence (PI) for each patient. Functional alignment was defined as postoperative alignment within a 10o window around the predicted T10PA. Linear regression modeling was also used to assess normative spine shape associating T10PA, L1PA, L4PA and PI in asymptomatic subjects. Normative spine shape was defined as postoperative alignment within 6-degree regional windows of predicted lumbar and thoracolumbar shape. Patients were grouped based on alignment and spine shape. The frequency of severe PJK, PJF, and HRQL outcomes were compared between groups.

Results

751 patients were included (Age: 63.7 ± 9.4; BMI: 28.4 ± 5.9; 79.2% female). Mean HRQL outcomes improved significantly for all groups with surgery ($p<0.05$) but there was no difference in HRQL improvement between the groups. The malaligned/poor spine shape group had the highest frequency of severe PJK and PJF by 2 years (27.6% and 18.1%, respectively), whereas the functional alignment/normative spine shape group had the lowest (13.3% and 7.7%, respectively), all $p<0.05$. Multinomial regression revealed a higher odds of severe PJK (2.48, CI: 1.37-4.50; $p=0.003$) and PJF (2.65, CI: 1.29-5.47; $p=0.008$) by 2 years in the malaligned/poor spine shape group compared to the functional alignment/normative shape group. No differences in frequency of revision for PJK were observed.

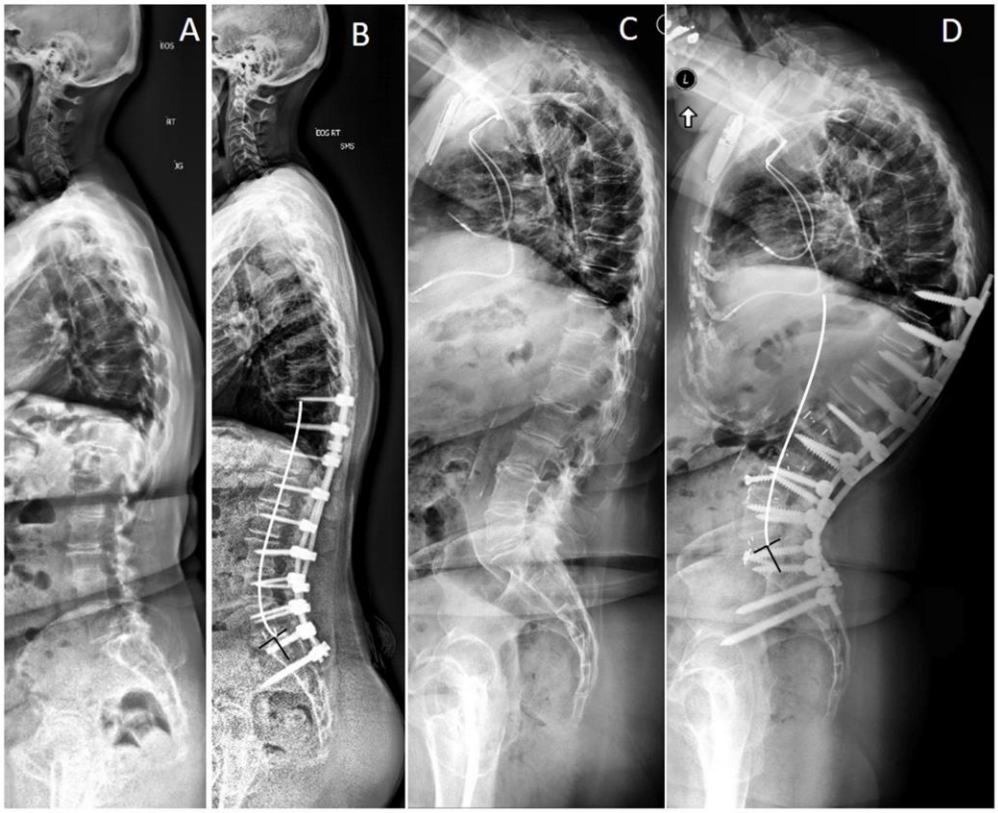
Conclusion

Normative spine shape with functional alignment is associated with lower frequency and lower odds of severe PJK and PJF, emphasizing the importance of assessing both shape and alignment in deformity corrections.

Table 1. Comparison of baseline information and mechanical complications between malaligned vs functional T10PA radiographic alignment and poor vs normative T10-L1, L1-L4 spine shape groups.

Total (N = 751)	Malaligned & Poor Spine Shape n = 105	Malaligned & Normative Spine Shape n = 331	Functional Alignment & Poor Spine Shape n = 120	Functional Alignment & Normative Spine Shape n = 195	p-value
Gender (% Female)	**83.7%**	**83.7%**	**72.5%**	**73.2%**	**0.005**
Age (years)	64.4 ± 9.4	64.2 ± 9.7	63.0 ± 9.0	62.8 ± 9.4	0.292
Body Mass Index (kg/m^2)	**27.7* ± 5.6**	**27.2^ ± 5.3**	**30.1'~ ± 6.2**	**29.8'~ ± 6.4**	**<0.001**
Charlson Comorbidity Index	1.9 ± 1.7	1.9 ± 1.7	2.0 ± 1.7	2.0 ± 1.7	0.789
1 year					
sPJK by 1 year	**25 (23.8%)**	**65 (19.6%)**	**14 (11.7%)**	**21 (10.8%)**	**0.005**
PJF by 1 year	**18 (17.1%)**	**41 (12.4%**	**8 (6.7%)**	**13 (6.7%)**	**0.012**
2 years					
sPJK by 2 years	**29 (27.6%)**	**71 (21.5%)**	**19 (15.8%)**	**26 (13.3%)**	**0.012**
PJF by 2 years	**19 (18.1%)**	**48 (14.5%)**	**10 (8.3%)**	**15 (7.7%)**	**0.016**
Revision for PJK	9 (8.6%)	19 (5.7%)	6 (5.0%)	7 (3.6%)	0.335
Rod Breakage	20 (19.0%)	36 (10.9%)	22 (18.3%)	23 (11.8%)	0.054
Revision for Rod Breakage	8 (6.7%)	18 (5.4%)	12 (10.0%)	10 (5.1%)	0.296
Any mechanical complication[†]	**47 (44.8%)**	**96 (29.0%)**	**39 (32.5%)**	**46 (23.6%)**	**0.002**

[†] Any mechanical complication is defined as having severe PJK by 2 years or rod breakage or pseudarthrosis.
PJA - proximal junctional angle; sPJK - severe proximal junctional kyphosis (≥ 20° change and proximal junctional angle ≥ 20°); PJF - proximal junction failure, defined as undergoing revision for PJK before 2-year visit or having a proximal junctional angle >28° and change in PJA > 22°



T10PA= 17.0° | T10PA= 16.2° Functional T10PA = 14.3° | T10PA= 3.6° | T10PA= -6.0° Functional T10PA = 7.7°

Figure 1. Preoperative (A) and Postoperative (B) radiographs of a patient with functional alignment/normative spine shape. Preoperative (C) and Postoperative (D) radiographs of a malaligned/poor spine shape patient who developed PJK. Normative spine shape is represented by the white line.

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Paper #152. Proximal Junctional Kyphosis After Prophylactic Tethers in Adult Spinal Deformity:Incidence, Mechanism and Risk Factors for Proximal Junctional Failure

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Hypothesis
Observational analysis of incidence, mechanism, and risk factors for proximal junctional complications in tethered ASD patients

Design
Retrospective cohort study

Introduction
Posterior tethers at the upper instrumented vertebrae (UIV) may reduce PJK after adult spinal deformity (ASD) surgery. PJK and PJF in tethered patients is not well understood.

Methods
Patients who underwent posterior tethering for PJK prophylaxis were pulled from two multicenter ASD datasets with pre-defined inclusion criteria and fusion >4 levels to S1. Surgeries were performed from 2013-2022 with min f/u of 1-2 yrs. PJK was defined as UIV/UIV+2 PJA of 10 and Δ10. PJF was defined as revision within the f/u period or UIV/UIV+2 PJA of 28 and Δ22. Tether techniques were surgeon-dependent. Radiographs were reviewed for PJF mechanism by a spine surgeon. Adjusted analyses controlling for the proximal level tethered, comorbidities, surgical factors, and alignment were conducted to determine independent associations.

