Lumbar Spine Research Society

2024 ANNUAL MEETING

Presented Abstracts

TABLE OF CONTENTS

Disclaimer: Some drugs or medical devices demonstrated at this course may not have been cleared by the FDA or have been cleared by the FDA for specific purposes only. The FDA has stated that it is the responsibility of the physician to determine the FDA clearance status of each drug or medical device he or she wishes to use in clinical practice.

Academy policy provides that "off label" uses of a drug or medical device may be described in the Academy's CME activities so long as the "off label" use of the drug or medical device is also specifically disclosed (i.e., it must be disclosed that the FDA has not cleared the drug or device for the described purpose). Any drug or medical device is being used "off label" if the described use is not set forth on the product's approval label.

Paper 01

Machine Learning of MRI Predicts the Outcome and Rate of Resorption of Lumbar Disc Herniations: a Prospective, Multi-Imaging, One-Year Study

Sabitova Fatima, BS[1], Safronova Anastasiia, MD[2], Giyazitdinova Elvina, MD[3], Albert Hanne, PhD[4], Samartzis Dino, PhD[5], Tkachev Alexander, MD[2]

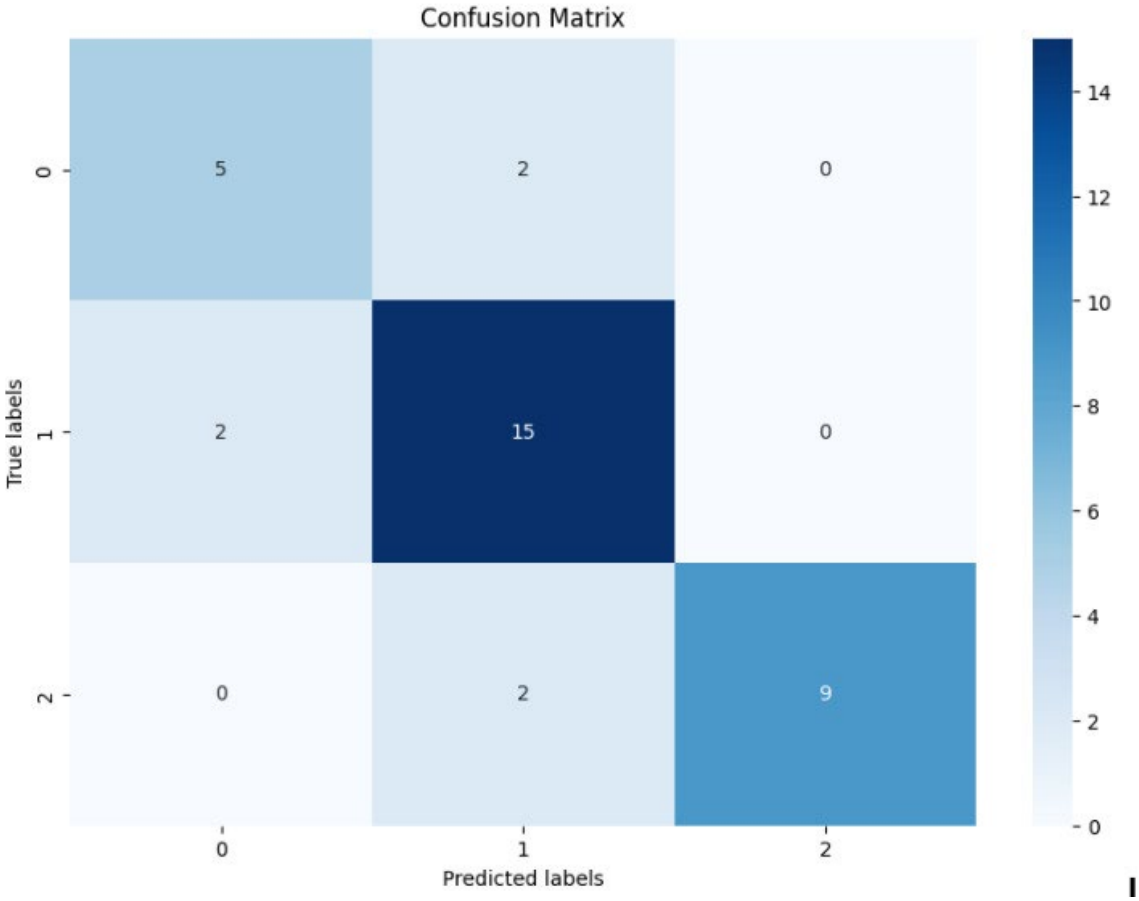
[1] Kazan State Medical Academy, Kazan, , Russia, [2] Tkachev and Epifanov Clinic, Volgograd, , Russia, [3] Tashkent Medical Academy, Tashkent, , Uzbekistan, [4] Rush University Medical Center, Chicago, Illinois, United States, [5] Midwest Orthopaedics at Rush University, Chicago, Illinois, United States

Background/Introduction: Lumbar disc herniation (LDH) can occur in any population worldwide, representing a substantial socioeconomic and healthcare burden. However, "resorption" on imaging (i.e. MRI) and symptom resolution of LDH can occur; conversely, rates of resorption can vary and are a challenge to prognosticate. Machine learning of imaging via radiomics and texture analysis have emerged as innovative approaches, offering a detailed examination of tissue characteristics that are often not perceived or overlooked with standard imaging. Such approaches involve extracting a large array of quantitative features from medical images. As such, the following study used such machine learning approaches to predict LDH resorption and rates of resorption based on MRI.

Materials/Methods: We performed a prospective study of 171 individuals with confirmed LDH, as based on T2-weighted MRI.Patients were stratified to fast, medium, slow, and prolonged recovery groups in relation to symptom resolution and disc resorption. We employed texture analysis on MRI. Advanced radiomics techniques, including 3D image segmentation and quantitative texture analysis using Pyradiomics, were applied to these images.

Results: Pronounced disparities in feature values across the three groups were noted. Specifically, 31 significant features were associated with the prolonged, 16 with the slow, 7 with the medium, and 28 with the fast recovery groups. LDH resorption prediction modelling showed an overall accuracy of 83%. The model effectively differentiated between fast, medium, slow, and prolonged resorption groups, demonstrating its potential to aid clinical decision-making. Texture analysis revealed significant biomarkers indicating changes in LDH structure, suggesting enhanced microcirculation and tissue nourishment in the herniated disc region.

Discussion/Conclusion: This is the "first" study to our knowledge to have utilized a machine learning approach to predict LDH resorption and its rates The integration of radiomics and texture analysis in diagnosing disc herniations presents a novel approach to medical imaging. Despite challenges, such as computational demands and the need for specialized expertise, these methodologies offer deeper insights into tissue pathology, potentially revolutionizing clinical practice. Our findings highlight the importance of further research and clinical validation of such artificial intelligence techniques in the management and prognostication of LDH.


Confusion Matrix
True labels
Predicted labels
0
1
2
5
2
0
2
15
0
0
2
9
14
12
10
8
6
4
2
0

Paper 02

Assessing the Impact of Surgical Invasiveness on Postoperative Recovery and Physical Function: A Multi-Center Retrospective Analysis

Peterson Thomas, PhD[1], Gholi Zadeh Kharrat Fatemeh, PhD[2], Lotz Jeffrey, PhD[2], Archer Kristin, PhD, DPT[3], Bishara Andrew, MD[2], Buser Zorica, PhD, MBA[4], Martin Brook, PhD, MPH[5], Fritz Julie, PhD[6]

[1] UCSF, Orthopaedic Surgery Department, San Francisco, California, United States, [2] UCSF Department of Orthopedic Surgery, San Francisco, California, United States, [3] Vanderbilt University Medical Center, Nashville, Tennessee, United States, [4] Gerling Institute, Brooklyn, New York, United States, [5] University of Utah Orthopaedic Center, Salt Lake City1, Utah, United States, [6] Department of Orthopaedics, University of Utah, Salt Lake City, , United States

Background/Introduction: The Surgical Invasiveness Index (SII) quantifies the complexity of spinal procedures but its correlation with patient outcomes post-surgery is not well-understood. This study evaluates the association between SII and 3-months patient-reported outcomes (PROs) such as pain intensity and physical function in patients with low back pain.

Materials/Methods: A retrospective analysis was conducted using electronic health records from UCSF and Utah, and clinical trials and registries at VUMC. The SII was calculated using Current Procedural Terminology codes. Patient outcomes including Numeric Rating Scale for pain (NRS) and Patient-Reported Outcomes Measurement Information System Physical Function (PROMIS PF) were compared pre- and post-surgery. Univariate regression analysis assessed the association between SII and changes in PROs.

Results: In Table 1, our study showed that a higher SII is associated with an increased length of stay (LOS) at UCSF ($p < 0.01$) and VUMC ($p < 0.01$), which is consistent with the literature. However, no significant association was found between SII and changes in pain intensity at all three institutions (0.09, 0.8, and 0.7 for UCSF, Utah, and VMUC, respectively). A statistically significant association was observed between SII and decreased PROMIS PF at 3-months post-surgery for UCSF ($p < 0.01$) and VUMC ($p < 0.01$) but not Utah ($p = 0.08$).

Discussion/Conclusion: The SII correlates with increased LOS, suggesting higher complexity procedures may require longer recovery periods. The lack of association with changes in pain intensity indicates that SII may not directly reflect pain outcomes. The negative association with PROMIS PF suggests that higher SII could predict decreased physical function post-surgery. These findings underscore the importance of considering SII in preoperative planning and postoperative care to optimize patient recovery and functional outcomes. Keywords: Surgical Invasiveness Index, Patient-Reported Outcomes, Spine Surgery, Length of Stay, PROMIS Physical Function.

Univariate Analysis of Relative Risk for Surgical Invasiveness Index (SII)

Dataset	Variables	Coefficient	P value (<0.05*)
UCSF	Length of Stay	0.03	0.00 *
	Change in Low Back Pain (Three Months)	-0.01	0.09
	Change in PROMIS Physical Function (Three Months)	-0.004	0.00*
Utah	Length of Stay	0.34	0.00*
	Change in Low Back Pain (Three Months)	-0.02	0.8
	Change in PROMIS Physical Function (Three Months)	-0.008	0.08
VUMC	Length of Stay	0.75	0.00*
	Change in Low Back Pain (Three Months)	0.01	0.7
	Change in PROMIS Physical Function (Three Months)	-0.14	0.00*

Table1: Univariate Analysis of Surgical Invasiveness Index (SII) and Its Association with Length of Hospital Stay and Changes in Patient-Reported Outcomes for Low Back Pain and Physical Function at UCSF, Utah, and VUMC

Paper 03

Applying GPT-4 to Automate Patient-Facing Communication of Spine Imaging Reports: A Pilot Study

Khazanchi Rushmin, BA[1], Chen Austin, BS[2], Follett Matthew, MD[1], Staub Jacob, BS[1], Balu Abhinav, BS[2], Hsu Wellington, MD[1], Patel Alpesh, MD, MBA[1], Divi Srikanth, MD[1]

[1] Northwestern University Department of Orthopaedic Surgery, Chicago, IL, , United States, [2] Northwestern University Feinberg School of Medicine, Northwestern, Chicago, Illinois, United States

Background/Introduction: As patients gain increased access to their healthcare data, attention must be drawn toward comprehension. For example, radiologist interpretations of spine imaging studies are written for medical professionals, but an operative candidate's understanding of this information is crucial to the shared decision-making process. Individual report summarization by a surgeon is a time-intensive task; therefore, we assessed the ability of a large-language model (LLM), GPT-4, to automate the simplification of preoperative spine MRIs.

Materials/Methods: Preoperative spine MRIs from patients that underwent lumbar fusion and/or decompression for degenerative spondylolisthesis in 2022 were retrospectively queried at a tertiary, academic medical center. Reports were deidentified and input into the GPT-4 API with the prompt: "Please translate a radiology report into plain language that is easy to understand". Default settings were used apart from setting temperature to 0 to maximize reproducibility. Output word counts and Flesch-Kincaid reading levels were compared to original reports with paired t-tests and Chi-square tests, respectively. A trained orthopaedic spine surgeon reviewed all translated radiographic reports for inaccuracies and omissions from the original reports. These a priori grading criteria were focused on information a spine surgeon would want their patient to understand, including the following minor criteria (presence of mild/moderate degenerative changes and mild/moderate canal narrowing) and major criteria (nerve compression, signs of instability, failure to describe stenosis severity, and failure to describe the location of stenosis).