Results
A total of 302 patients met inclusion criteria, with a mean f/u 1.5 yrs. PJK and PJF rates were 46% (n=139) and 9.2% (n=28), respectively. 163 patients had specific placement of tether level data (54% were to UIV+2, 45% UIV+1, and 1% UIV+3). On adjusted analysis, prior fusion (OR 0.32 [0.12-0.77], p=0.01), #interbody fusion (2.27 [1.14-5.33], p=0.03), supplemental rod (4.82 [1.90- 13.3], p<0.01), and proximal level tethered (2.55 [1.07-6.67], p=0.04) were associated with PJK. BMI (1.20 [1.08-1.36], p<0.01), osteoporosis (9.44 [2.18-50.1], p<0.01), preop PT (1.10 [1.01-1.22], p=0.03), preop C7PL (0.98 [0.96-0.99], p=0.01), and change in T4PA (1.16 [1.06-1.29], p<0.01) were associated with PJF. In the PJF cohort, screws were used at the UIV in 93% of cases. Failure modes included UIV superior endplate fracture (54%, 93% lower thoracic [LT] UIV), disc degeneration with increased distance across the interspinous processes (ISP) (18%, all UT UIV), UIV screw pullout (11%), UIV+1/+2 compression fractures (7.1%), and disc degeneration without increased distance across the ISP (10%).

Conclusion
PJF occurred via bony mechanisms in the LT spine and through soft-tissue mechanisms in the UT spine. Risk factors and mechanisms for PJF in tethered patients are similar to reported risk factors in non-tethered patients.

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Paper #153. Postoperative Thoracic Kyphosis Morphology Following Adult Spinal Deformity Surgery: An Analysis of Fused and Unfused Segments

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Hypothesis

This study aimed to quantify iatrogenic and reciprocal changes in TK between pre and post-surgery and identify influencing parameters, assess the maintenance of unfused thoracic curvature between early and 2-year follow-up, and identify parameters affecting proximal failure.

Design

Retrospective analysis of prospective data

Introduction

Predicting postoperative changes in thoracic kyphosis (TK) and reciprocal changes in the unfused thoracic spine is challenging in adult spinal deformity (ASD) surgery.

Methods

362 ASD patients treated with posterior instrumentation from T9-11 to the pelvis, with a minimum 2-year follow-up were included. After reporting TK values and distribution vs normative data (Figure), multilinear hierarchical regression was used to investigate post-operative lumbar parameters associated with reciprocal thoracic changes. The rate of thoracic failure was reported, and logistic regression was used to investigate associated risk factors.

Results

In this cohort (65±9 yo, 73.5% female), the pre-op T1-T12 TK (median 34°) was normal for 59.7% and hypo-kyphotic for 39.3% of patients. At 6 weeks, TK normalized for 79.1% of hypo-kyphotic patients and deteriorated for 11.7% of normo-kyphotic patients. The post-op TK increase (+7° across T5-10 and across T10-L1) was significantly associated with an increase in L1-S1 lordosis ($p<0.001$) and a decrease in L4-S1 lordosis ($p<0.012$) (r-square 0.69). From 6 weeks to 2 years, 9.1% experienced TK decompensation >15° and 9.4% a proximal extension due to junctional issues (collectively coined “thoracic failures” = 17.1%). Multivariate analysis showed early post-op thoracic alignment was a significant predictor of 2-year thoracic failure based on T10-L1 <15° and T5-T10 contribution to TK < 38%.

Conclusion

Following ASD surgery with the UIV at T9-T11, deviations in thoracic kyphosis within non-fused segments increase the likelihood of revision surgery. Despite achieving TK normalization in most cases, postoperative spinal shape often strays from the norm. Accurate postoperative thoracic kyphosis estimation is possible with preoperative alignment and lumbar correction. A two-year failure trend is associated with early postoperative lower kyphosis and the distribution of thoracic curvature, emphasizing the importance of meticulous preoperative planning.

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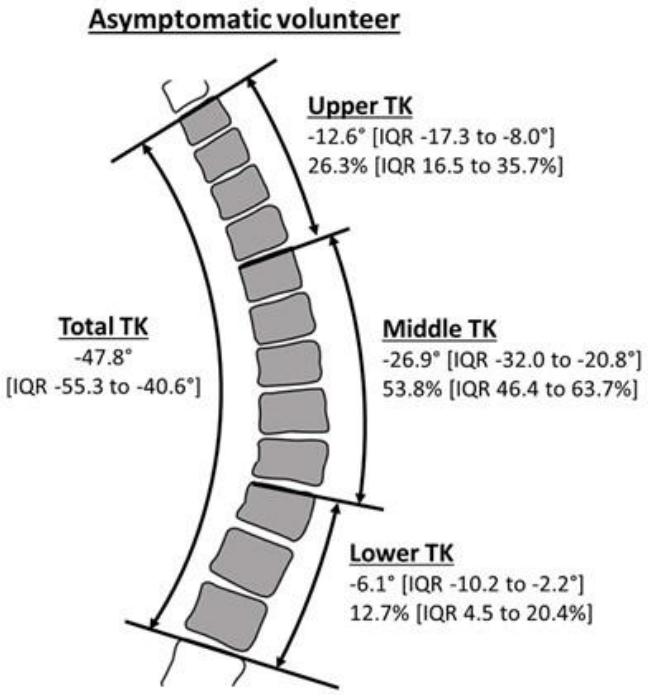

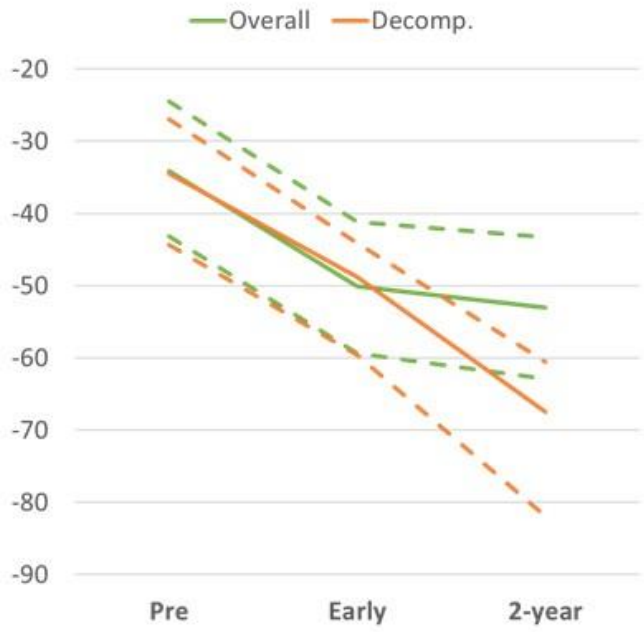

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Paper #154. Identifying Risk of Proximal Junctional Kyphosis Prior to Choosing Upper Instrumented Vertebra

Jeffrey M. Hills, MD; Han Jo Kim, MD; Lawrence G. Lenke, MD; Justin S. Smith, MD, PhD; Shay Bess, MD; Breton G. Line, BS; Virginie Lafage, PhD; Renaud Lafage, MS; Eric O. Klineberg, MD; Jeffrey L. Gum, MD; Khaled M. Kebaish, MD; Gregory M. Mundis Jr., MD; Alex Soroceanu, MD, FRCS(C), MPH; Richard Hostin, MD; Themistocles S. Protopsaltis, MD; Kojo D. Hamilton, MD, FAANS; Munish C. Gupta, MD; Frank J. Schwab, MD; Christopher I. Shaffrey, MD; Douglas C. Burton, MD; Christopher P. Ames, MD; Michael P. Kelly, MD; International Spine Study Group

Hypothesis

Preoperative cervicothoracic sagittal alignment is associated with risk of PJK after long fusions, and the risk is dependent on UIV region (higher risk with lower thoracic(LT UIV vs upper thoracic(UT UIV))

Design

Retrospective Cohort

Introduction

Surgical alignment is an important PJK risk factor, but malalignment in the unfused spine increase risk despite achieving instrumented alignment goals. Some cases of PJK may represent high risk UIV selection. We aimed to determine if PJK risk was associated with preoperative cervicothoracic malalignment, and if the risk depended on UIV region.

Methods

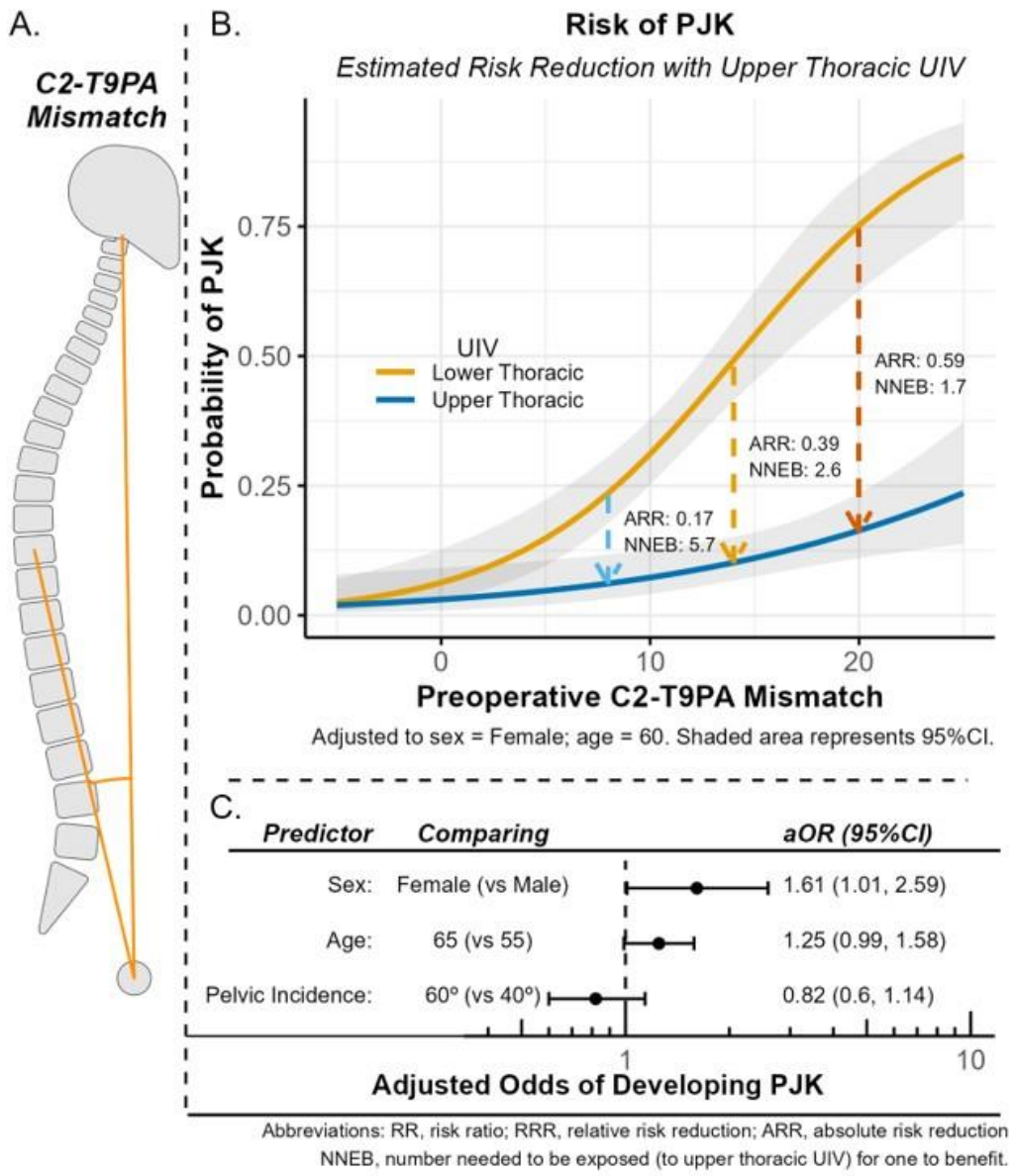
A multi-center, prospective ASD registry was queried to identify patients instrumented to the sacrum with a UIV in the UT or LT spine, without prior fusion >4 levels, and minimum 2yr radiographic follow-up. Primary outcome was PJK (>20 change or failure) within 2 years. A multivariable logistic regression model examined the risk of PJK by UIV region, preoperative C2-T9PA mismatch (Fig 1A), age, sex, pelvic incidence and tested for an interaction between preoperative C2-T9PA mismatch and UIV region. Adjusted absolute risk reduction (ARR) and number needed to be exposed (to upper thoracic UIV) to benefit 1 (NNEB) was computed.

Results

627 patients across 20 centers were included, with a median age 66 (IQR, 59, 70), 483 (77%) females, 380 (61%) with a LT and 247 (39%) with an UT UIV. PJK developed in 149 (39%) patients with a LT, and 30 (12%) patients with an UT UIV. A significant interaction between UIV and preoperative C2-T9PA mismatch was observed (P=.03), indicating the risk of PJK associated with preoperative C2-T9PA mismatch depended on the UIV. With a preoperative C2-T9PA mismatch of 14°, an UT UIV had an adjusted ARR of 39% and NNEB was 2.6 (Fig 1B). Females had an aOR of 1.6 (P=.047) for developing PJK (Fig 1C).

Conclusion

Higher preoperative C2-T9PA mismatch (cervical/thoracic kyphosis) was associated with higher risk of PJK and depended on the UIV. An UT UIV for patients with high preoperative C2-T9PA mismatch may lower the risk of PJK.



A) C2-T9PA Mismatch. B) Probability of PJK due to higher preoperative C2-T9PA mismatch depended on UIV region. C) Adjusted odds of PJK was significantly higher in females.

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Paper #155. Hip Range of Motion Predicts Outcomes Following Spinal Fusion Surgery in Adult Spinal Deformity Patients

Shane Burch, MD; *Andrew Sawires, MD*

Hypothesis
Hip range of motion predicts global and disease specific patient reported outcome scores (PROS) following spinal fusion surgery.

Design
Non-randomized prospective study.

Introduction
ADLs include reaching the ground, tie shoes, and perineal care. After spinal fusion surgery patients lose spinal motion and must rely on other joints compensate.

Methods
A 3D motion capture system (Motion Analysis, Petaluma CA) with standardized spine and appendicular marker sets was used to capture motion of the spine and appendicular skeleton through a flexion and extension and sit to stand cycle. Patients who had undergone 1- 3 levels, 4-8 levels or > 8 level fusions were captured during a flexion / extension and sit-to-stand maneuver and compared to back pain patients without fusions and to healthy control subjects. Standardized radiographic parameters (PI, PT, SVA, LL and TK) and PROMS (EQ5D, ODI and NRS) were measured for each group and compared. Correlation coefficients were derived between hip ROM in the sagittal plane and PROMS. A radial based neural network algorithm was employed to model hip ROM to predict ODI scores <40 and EQ5D scores >0.7 in each cohort.

Results
67 patients (49 females) with average age of 65.4 years and follow up time of 25.9 months were enrolled along with 8 controls. (>8 levels fused: n= 11, 4-8 level fused: n=13, 1-3 levels fused: n=15 and 0 levels fused n=10). No difference in sagittal alignment parameters (mean PI°-LL°=6.01°) was observed between groups. PRO scores were: EQ5D (mean =0.575, SD ,225, range 0.101-0.860), ODI (mean = 41.08, SD 17.3, range 10-72) and NRS scores (mean = 5.35, SD 2.8, range 0-10) p.0.05 between groups. Mean ROM of the TL spine in controls (59°) and greater than all fusion groups, p<0.05). No difference in mean hip ROM between fusion groups was identified (p=>0.05).Hip ROM during flexion / extension was moderately correlated to EQ5D (R^2=0.156, p=0.019) and ODI (R^2=0.178, p=0.016) in patients with >8 levels fused. The neural networks model predicted 87.5% ODI outcomes correctly with an AUROC of 0.795 while the same model predicted 68.8% of EQ5D scores of >0.7 with an AUROCC of 0.728

Conclusion
Hip ROM predicts PROM scores in adult degenerative scoliosis patients following spinal fusion surgery. Those with limited hip ROM prior to spinal fusion surgery may benefit less than those with greater hip ROM.