Results: Of 40 included reports, the average word count was 374 ± 116 with a mode reading level of 12th grade (33%). The GPT translations had a similar word count (406 ± 79, $p = 0.1383$) with a lower reading level distribution (mode: 9th grade [35%], $p = 0.0017$) (Table 1). Five (13%) of translations were indicated to have a major inaccuracy while 23 (58%) had a major omission.

Discussion/Conclusion: In our pilot cohort, GPT-4 significantly improved the readability of preoperative spine MRI radiology reports. While summarizations rarely included inaccuracies, omissions were more common. This highlights GPTs lack of domain-specific information, likely secondary to the lack of healthcare data in its development. More focused training data is required before LLMs can competently augment this spine surgeon's task.

Table 1. *Original radiology reports versus GPT summarizations, n = 40*

	Original	GPT	p-value
Word Count (Mean [SD])	374 (117)	406 (79)	0.1383
FK Grade Level (%)			0.0017
6th	0%	10%	
7th	3%	15%	
8th	0%	20%	
9th	8%	35%	
10th	13%	15%	
11th	25%	0%	
12th	33%	5%	
13th	8%	0%	
14th	13%	0%	
Accuracy (n [%])			
Major inaccuracies (> 0)	-	5 (13%)	
Minor inaccuracies (> 0)	-	1 (3%)	
Major omissions (> 0)	-	23 (58%)	
Minor omissions (> 0)	-	0 (0%)	

Paper 04

Postoperative Home Health Care Associated with Increased 90-Day Resource Utilization after Lumbar Fusion: An Analysis of Bundled Payment Data

McCurdy Michael, MD[1], Narayanan Rajkishen, MD[2], Lee Yunsoo, MD[3], Glover Abbey, BS[1], Kim James, BS[1], Gajjar Aryan, BS[1], Canseco Jose, MD, PhD[1], Hilibrand Alan, MD[1], Vaccaro Alexander, MD, PhD, MBA[1], Kepler Christopher, MD, MBA[1], Schroeder Gregory, MD[1]
[1] Rothman Institute at Thomas Jefferson University, Philadelphia, Pennsylvania, United States, [2] Department of Orthopaedic Surgery, Rothman Institute, Thomas Jefferson University, Philadelphia, Pennsylvania, United States, [3] Rothman Institute, Philadelphia, Pennsylvania, United States

Background/Introduction: As value-based care grows in popularity across the United States, more payers have turned away from fee-for-service and toward bundled payment models for surgical procedures. In a bundled payment model, the payer provides reimbursement for a given episode-of-care (EOC) related to a single surgical procedure, incentivizing staff to provide high-quality care and limit unnecessary resource utilization postoperatively. The goal of this study was to identify differences in 90-day resource utilization between patients who received home health nursing after surgery compared to patients who did not.

Materials/Methods: After Institutional Review Board approval, bundled payment information of lumbar fusion EOC from a private payer from January 2019 to December 2021 was reviewed to identify patients at a single, urban, tertiary care center. Patient demographics, characteristics, complications, readmissions, and patient-reported outcomes were collected. Home health visits were counted using claims-level data from a private insurance provider utilizing bundled payments. Patients were grouped into those that received home health (HH) and those that did not (no HH) for statistical analysis.

Results: Patients that were sent home with home healthcare services were, on average, older (59.5 vs. 68.6, $p<0.001$), more obese (BMI: 30.0 vs. 31.3, $p=0.042$), more medically complex (CCI: 0.57 vs. 1.05, $p=0.005$), and less frequently had a smoking history (nonsmoker: 74.2% vs. 79.6%, $p=0.032$). HH patients also had longer length of stay (2.83 vs. 3.18, $p<0.001$), longer operative time (178 vs. 211 minutes, $p=0.005$), higher rates of 30-day readmission (2.14% vs. 7.77%, $p=0.006$), higher rates of 90-day readmission (4.12% vs. 13.6%, $p<0.001$). HH patients had increased 90-day resource utilization including a great number of PT sessions (7.03 vs. 13.1, $p<0.001$), ED visits (0.05 vs. 0.17, $p=0.015$), and phone calls to the office (4.86 vs. 7.93, $p<0.001$). Patients that had home healthcare services had an average of 7.3 visits and total cost of $1,225.

Discussion/Conclusion: Patients utilizing home health care after elective lumbar surgery used a significantly greater amount of resources in terms of therapy, ED visits, and physician office communications. In the era of bundled payment models, home health may be a necessary consideration for risk adjustment in reimbursement after lumbar fusion.

Paper 05

Assessing the Variation and Drivers of Cost in 1-Level Lumbar Fusion: A Time-Driven Activity-Based Costing Analysis

Bernstein David, MD[1], Hammoor Bradley, MD[1], Ukogu Chierika, MD[1], Bono Christopher, MD[2], Hershman Stuart, MD[2], Tobert Daniel, MD[2], Cha Thomas, MD[2], Fogel Harold, MD[2]
[1] Harvard Combined Orthopaedic Residency Program, Massachusetts General Hospital, Boston, Massachusetts, United States, [2] Massachusetts General Hospital, Harvard Medical School, Boston, , United States

Background/Introduction: As value-based health care arrangements continue to be developed and revised in spine care, understanding the true cost of care becomes critical. Historically, inaccurate cost proxies have been used, including negotiated reimbursement rates or list prices. However, time-driven activity-based costing (TDABC) allows for a more accurate cost assessment, including a better understanding of the primary drivers of cost in 1-level lumbar fusion. The purpose of this study was to determine the variation of total hospital cost, differences in characteristics between high-cost and non-high-cost patients, and identify the primary drivers of total hospital cost in a sample of patients undergoing 1-level lumbar fusion.

Materials/Methods: Patients undergoing a 1-level lumbar fusion between November 2, 2021 and December 2, 2022 were identified at two hospitals (one quaternary referral academic medical center and one community-based hospital) within our health system. TDABC was used to calculate total hospital cost, which was also broken up into: pre-, intra-, and postoperative timeframes. Operating surgeon and patient characteristics were also collected and compared between high- and non-high-cost patients. Multivariable linear regression was used to determine factors associated with total hospital cost.

Results: A total of 403 patients undergoing 1-level lumbar fusion were identified. The most expensive 1-level lumbar fusion was 9.4x more expensive than the least expensive 1-level lumbar fusion, with the intraoperative period accounting for 87% of total cost, on average. High-cost patients were more likely to have commercial health insurance (27 out of 42 (64%) vs. 187 out of 361 (52%) and have their surgeries done at the academic medical center (206 out of 361 (57%) vs. 17 out of 42 (40%), $p=0.04$). Outpatient surgery (RC: -0.11 [95% CI: -0.20 to -0.03], $p=0.009$) and numerous surgeons ($p<0.05$) were associated with total cost when accounting for other factors.