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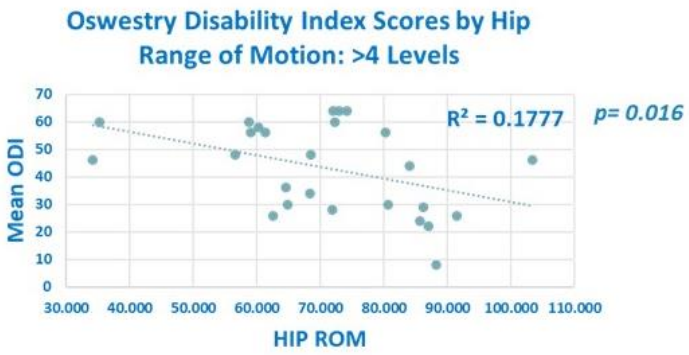

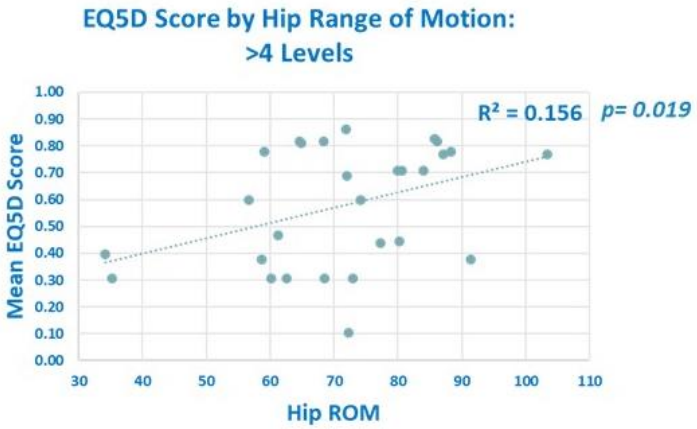

Hip ROM Predicts Spinal PROMS

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Paper #156. Increased Posterior Pincer Might Increase the Risk of Hip Osteoarthritis in Adult Spinal Deformity with High Pelvic Retroversion

Elena Jaber, MS; Rami Rachkidi, MD, MS; Abir Massaad, PhD; Ali Rteil, MS; Elma Ayoub, MS; Maria Saadé, MS; Celine Chaaya, MS; Elio Mekhael, BS; Nabil Nassim, BS; Rami Rhayem, BS; Mohammad I. Karam, PhD; Ismat Ghanem, MD, MS; Virginie Lafage, PhD; Wafa Skalli, PhD; Ayman Assi, PhD

Hypothesis
Posterior femoro-acetabular impingement might increase the risk of hip osteoarthritis in ASD with high pelvic retroversion.

Design
Retrospective analysis of prospectively collected data.

Introduction
Pelvic retroversion is a primary compensatory mechanism in patients with adult spinal deformity (ASD). These patients are known to have a higher risk of developing hip osteoarthritis (HOA), which may be due to alterations in acetabular orientation. This study aims to investigate possible alterations in acetabular orientation in ASD patients with increased PT.

Methods
121 ASD patients and 32 controls underwent biplanar X-rays in standing position with calculation of 3D spinopelvic and acetabular parameters: tilt, anteversion, abduction, anterior coverage and posterior coverage. Hip osteoarthritis (HOA) grade was determined according to Kellgren and Lawrence. PT adjusted to PI was calculated in the control group (adj.PT=0.37*PI-7°) then patients with high adjusted PT (>2SD in controls) were grouped as ASD-HighPT, otherwise as ASD-NormPT. Spinopelvic and acetabular parameters were compared between groups.

Results
42 patients were categorized as ASD-HighPT and 79 as ASD-NormPT (PT= 31 vs 13°, $p<0.001$). ASD-HighPT had a decreased lumbar lordosis (L1S1=33 vs 63°) and a decompensated sagittal alignment (SVA=75 vs 10mm, both $p<0.001$). ASD-HighPT showed an increased acetabular tilt (38 vs 25°), anteversion (27 vs 19°), abduction (61 vs 56°), posterior coverage (103 vs 97°), and decreased anterior coverage (50 vs 56°), compared to ASD-NormPT (all $p<0.001$). ASD-HighPT had an increased grade of HOA (median: 2 vs 1, $p=0.003$). ASD-NormPT had normal acetabular orientation. PT was positively correlated to acetabular tilt ($r=0.74$), anteversion ($r=0.68$), abduction ($r=0.64$), posterior coverage ($r=0.57$), and negatively correlated to anterior coverage ($r=-0.47$, all $p<0.05$).

Conclusion
ASD patients with increased pelvic retroversion are subject to increase their acetabular tilt, anteversion, and abduction leading to an increased posterior coverage and a decreased anterior coverage. These alterations, characteristic of a posterior pincer type of femoro-acetabular impingement, may contribute to the heightened risk of HOA development in ASD patients.

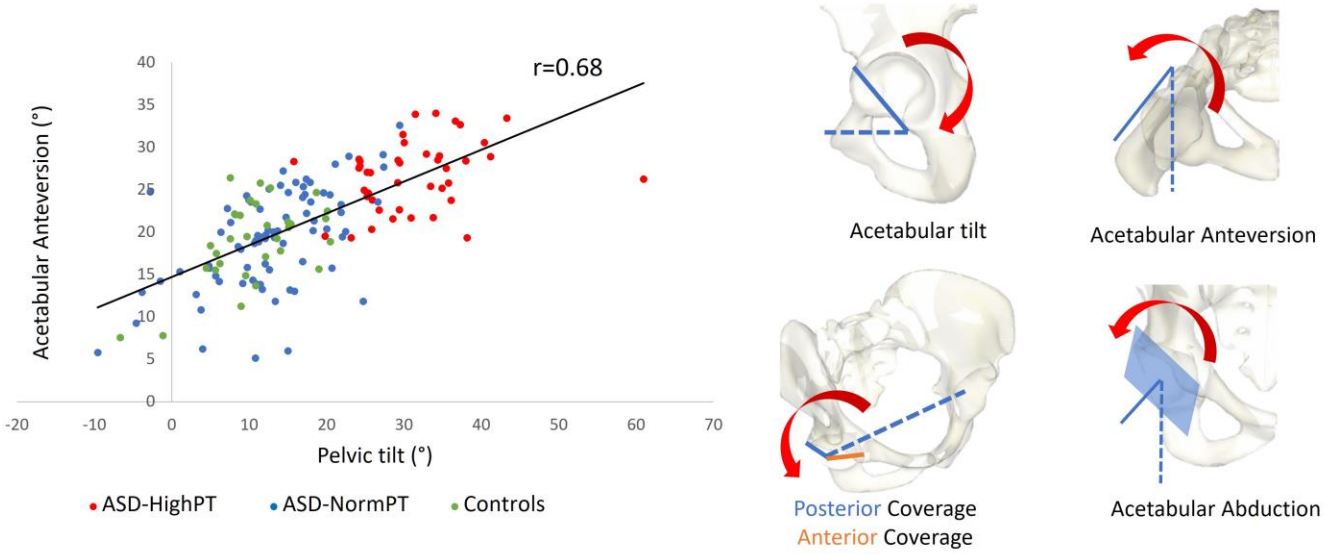

Fig 1: Correlation between acetabular anteversion and PT.

Session 10 | Adult Spinal Deformity & Miscellaneous Abstracts

Paper #157. Patterns and Predictors of Mechanical Complications Following 3-Column Osteotomies for Correction of Adult Thoracolumbar Spinal Deformity with 2 Years of Follow Up

Winward Choy, MD; Jaemin A. Kim, Research Assistant; Terry Nguyen, Research Assistant; Tony Catalan, BS; Austin Lui, MS; Ping-Yeh Chiu, MD; David Mazur-Hart, MD; Aaron J. Clark, MD; Vedat Deviren, MD; Christopher P. Ames, MD

Hypothesis
Rates of mechanical failure following 3 column osteotomies for adult thoracolumbar spinal deformity have decreased with the advent of new surgical techniques

Design
retrospective study

Introduction
Correction of fixed thoracolumbar adult spinal deformities (ASD) may require three column osteotomies to restore adequate spinal alignment. However, mechanical complications (MC) remain significant following ASD surgery. We report the outcomes of patients with thoracolumbar deformities undergoing 3-column osteotomies.

Methods
Consecutive patients who underwent 3-column osteotomies from 2006 to 2021 performed by the senior author were identified. Those with a minimum of 2 years of clinical and radiographic follow up were included. Main outcome comprised MC, defined by rod fracture, proximal junctional failure (PJF)/distal junctional failure (DJF), or other implant related complications. Univariate and multivariate analysis of clinical, radiographic and operative features was used to identify predictive factors.

Results
253 patients follow up were included. Mean age was 63 years, 36.8% of patients were male, 71.9% of patients had a previous fusion. Mean number of levels fused was 12.5. The most common site of the 3-column osteotomy was at L3 in 30.8% and L4 in 33.2% of patients. 13.8% of patients were smokers. Mean follow up was 38 months. Rates of MC were 59.3% and overall reoperation rate was 31.7%. The most common types of MC were rod fracture (32.5%), pseudoarthrosis (21.4%) and proximal junctional failure (10.7%). Reoperation was required in 52% of all MC. Rates of rod fracture and PJF have significantly decreased in the last 5 years of the series. Only half of MC occurred within 2 years of index operation, and rate of mechanical complications increases with length of follow up. On multivariate analysis, ligamentoplasty and use of multi-rod constructs were correlated with decreased rates of MC.

Conclusion
Mechanical complications following 3-column osteotomy are significant, and require long term follow up for detection. However, advancements in surgical techniques have significantly decreased rates of MC.

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Paper #158. Adjacent Segment Disease (AdSD) After Spinal Fusion in the Uk Biobank (UKB)

Rohit Bhan, MD, MS; Vy Pham, MD, MPH; Elizabeth L. Yanik, PhD; Brian J. Neuman, MD

Hypothesis

The rate of AdSD in the cervical or lumbar spine will be less than 3% annually after primary fusion.

Design

Cohort Study

Introduction

The prevalence of symptomatic spinal disease requiring fusion is increasing with an aging population. Patients are counseled there is a 3% annual risk of additional surgery due to AdSD, though this may not account for advances in surgical technique. The UKB is a large population-based cohort of 500,000 deidentified people, with in-depth genetic and non-genetic information, as well as linked hospital records. The database is regularly updated and includes >20 years of hospital records. We investigated the rate of AdSD after primary cervical and lumbar fusion in the UKB cohort, as well as risk factors that may contribute.

Methods

UKB patients that underwent primary cervical or lumbar fusion were identified using OPCS-4 codes. AdSD was defined as subsequent fusion, revision, or decompression within the same spinal region as their primary surgery. Associations with risk factors were assessed using Cox regression.

Results

3487 patients underwent primary fusion in the cervical (N=1732) or lumbar (N=1755) spine. 211 (12.1%) cervical and 230 (13.1%) lumbar patients were revised for AdSD. 5-year cumulative incidence for cervical and lumbar spine revision surgery was 8.19% and 10.16%. 20-year cumulative incidence for revision cervical and lumbar spine surgery was 19.67% and 19.79% respectively, amounting to an annual risk of ~1%. Unemployed/Retired status achieved significance as a risk factor for AdSD in univariate (p=0.011) and multivariate analysis (p=0.0063). BMI, Age, Gender, Race, Tobacco Use, area deprivation, and Osteoporosis were not significant in univariate or multivariate models.

Conclusion

Our findings suggest the rate of AdSD in the cervical and lumbar spine is lower than previously reported, roughly 1% annually, with about half of the revisions occurring within the first 5 years. Occupational status as Unemployed/Retired was found to increase risk of developing AdSD, suggesting that decreased work activity may be indicative of greater disability and disease burden. The first 5 years has a higher rate of AdSD compared to the next 15 years. There may be underlying risk factors that account for the increased early rate of AdSD, such as genetic variation, spine characteristics, surgical factors, and medical comorbidities.

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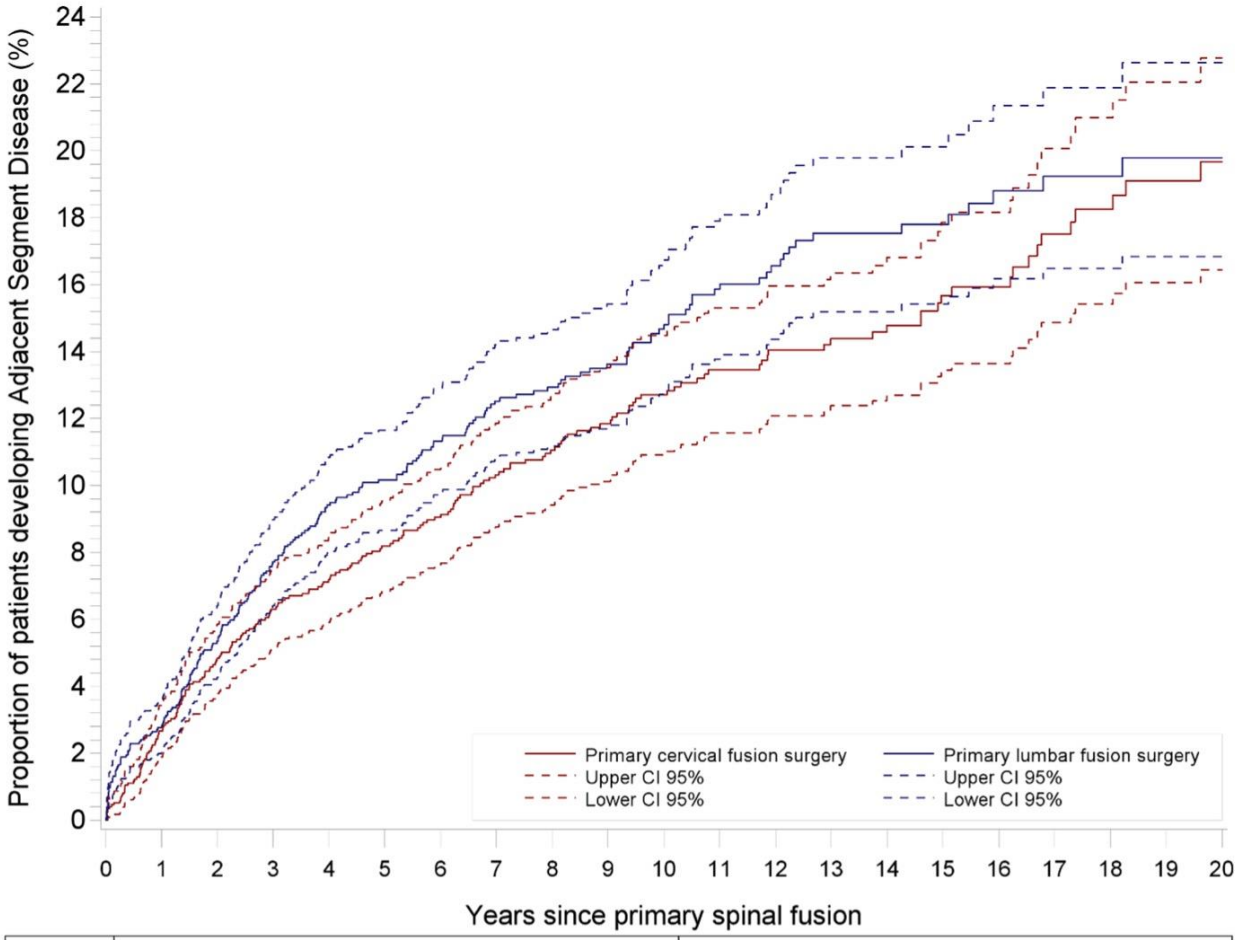

Year since primary spinal fusion	For primary cervical fusion surgery				For primary lumbar fusion surgery			
	Survival Probability (%)	95% CI for Survival Probability	Cumulative Incidence (%)	95% CI for Cumulative Incidence	Survival Probability (%)	95% CI for Survival Probability	Cumulative Incidence (%)	95% CI for Cumulative Incidence
5	91.81	90.46-93.17	8.19	6.83-9.54	89.84	88.36-91.34	10.16	8.66-11.64
10	87.28	85.52-89.09	12.72	10.91-14.48	85.33	83.42-87.28	14.67	12.72-16.58
15	84.32	82.14-86.56	15.68	13.44-17.86	82.20	79.88-84.59	17.80	15.41-20.12
20	80.33	77.23-83.56	19.67	16.44-22.77	80.21	77.36-83.16	19.79	16.84-22.64

Cumulative incidence of revision for cervical (red) and lumbar (blue) AdSD over time.