Discussion/Conclusion: A large variation exists in the total hospital cost for patients undergoing 1-level lumbar fusion, which is primarily driven by surgeon-level decisions and preferences. As efforts continue to optimize patient value through ensuring appropriate clinical outcomes while also reducing cost, spine surgeons must use this knowledge to lead discussions that could impact the care they give to patients.

Paper 06

Long Term Cost Difference in Surgical vs Nonsurgical Treatment of Lumbar Spondylolisthesis

Philipp Travis, MD[1], Kark Jonathan, MD[2], Ryu Won Hyung A., MD[2], Lin Clifford, MD[2], Yoo Jung, MD[1]
[1] Oregon Health Sciences University, Portland, Oregon, United States, [2] Oregon Health & Science University, Portland, Oregon, United States

Background/Introduction: Prior research has indicated that long-term non-operative treatments before fusion are cost-inefficient, and surgical treatment for lumbar spondylolisthesis is a cost-effective strategy. Nevertheless, there is a lack of data regarding the long-term cost difference between patients treated with lumbar spondylolisthesis surgery and those without surgery. This study examines the yearly and cumulative cost differential over a 10- year period between patients with lumbar spondylolisthesis and those without as well as those with lumbar spondylolisthesis treated surgically vs. non-surgically.

Materials/Methods: The PEARL diver database was queried for patients age 55-60, with a diagnosis of acquired spondylolisthesis in 2010. These patients were age and sex matched to patients without the diagnosis. Annual total healthcare expenditures were then obtained for the next 10 years and compared. The patients with the diagnosis of spondylolisthesis were then divided based on if they were treated with surgery or without surgery and again annual healthcare expenditures were obtained for the next 10 years and compared.

Results: 27,073 patients with spondylolisthesis were identified. The mean cumulative costs for patients with no diagnosis of lumbar spondylolisthesis was $64,936 ± 34,993 vs $85,159 ± 53,332 ($p<0.0001$) over the 10 year study period with a cumulative difference of $20,223. The largest annual difference in cost was year 1 at $8916 more for the spondylolisthesis group. By year 10 the annual cost difference was inverted at $154. The mean cumulative cost for patients with spondylolisthesis that did not undergo surgical treatment (n =4,754) was $78,035 ± 98,105 vs $104,221 ± 72,843 ($p<0.001$) for patients that undergo surgical treatment (n =22,319), a difference of $26,186. However, at year 6 the per annum cost difference inverts with patients treated without surgery costing more. This difference increases every year until year 10 where the per annum health expenditures for those treated with surgery were $1405 less than those treated without surgery.

Discussion/Conclusion: Patient treated with surgery for lumbar spondylolisthesis have higher cumulative healthcare costs over 10 years. However, the cost difference decreases the further out from surgery, with the per annum cost being less for those treated with surgery from year 6 on.

Paper 07

The Superiority of Endplate Hounsfield Units Relative to Lumbar Vertebral Hounsfield Units in Predicting Subsidence After Transforaminal Lumbar Interbody Fusion

Levy Hannah, MD[1], Magera Adam, BA[2], Astudillo Potes Maria, BS[3], Messer Caden, BS[2], Pinter Zachariah, MD[4], Hamouda Abdelrahman, BS[2], Fogelson Jeremy, MD[4], Bydon Mohamad, MD[4], Elder Benjamin, MD, PhD[4], Currier Bradford, MD[1], Nassr Ahmad, MD[4], Sebastian Arjun, MD[4], Karamian Brian, MD[5], Freedman Brett, MD[4]

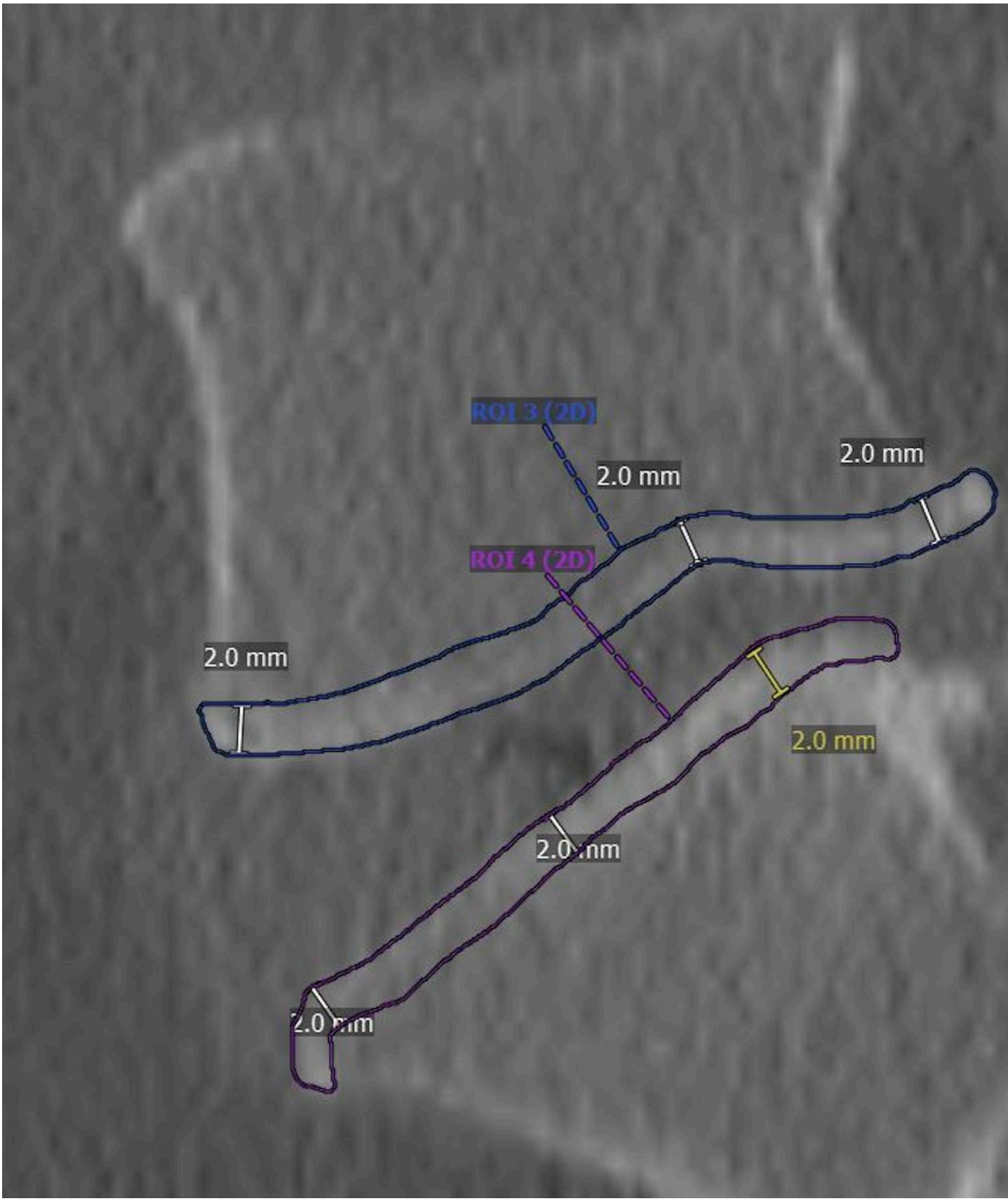
[1] Mayo Clinic College of Medicine, Rochester, Minnesota, United States, [2] Mayo Clinic Rochester, Rochester, Minnesota, United States, [3] Mayo Clinic Michigan, Rochester, Minnesota, United States, [4] Mayo Clinic College of Medicine and Science, Rochester, Minnesota, United States, [5] Rothman Institute at Thomas Jefferson University, Philadelphia, Pennsylvania, United States