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Paper #159. Does Strategy Derived from the Ghailane-Gille Classification for Degenerative Spondylolisthesis of the Lumbar Spine Affect Surgical Outcome: A Match-Mismatch Study

Soufiane Ghailane, MD; Jean-Etienne Castelain, MD; Matthieu Campana, MD; Vincent Challier, MD

Hypothesis

Restoring sagittal alignment (SA) when treating degenerative spondylolisthesis of the lumbar spine (DSLS) yields better clinical and radiographic results. Ghailane and Gille proposed treatment guidelines (TG) according to their classification based on SA. Objective: To investigate whether adherence to TG affects surgical outcome in DSLS.

Design

Retrospective match-mismatch study

Introduction

DSLS is a common cause of low back pain, leg pain, neurogenic claudication and sagittal imbalance. Numerous studies highlighted the impact of SA on surgical outcome. A validated a DSLS classification based on SA was proposed. TG were the following: Type 1 requires a segmental strategy consisting of treating the spondylolisthesis level with decompression with dynamic stabilization or fusion. Type 2 and 3 require regional or global correction to address associated spinal deformity.

Methods

Patients treated for DSLS, who underwent surgical treatment from September 2021 to May 2023 in our institution were retrospectively reviewed. Radiographic measurements, clinical data and health-related quality of life scores, including Oswestry index (ODI), Visual Analogue Scale (VAS) for pain, were recorded preoperatively, and postoperatively with a minimum 1 year follow-up. Patients were divided in two groups according to TG: the first group is a match (TG followed), the second group is a mismatch (rule-breaker). Patients' satisfaction, complications were recorded. Normality and heteroskedasticity of data were assessed with the Shapiro-Wilk test. The difference between the two groups were assessed using Mann-whiteney, Fischer's exact tests.

Results

Eighty-four patients were enrolled. Among them, 67 were in the Match group and 18 in the Mismatch Group. Table 1 summarizes the main results. No difference was found between the groups regarding L-VAS, R-VAS or ODI. The perioperative complication rate was 0% and 25 % (2 dural tear, 1 mechanical failure, acute lung edema) in patients for match and mismatch group p=0.003). Median values of satisfaction score were 72.5% (IQR 33.25) for TG-followed and 50.0% (IQR 35.0) for rule-breaker (p=0.008).

Conclusion

Restoring satisfactory alignment following the Ghailane-Gille Classification TG seems to decrease intraoperative complications and improves patients' satisfaction.

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Variable	Match	Mismatch	p-Value
	N = 65	N = 17	
Gender			0.757
M	16 (24.62%)	5 (29.41%)	
W	49 (75.38%)	12 (70.59%)	
Age	69.29 (± 9.62)	70.29 (± 11.99)	0.731
Pre L-VAS	7.31 (± 1.88)	7.18 (± 2.04)	0.806
Pre R-VAS	7.22 (± 1.81)	7.24 (± 2.31)	0.541
Pre ODI	41.63 (± 15.81)	41.71 (± 13.7)	0.986
Classification Ghailane-Gille Preop			0.752
1A	16 (26.23%)	7 (43.75%)	
1B	7 (11.48%)	1 (6.25%)	
2A	2 (3.28%)	0 (0.0%)	
2B	1 (1.64%)	0 (0.0%)	
3	35 (57.38%)	8 (50.0%)	
DSLS Level(s)			>0.999
L3L4	10 (15.39%)	2 (11.76%)	
L4L5	51 (78.46%)	15 (88.24%)	
L4S1	1 (1.54%)	0 (0.0%)	
L5S1	3 (4.62%)	0 (0.0%)	
Perioperative Complication			**0.003**
Yes	0 (0.0%)	4 (25.0%)	
No	50 (100.0%)	12 (75.0%)	
Surgical satisfaction score	70.36 (± 18.79)	53.94 (± 23.88)	**0.008**
Are you satisfied with the results of your surgery?			**<0.001**
Dissatisfied	0 (0.0%)	14 (87.5%)	
I don't know	1 (1.64%)	0 (0.0%)	
Satisfied	42 (68.85%)	0 (0.0%)	
Very satisfied	18 (29.51%)	2 (12.5%)	
Given your results, would you do this surgery again?			**<0.001**
Certainly	47 (77.05%)	2 (12.5%)	
Certainly not	0 (0.0%)	13 (81.25%)	
Certainly	13 (21.31%)	1 (6.25%)	
I don't know	1 (1.64%)	0 (0.0%)	
Given the results of your surgery, would you recommend this surgery to a family member or friend?			**<0.001**
Certainly	47 (77.05%)	3 (18.75%)	
Certainly not	0 (0.0%)	12 (75.0%)	
Certainly	14 (22.95%)	1 (6.25%)	
Post L-VAS (1YFU)	4.91 (± 2.81)	3.67 (± 3.16)	0.267
Post R-VAS (1YFU)	3.78 (± 2.9)	3.11 (± 3.62)	0.503
Post-ODI (1YFU)	23.59 (± 17.58)	20.44 (± 14.59)	0.682

Main Results

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Paper #160. Contemporary Guidelines for Acetabular Positioning in Hip Arthroplasty May Jeopardize Hip Dislocation for Select ASD Patients

Marc Boutros, BS; Mohammad Daher, BS; Ayman Assi, PhD; Gilles Prince, MD; Mohammad I. Karam, PhD; Christopher P. Ames, MD; Shay Bess, MD; Alan H. Daniels, MD; Munish C. Gupta, MD; Richard Hostin, MD; Michael P. Kelly, MD; Han Jo Kim, MD; Eric O. Klineberg, MD; Lawrence G. Lenke, MD; Pierce D. Nunley, MD; Peter G. Passias, MD; Frank J. Schwab, MD; Christopher I. Shaffrey, MD; Justin S. Smith, MD, PhD; Renaud Lafage, MS; *Bassel G. Diebo, MD*; Virginie Lafage, PhD; International Spine Study Group

Hypothesis
The conventional Lewinnek safe zone does not apply to adult spinal deformity (ASD) patients with high pelvic tilt (PT).

Design
Retrospective analysis of prospectively collected data.

Introduction
Lewinnek et al. defined a safe zone for cup inclination (40° ± 10°) and anteversion (15° ± 10°) to reduce dislocations after total hip arthroplasty (THA). Despite the Lewinnek safe zone being respected, higher rates of prosthetic dislocation are found in ASD patients undergoing THA. This study aims to investigate if ASD patients with high PT need a specific safe zone for acetabular positioning.

Methods
ASD patients with moderate to severe sagittal deformity underwent full-body xrays and a detailed 3D reconstruction of the pelvis and lower limbs in standing position pre-op. The PI-adjusted PT was calculated using Vialle et al formula (adj.PT=0.37*PI-7°) and patients with PT> adj.PT were grouped as HighPT, otherwise as NormPT. Spino-pelvic, 3D acetabular parameters were compared between the groups. PT offset from adj.PT was calculated. The number of patients falling outside the Lewinnek safe zone between the 4 quartiles of PT offset was compared. The relationship between PT and acetabular parameters was assessed with linear regression.

Results
132 patients were included (HighPT:86, NormPT:46) with no differences in age, sex, comorbidities, and hip OA grades between the groups. HighPT had higher PI-LL (32.1, 12.4°), SVA (79.7, 59.0 mm), T1PA (31.2, 19.5°), SFA (209.1, 199.3°), pelvic Shift (50.3, 17.2 mm), GSA (7.6, 4.5°), and L4-S1 lordosis (26.2, 34.5°; all $p<0.05$). HighPT had higher acetabular abduction (60.5, 58.4°), acetabular anteversion (23.4, 20.1°), acetabular tilt (36.5, 29.8°) and posterior coverage (102.6, 98.6°, all $p<0.05$).The % of patients falling outside of the anteversion safe zone increased with PT offset (Q1:32%, Q2:47, Q3:57, Q4:75%, $p=0.003$) without being significant for abduction. The equation to determine acetabular anteversion in function of PT was derived: 16.582 + 0.215*PT (SE:6) (Figure). Anteversion of 21, 23, 25, 27 was associated with PT of 20, 30, 40 and 50°.

Conclusion
This is the first study to investigate impact of severe spinal deformity on pelvic tilt and acetabular anteversion in native hips. It also proposes an equation to calculate safe zone for acetabular component position and establishes thresholds of PT adjusted acetabular anteversion (Figure).

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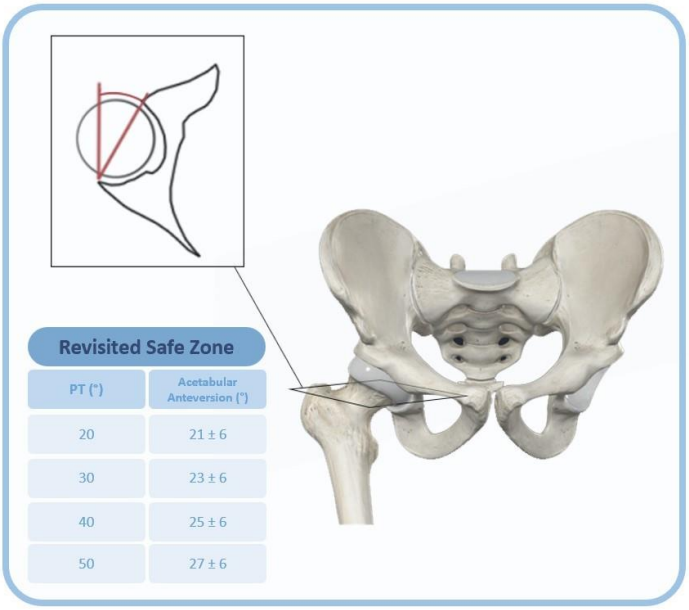
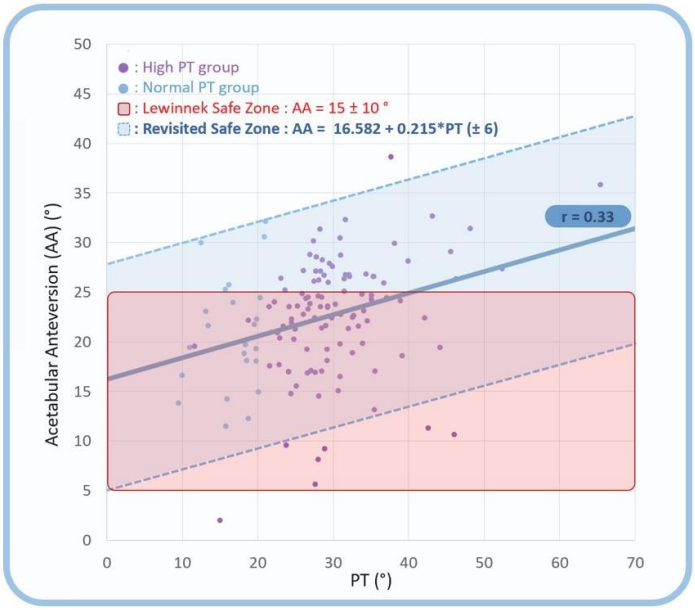


Revisited Safe Zone

PT (°)	Acetabular Anteversion (°)
20	21 ± 6
30	23 ± 6
40	25 ± 6
50	27 ± 6



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Paper #161. Comparison of Reoperation Rates for Anterior Cervical Discectomy and Fusion and Cervical Disc Arthroplasty: A Retrospective Cohort Study from a Multicenter Healthcare System

Samir AlSalek, BS; Richard N. Chang, PhD; *Shayan U. Rahman, MD*; Harsimran S. Brara, MD; Daniel Hirt, MD; Heather A. Prentice, PhD; Jessica Harris, MS; Maya Harary, MD; Hunter G. Richards, BS; Azim N. Laiwalla, MD; Kern H. Guppy, MD, PhD

Hypothesis
There is no difference in all-cause reoperation rates between ACDF and CDA.

Design
multi-center, multi-surgeon retrospective cohort

Introduction
Cervical degenerative disc disease (DDD) has historically been treated with ACDF. Anterior Cervical Discectomy and Fusion (ACDF) is associated with favorable clinical outcomes but may increase the risk of adjacent segment disease (ASD) and subsequent reoperation. Cervical disc arthroplasty (CDA) was introduced as an alternative technique to preserve cervical mobility and reduce the risk of ASD. Few prior studies have evaluated the long-term outcomes of ACDF compared to CDA in large patient cohorts. We sought to compare these two techniques with regard to all-cause reoperation.

Methods
A retrospective cohort study using data from a US-based multicenter healthcare system's Spine Registry identified a propensity score-matched cohort (3:1, ACDF vs CDA) of adult patients (>18 years) with cervical DDD who had primary ACDF or CDA between levels C3 and C7 (2009-2022). Patients were followed until validated reoperation, membership termination, death, or end of study. Cox-proportional hazards regression was used to evaluate reoperation rates. 10-year crude cumulative incidence rates were calculated.

Results
The original cohort consisted of 5,830 patients. 2,286 ACDF patients were propensity-score matched to 762 CDA patients. The average age was 48.3 years (SD ±7.9), and average follow-up was 6.5 years (SD ±4.0). For CDA versus ACDF, we found a 10-year reoperation rate of 8.9% versus 12.4%; ASD rate of 5.7% vs 9.3% and implant failure 2.8% vs 0.2%. In regression analysis, no difference in all-cause reoperation risk was observed for CDA compared to ACDF (HR=0.79, 95% CI=0.60-1.05); a lower risk of ASD was found in the CDA group (HR=0.72, 95% CI=0.54-0.96), however, there was a higher risk of implant failure (HR=13.85, 95% CI=4.70-40.84).

Conclusion
In a large, matched cohort, CDA was associated with a 30% reduction in operative ASD, but a significantly higher rate of implant failure compared to ACDF. No difference in all-cause reoperation rates was observed between the two techniques.

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Paper #162. Deep Learning Classification of Pediatric Spinal Radiographs

Kellen Mulford, PhD; Christina M. Regan, BS; Julia Todderud, BA; Charles P. Nolte; Zachariah W. Pinter, MD; Cody C. Wyles, MD; Bardia Khosravi, MD; Pouria Rouzrokh, MD; Hilal Maradit Kremers, MD; *A. Noelle Larson, MD*

Hypothesis

We hypothesize that this deep learning classifier will correctly identify patient radiographs with a high degree of accuracy.

Design

Development of a computer vision model to identify pediatric spine radiographs for development of an automated image classifier.

Introduction

Large imaging registries frequently rely on DICOM header information for entering new images into the registry which is unreliable or alternatively manual data entry which is labor-intensive and comparatively slow. Artificial intelligence and deep learning methods particularly suited for the analysis and classification of unstructured data, such as medical images, may provide fast and accurate methods for classifying incoming images.