Background/Introduction: Subsidence represents a well-known complication after lumbar interbody fusion that has been previously associated with segmental kyphosis, foraminal narrowing, pseudoarthrosis, recurrence of preoperative symptoms, and higher reoperation rates. Decreased bone quality is a known risk factors for interbody subsidence. CT vertebral Hounsfield Units (HUs) are often preferred relative to dual X-ray absorptiometry in assessment of bone quality because of increased regional specificity and less susceptibility to false elevations. However, HUs are a measure of only trabecular bone density and do not account for the strength of endplate cortical bone in contact with interbody surface. The present investigation developed a novel CT-based assessment of endplate bone density (EB-HU) and aimed to determine if EB-HU was a stronger predictor than trabecular HU for subsidence after transforaminal lumbar interbody fusion (TLIF).

Materials/Methods: All adult patients who underwent single-level TLIF for lumbar degenerative conditions at an academic center between 2017-2022 were retrospectively identified. A 2mm superior and inferior endplate region was circumscribed on the preoperative left, right, and mid sagittal CT scans using the free draw function to account for endplate surface undulations (Figure 1). EB-HUs were calculated as the average HUs of the superior and inferior endplate regions on all views. Average standard lumbar vertebral HUs were determined from circumscribed trabecular bone within cranial, middle, and caudal axial CT cuts. Interbody subsidence at the superior and inferior endplate of each TLIF level was directly measured on the endplate-facing surface of both coronal and sagittal CT scans obtained at one year postoperatively to determine the maximum subsidence (severe ≥4mm). Univariate and multivariate analysis compared subsidence based on CT bone metrics.

Results: A total of 138 patients met the inclusion/exclusion criteria. EB-HUs were moderately correlated with lumbar vertebral HUs (Pearson's ρ=0.49). Severe subsidence was significantly associated with decreased EB-HUs (Severe [S]: 348HU, not severe [NS]: 408HU, p=0.001) and decreased lumbar vertebral HUs (S: 126HU, NS: 152HU, p=0.001). Linear regression demonstrated that decreased EB-HUs (Beta: -0.007, p=0.004), but not decreased lumbar vertebral HUs (Beta: -0.007, p=0.108), significantly predicted maximum interbody subsidence.

Discussion/Conclusion: CT endplate HUs rather than vertebral trabecular HUs may be a better predictor of subsidence after TLIF.


ROI 3 (2D)
2.0 mm
2.0 mm
ROI 4 (2D)
2.0 mm
2.0 mm
2.0 mm

Paper 08

Utility of Vertebral Bone Quality Score in Predicting Osteoporosis Related Complications in Long-Segment Fusion Patients

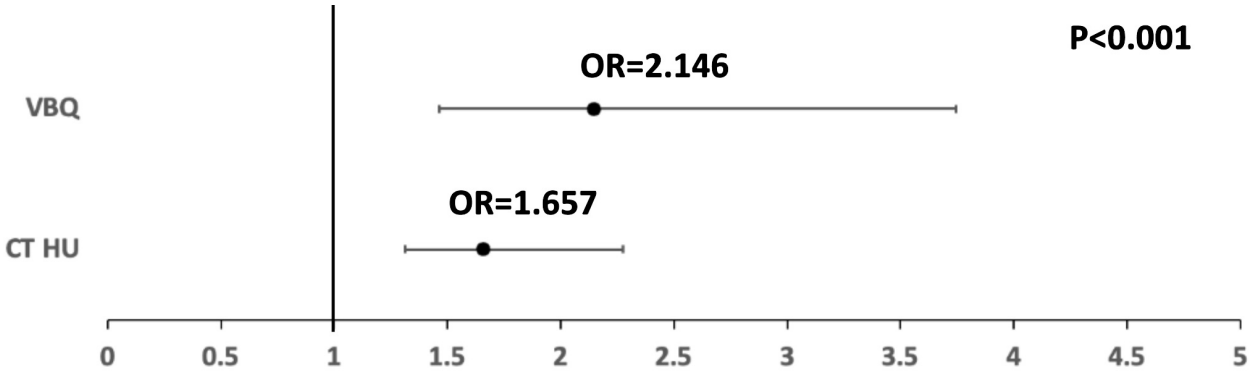
Kadri Aamir, MD[1], *Yates Rob, BS*[2], *Kapp Sabryn, BS*[2]
[1] *University of Kentucky Department of Orthopaedic Surgery and Sports Medicine, Lexington, Kentucky, United States,* [2] *University of Kentucky College of Medicine, Lexington, Kentucky, United States*

Background/Introduction: Osteoporosis is common in spine surgical patients and associated with adverse outcomes. CT Hounsfield units (HU) and MRI based vertebral bone quality score (VBQ) have been shown to estimate bone quality and predict the risk of osteoporosis related complications (ORC). However, minimal data exist in long segment fusion patients. Thus, we aimed to determine the association between VBQ score and ORCs in long segment fusion patients, identify a threshold value at which the likelihood of ORCs may increase, and determine whether VBQ better predicts ORCs compared to HU.

Materials/Methods: Between January 2018 – January 2023, 73 patients age>50 who underwent long-segment fusion, had pre-operative T1-weighted non-contrast MRI and non-contrast CT scans of the lumbar spine, and a minimum of 24 months follow-up were included. ORCs included pseudarthrosis, hardware failure, or revision surgery. VBQ score was calculated as the median signal intensity of the L1-L4 vertebra divided by the signal intensity of the L3 CSF. CT HU were obtained at the L1 vertebra. Regression analysis was performed to identify the association between VBQ, HU, and ORCs, with age and sex used as covariates. The threshold value with optimal sensitivity and specificity was determined using a one-split classification tree.

Results: Pseudarthrosis occurred in 39.8%, hardware failure in 17.8%, and revision surgery in 34.2%. Mean VBQ score was 3.22 (0.77), and mean CT HU were 138.51 (39.81). The estimated odds of pseudoarthrosis, hardware failure, or revision surgery increased by 114% per 0.25-point increase in VBQ (OR=2.146 [2.5 to 21.3]), compared to 66% per 10-point decrease in HU (OR=1.657 [1.313 to 2.273]), $p<0.001$ (Figure 1). The threshold value at which the risk of an adverse outcome increased was VBQ=3.111 (OR=10.9 [2.5 to 62.3]).

Discussion/Conclusion: Higher VBQ score was associated with an increased risk ORCs, with a simplified threshold value > 3.0 suggesting the need for further bone health evaluation. Based on odds ratios, VBQ score better recognized those at risk of ORCs compared to HU. These findings suggest that VBQ score may be useful in recognizing patients at risk for surgical complications related to osteoporosis who may benefit from further osteoporosis evaluation and potential treatment.


P<0.001
OR=2.146
VBQ
OR=1.657
CT HU
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Paper 09

The Impact of CT-based Subsidence Assessment on Radiographic and Clinical Outcomes After Transforaminal Lumbar Interbody Fusion

Levy Hannah, MD[1], Pinter Zachariah, MD[2], Reed Ryder, MD[1], Harmer Joshua, MD[1], Fogelson Jeremy, MD[2], Bydon Mohamad, MD[2], Elder Benjamin, MD, PhD[2], Currier Bradford, MD[1], Nassr Ahmad, MD[2], Freedman Brett, MD[2], Karamian Brian, MD[3], Sebastian Arjun, MD[2]
[1] Mayo Clinic College of Medicine, Rochester, Minnesota, United States, [2] Mayo Clinic College of Medicine and Science, Rochester, Minnesota, United States, [3] Rothman Institute at Thomas Jefferson University, Philadelphia, Pennsylvania, United States

Background/Introduction: Subsidence represents a well-known complication after interbody fusion that has been previously associated recurrence of preoperative symptoms and higher reoperation rates. Currently, there is incomplete evidence to characterize the effect of subsidence on postoperative alignment and patient reported outcomes measures (PROMs) after transforaminal lumbar interbody fusion (TLIF). The present investigation utilized CT-based subsidence assessment to determine if subsidence was an independent predictor of change in lumbar alignment, PROMs, and complications after TLIF.

Materials/Methods: All adult patients who underwent one-two level TLIF for lumbar degenerative conditions at a multi-institutional academic center between 2017-2019 were retrospectively identified. Interbody subsidence at the superior and inferior endplate of each TLIF level was directly measured on the endplate-facing surface of both coronal and sagittal CT scans obtained at six months- one year postoperatively. Patients were grouped based on the maximum subsidence at each operative level: mild-moderate ≤4mm or severe ≥4mm. Preoperative and immediate (<3 months) and long-term (>6 months) postoperative radiographic outcomes (fusion status, local lumbar alignment, global alignment) and PROMs (VAS Back, Oswestry Disability Index, Short Form-12) were collected. Univariate and multivariate analysis compared patient demographics, surgical factors, change in radiographic measures, change in PROMs, and complication rates across subsidence groups.

Results: A total of 67 patients with 85 unique fusion levels met the inclusion/exclusion criteria (55 with mild-moderate subsidence, 30 with severe subsidence). Severe subsidence was associated with lower Hounsfield units at the L3 vertebral body (Severe [S]:126.4, not severe [NS]:177.3, p=0.046), greater preoperative disc height at the TLIF level (S:9.2mm, NS:6.9mm, p=0.013), and greater superior (S:33.6mm, NS:29.8mm, p<0.001) and inferior (S:32.7mm, NS:28.5mm, p=0.002) vertebral body heights. Preoperative and postoperative PROMs and preoperative radiographic alignment did not differ significantly on the basis of moderate or severe subsidence. Severe subsidence was associated with reduced regional lordosis (S:7.2 degrees, NS:8.8 degrees, p= 0.05) at six months, reduced long-term change in regional lordosis (S:0.0 degrees, NS:3.6 degrees, p=0.007), reduced fusion rate (S: 50.0%, NS:92.7%, p<0.001), and increased revision rate (S:23.3%, NS:5.5%, p=0.029).

Discussion/Conclusion: Severe subsidence was identified as a significant risk factor for regional

kyphosis, pseudoarthrosis, and need for revision surgery. However, subsidence was not significantly associated with PROMs.

Paper 10

Anatomic Variation with Supine to Prone Positioning: Implications for Prone Transpsoas Single-Position Lumbar Fusion

Ton Andy, BS[1], Gettleman Brandon, BS[2], Palmer Ryan, BS[1], Abdou Marc, BS[1], Mills Emily, MD[3], Safaee Michael, MD[1], Wang Jeffrey, MD[4], Hah Raymond, MD[4], Alluri Ram, MD[1]
[1] University of Southern California Keck School of Medicine, Los Angeles, California, United States, [2] University of South Carolina School of Medicine, Columbia, South Carolina, United States, [3] Department of Orthopaedic Surgery, Keck School of Medicine, University of Southern California, Los Angeles, California, United States, [4] Keck Medical Center of USC, Los Angeles, California, United States

Background/Introduction: The prone transpsoas (PTP) approach is a novel lumbar fusion technique performed entirely in the prone position, offering benefits of lateral-based fusions and posterior spinal column access. Preoperative supine magnetic resonance imaging (MRI), however, may misrepresent surgical anatomy in the prone position. As such, the present study describes relative anatomical shifts, with pertinence to the lumbar spine, from supine to prone.