Methods

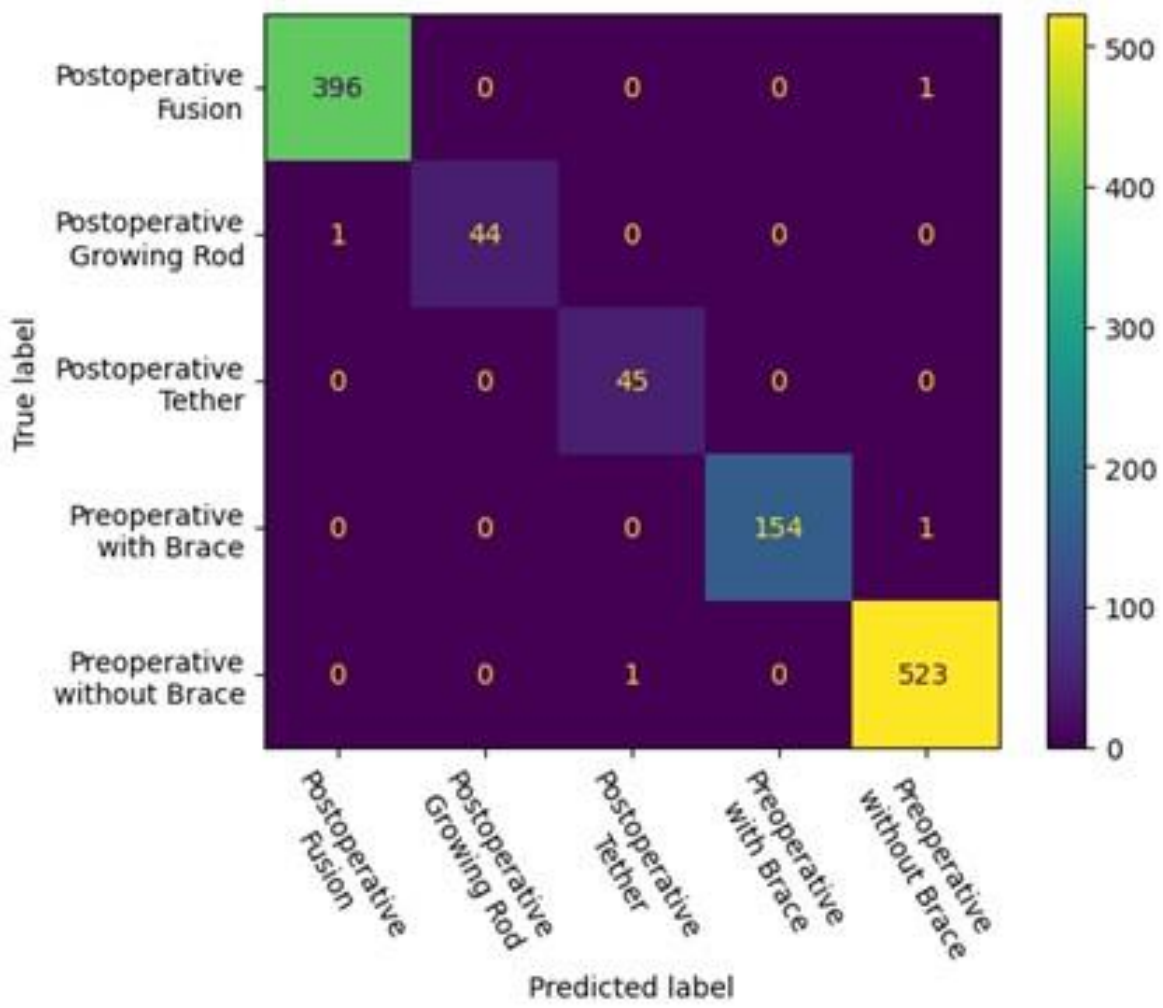
Anterior-posterior (AP) and lateral spine radiographs were extracted from a single center for patients with confirmed scoliosis diagnoses over the last 20 years, for a total of 13,398 images (7777 AP images, 5621 lateral). Radiographs were manually classified into ten categories including in-brace, out-of-brace, fusion, growing rod, non-fusion surgeries (2 preop and 3 postop each for AP/lateral). The images were split into training, validation, and testing sets in a 70:15:15 proportional split. A deep learning classifier using the EfficientNet B6 architecture with pretrained weights was trained on the images. Hyperparameters and model architecture were tuned with the validation set. Final performance metrics were calculated on the test set, including accuracy, positive predictive value as defined by precision, recall, and F1 score (the harmonic mean of precision and recall).

Results

The trained classifiers had nearly perfect performance with an overall accuracy of 1.00 on 1166 AP images in the test set, and 1.00 on 843 lateral images in the test set. Precision ranged from 0.98 to 1.00 in the AP images, and from 0.91 to 1.00 on the lateral images. Performance was higher on the more common classes in the dataset, while the lower performance was observed on classes with fewer than 100 images in the dataset.

Conclusion

A deep learning convolutional neural network classifier was trained to a high degree of accuracy to distinguish between 10 categories pre- and postoperative spine radiographs of children with scoliosis. These models represent an important step in developing automated classification for large, labeled imaging registries.



AP classifier confusion matrix analyzing predicted versus true labeling.

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Paper #163. PROMIS and ODI Tools: Clinically Useful Predictors of Abnormal MRIs in Pediatric Back Pain?

Devan J. Devkumar, BSA; Karina A. Zapata, PhD, PT, DPT; Chan-Hee Jo, PhD; *Brandon A. Ramo, MD*

Hypothesis

Patient-Reported Outcomes Measurements Information System (PROMIS) and Oswestry Disability Index (ODI) tools may help predict abnormal MRIs in adolescents with back pain.

Design

Retrospective case series

Introduction

Back pain is growing in prevalence in adolescents, and MRIs are increasingly ordered to elucidate an underlying cause which can strain resource utilization. The usefulness of patient reported outcome measures (PROMs) to help providers determine whether to order an MRI is unknown.

Methods

Retrospective review of 300 children (100M, 200F) ages 5-18 years, presenting with caregiver-reported back pain, who underwent spine MRIs, and who had completed 1) the PROMIS Pediatric Computer Adapted Test Pain Interference, Mobility, and Anxiety measures, 2) the 9-item ODI, and 3) back pain intensity on a scale of 0-5, from April 2021 to June 2023. Patients were excluded if they had non-idiopathic scoliosis, previous spinal surgeries, or specifically neck pain. PROMs were compared in both normal MRIs and abnormal MRIs (defined by presence of correlative and/or causative findings) with Mann-Whitney tests and logistic regression analyses. PROMIS and ODI score thresholds were determined with abnormal MRIs via ROC analyses.

Results

174 children had normal MRIs (59%) and 126 had abnormal MRIs. Average overall scores were PROMIS Mobility mild severity (41.3±8.7), PROMIS Pain Interference moderate severity (57.5±8.4), PROMIS Anxiety within functional limits (47.1±10.9), ODI Percentage moderate disability (25.0±16.8), and back pain intensity 1.7±1.1 out of 5. Lower PROMIS Mobility scores (OR 0.951; 95%CI 0.923-0.978) and higher ODI Percentage (OR 1.015; 95% CI 1.001-1.029) were associated with abnormal MRI findings. There were no associations between PROMIS Anxiety, PROMIS Pain Interference, and pain intensity with abnormal MRI findings (Table). A PROMIS Mobility threshold of 40.5 (AUC=0.64) and ODI Percentage of 21.1 (AUC=0.58) were associated with abnormal MRIs.

Conclusion

“What you see is more important than what you hear”: Decreased mobility and increased disability are more indicative of abnormal MRI findings than pain interference and intensity. While AUC for PROMIS mobility and ODI scores were not strong, they still reflect positive results. In conjunction with a thorough history and physical exam, PROMIS Mobility and ODI tools may aid clinical decision making on the utility of MRIs in pediatric back pain.

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	MRI Findings						
PROM	Normal* (n=174)	Abnormal Spine (Causative + Correlative, n=122)	p-value: Normal vs. Abnormal spine	Spine Causative (n=94)	p-value: Normal vs. Spine Causative	Spine Correlative (n=28)	p-value: Normal vs. Spine Correlative
PROMIS Mobility	42.8 ± 8.6	39.2 ± 8.7	**0.001***	39.3 ± 9.0	**<0.001***	38.7 ± 7.8	**0.014***
PROMIS Pain Interference	56.9 ± 8.7	58.3 ± 7.8	0.13	58.3 ± 8.1	0.15	58.2 ± 6.8	0.43
PROMIS Anxiety	47.7 ± 11.4	46.3 ± 10.2	0.40	46.9 ± 10.1	0.73	44.4 ± 10.5	0.17
ODI Percentage	23.3 ± 16.5	27.4 ± 17.1	**0.015***	27.6 ± 17.2	**0.018***	26.8 ± 17.0	0.24
Pain Intensity	1.6 ± 1.1	1.8 ± 1.2	0.32	1.8 ± 1.2	0.21	1.6 ± 1.0	0.90

*P < 0.05. MRI was considered normal if either no findings (n=158), incidental findings of the spine (i.e. hemangioma, n=5), or incidental findings of the non-spine regions (i.e. kidney cyst, n=11). Abnormal spine findings (n=122) included findings causative (i.e. disc herniation, n=94) or correlative (i.e. Schmorl's node, n=28) with back pain. Abnormal non-spinal findings (n=4) included findings causative (i.e. pancreatitis) or correlative (ovarian cyst).