Materials/Methods: This was a retrospective cohort review of posterior lumbar fusion patients from 2018-2022 with preoperative MRI and intraoperative prone CT-guided images. Deformity, infection, trauma, or malignancy was excluded. Anteroposterior (AP) and mediolateral (ML) distances (mm) were measured on axial slices from reference lines relative to vertebral endplates at each lumbar level. Both AP and ML distances to abdominal great vessels, psoas major, intervertebral discs (IVD) were measured. Dependent samples t-test and analysis of variance (ANOVA) were used to assess shifts from supine to prone and between segments respectively. Subanalysis was performed in patients with history of anterior/lateral-based lumbar surgery.

Results: Across 58 patients (45% female), overall mean age and body mass index (BMI) were 62.4+11.0 years and 29.8+6.5 kg/m2 respectively. Eight patients (14%) had a history of anterior/lateral-based lumbar surgery (revision group). Significant AP translation was seen at L2-L3 and L3-L4 for the IVC ($p<0.001$) and aorta ($p<0.05$), and L4-L5 for common iliac arteries ($p<0.001$) and veins ($p<0.05$). Symmetric AP excursion of the psoas major was seen at L2-L3 and L4-L5 in prone ($p<0.05$). Significant AP translation was limited to the IVC at L2-L3 and L3-L4 ($p<0.05$) in the revision subgroup. No significant differences in mean translation were seen across levels (Table 1).

Discussion/Conclusion: Intraoperative prone positioning may alter anatomical parameters seen on preoperative MRI, which can be further impacted by post-surgical changes. These shifts should be accounted for when performing PTP.

Non-Revision Cohort						
AP Measurements		**Supine Mean Distance (± SD)**	**Prone Mean Distance (± SD)**	**Mean Difference (± SD)**	**95%CI**	**p-value**
Vessels	**Lumbar Level**					
IVC	L2/L3	7.25 ± 4.98	13.60 ± 4.9	6.35 ± 3.93	4.89 to 7.82	**p<0.001**
Aorta		11.64 ± 4.54	14.10 ± 4.93	2.46 ± 3.21	1.28 to 3.63	**p<0.001**
IVC	L3/L4	8.68 ± 14.17	11.03 ± 4.44	2.36 ± 14.19	-1.81 to 6.52	p=0.131
Aorta		12.30 ± 4.47	14.28 ± 5.18	1.99 ± 4.85	0.56 to 3.41	**p=0.004**
Right Iliac Vein	L4/L5	5.51 ± 4.83	7.40 ± 4.47	1.89 ± 4.24	0.69 to 3.10	**p=0.001**
Left Iliac Vein		7.51 ± 5.70	8.79 ± 4.51	1.28 ± 5.14	-0.19 to 2.74	**p=0.043**
Right Iliac Artery		12.84 ± 8.20	17.36 ± 6.61	4.52 ± 6.74	2.54 to 6.50	**p<0.001**
Left Iliac Artery		10.19 ± 6.95	13.99 ± 6.88	3.80 ± 6.45	1.91 to 5.70	**p<0.001**
Psoas to IVD Ratio (%)	**Lumbar Level**					
Right Psoas to IVD	L2/L3	82.0% ± 11.0%	87.0% ± 11.0%	5.49% ± 11.2%	1% to 10%	**p=0.005**
Left Psoas to IVD		85.0% ± 13.0%	89.0% ± 13.0%	4.29% ± 13.0%	0% to 9%	**p=0.038**
Right Psoas to IVD	L3/L4	95.0% ± 17.0%	97.0% ± 22.0%	2.32% ± 17.9%	-3% to 8%	0.189
Left Psoas to IVD		98.0% ± 18.0%	97.0% ± 18.0%	0.48% ± 17.6%	-6% to 5%	0.427
Right Psoas to IVD	L4/L5	116.0% ± 35.0%	128.0% ± 34.0%	12.72% ± 34.1%	3% to 23%	**p=0.006**
Left Psoas to IVD		115.0% ± 32.0%	127.0% ± 29.0%	12.58% ± 27.5%	5% to 21%	**p=0.001**
ML Measurements		**Supine Mean Distance (± SD)**	**Prone Mean Distance (± SD)**	**Mean Difference (± SD)**	**95%CI**	**p-value**
Vessels	**Lumbar Level**					
IVC	L2/L3	16.89 ± 4.83	14.63 ± 4.74	2.26 ± 4.99	-4.12 to -0.40	**p=0.019**
Aorta		9.57 ± 4.14	10.23 ± 3.15	0.67 ± 4.34	-0.93 to 2.26	0.400
IVC	L3/L4	16.16 ± 4.78	16.73 ± 5.43	0.56 ± 5.40	-1.02 to 2.15	0.478
Aorta		8.12 ± 4.70	7.24 ± 4.05	0.89 ± 3.94	-2.04 to 0.27	0.130
Right Iliac Vein	L4/L5	19.96 ± 5.25	19.94 ± 5.67	0.03 ± 5.85	-1.69 to 1.64	0.973
Left Iliac Vein		11.42 ± 8.14	9.07 ± 6.29	2.35 ± 8.14	-4.67 to -0.04	**p=0.046**
Right Iliac Artery		13.99 ± 9.11	14.33 ± 7.29	0.35 ± 9.25	-2.37 to 3.06	0.799
Left Iliac Artery		14.45 ± 9.10	13.71 ± 8.28	0.74 ± 8.64	-3.28 to 1.79	0.558
Psoas to IVD Ratio (%)	**Lumbar Level**					
Right Psoas to IVD	L2/L3	98.0% ± 19.0%	98.0% ± 18.0%	0.13% ± 18.9%	-7% to 7%	0.971
Left Psoas to IVD		97.0% ± 18.0%	99.0% ± 20.0%	1.53% ± 19.1%	-6% to 9%	0.665
Right Psoas to IVD	L3/L4	106.0% ± 17.0%	109.0% ± 22.0%	3.33% ± 21.0%	-3% to 10%	0.288
Left Psoas to IVD		104.0% ± 20.0%	108.0% ± 21.0%	3.21% ± 19.6%	-3% to 9%	0.273
Right Psoas to IVD	L4/L5	113.0% ± 19.0%	121.0% ± 27.0%	8.07% ± 26.2%	0% to 16%	**p=0.040**
Left Psoas to IVD		115.0% ± 21.0%	121.0% ± 27.0%	6.52% ± 28.4%	-2% to 15%	0.122
Segmental Lordosis (deg)	L2/L3	9.60 ± 7.09	8.60 ± 6.2	1.00 ± 4.17	-3.31 to 1.31	0.369
	L3/L4	15.49 ± 6.12	15.73 ± 6.14	0.24 ± 6.00	-1.76 to 2.24	0.807
	L4/L5	20.06 ± 8.69	22.04 ± 8.2	1.98 ± 9.23	-0.67 to 4.63	0.140
	L5/S1	29.14 ± 10.17	30.07 ± 9.52	0.93 ± 8.84	-1.83 to 3.68	0.500

Table 1. Mean changes in anteroposterior (AP) and mediolateral (ML) distances of anatomical parameters relative to corresponding lumbar vertebral body segments during supine and prone positioning. * = *Denotes significance.*

Paper 11

Leg length discrepancy is associated with lumbar disc disease : A study of 350 postmortem specimens

Bhandutia Amit, MD[1], Ng Mitchell, MD[2], Ahn Nicholas, MD[3]
[1] Louisiana State University Medicine, New Orleans, Louisiana, United States, [2] Maimonides Medical Center, Brooklyn, New York, United States, [3] University Of Louisville, Louisville, Kentucky, United States

Background/Introduction: Leg length discrepancy (LLD) is common. LLD even < 10 mm is associated with low back pain and lumbar radiculopathy. LLD may lead to an alteration of gait and posture, and increased stress upon the lumbar elements. We sought to study if a relationship exists between LLD and lumbar disc disease.

Materials/Methods: 350 cadaveric lumbar spines from the Hamann-Todd osteologic collection were evaluated for lumbar disc disease. Subjects included 284 men and 66 women, ages 17-87. Disc disease was graded from 0 to IV on the Kettler and Wilke system at each level from L1-2 to L5-S1. Total disc disease (DDD) was calculated as the sum of across all lumbar levels. LLD was calculated by measuring the combined length of the tibia and femur on each side, and calculating the difference. Linear regression was performed to study the relationship between DDD and LLD, correcting for age, sex, and race.

Results: LLD had a significant, positive association with DDD ($p<0.01$); For each 10 mm increment in LLD, DDD increased 3.2 grades (0.6 grades per level). The association was not present ($p>0.05$) in subjects < 20 or > 70 years old ($p>0.05$); these subjects either had no disk degeneration or widespread degeneration. A significant association existed between DDD and LLD > 5 mm ($p<0.01$) and DDD and LLD >10 mm ($p<0.01$); no significant increase was noted for subjects with LLD < 5 mm ($p>0.05$). A mild increase in DDD was noted in the LLD > 10 group ($p<0.05$) when compared to the LLD > 5 group (0.6 grades/level vs. 0.8 grades/level).

Discussion/Conclusion: Our results support that DDD is associated with LLD, which is most significant in individuals between ages of 20-50. Most of this association comes with LLD of > 5 mm. LLD > 10 mm did lead to further increases in DDD, but to a lesser extent. LLD < 5 mm was not associated with DDD. This study suggests that LLD of at least 5 mm may be associated with lumbar disc degeneration and low back pain.

Paper 12

Does Paraspinal Muscle Mass Predict Lumbar Lordosis after Decompression for Degenerative Spinal Stenosis?

Ezeonu Teeto, BS[1], Narayanan Rajkishen, MD[2], Lee Yunsoo, MD[3], Kellish Alec, MD[2], McCurdy Michael, MD[4], Somers Sydney, BS[5], Fras Sebastian, BS[2], Labarbiera Anthony, BS[1], Khanna Akshay, BS[1], Canseco Jose, MD, PhD[4], Hilibrand Alan, MD[4], Vaccaro Alexander, MD, PhD, MBA[4], Kepler Christopher, MD, MBA[4], Schroeder Gregory, MD[4]

[1] Sidney Kimmel Medical College at Thomas Jefferson Iniversity, Philadelphia, Pennsylvania, United States, [2] Department of Orthopaedic Surgery, Rothman Institute, Thomas Jefferson University, Philadelphia, Pennsylvania, United States, [3] Rothman Institute, Philadelphia, Pennsylvania, United States, [4] Rothman Institute at Thomas Jefferson University, Philadelphia, Pennsylvania, United States, [5] Thomas Jefferson University, Philadelphia, Pennsylvania, United States

Background/Introduction: Adequate lumbar lordosis is crucial for ensuring that the body can withstand the compressive forces of gravity and maintain an evolutionarily unique upright posture. While several patient factors have been identified as impacting lumbar lordosis including age, sex, and weight, the impact of paraspinal muscle quality has yet to be studied. Therefore, the purpose of this study was to determine if changes in lumbar lordosis after posterior lumbar decompression (PLD) were related to muscle mass of the lumbar paraspinal muscles.

Materials/Methods: Upon IRB approval, patients > 18 years who underwent one-to-four-level PLD for lumbar stenosis were identified. Preoperative and postoperative lateral lumbar radiographs were reviewed to assess sagittal parameters. Sagittal parameters included lumbar lordosis (LL), sacral slope (SS), and pelvic tilt (PT). Pelvic incidence (PI = PT + SS) and pelvic incidence minus lumbar lordosis (PI-LL) were also calculated from measurements. Preoperative MRIs were used to evaluate paravertebral muscle (PVM) cross-sectional area at the base of the L4 vertebral body. The cohort was split into equal thirds based on a normalized PVM measure (PVM/BMI) for analysis.

Results: There were 143 patients included in the analysis. Patients in the largest muscle size group were more likely to be male ($p=0.001$) and have lower BMIs ($p<0.001$). Patients in the largest muscle size group had greater lumbar lordosis preoperatively (51.5 vs. 47.9 vs. 43.2, $p=0.005$) and postoperatively (52.2 vs. 48.9 vs. 45.7, $p=0.043$). There was no significant difference in delta LL values between groups ($p>0.05$). The proportion of patients with PI-LL mismatch (>10°) was not significantly different between muscle size groups at the preoperative or postoperative time points ($p>0.05$). A multivariable regression analysis confirmed that increased PVM/BMI was a significant predictor of greater lumbar lordosis preoperatively and postoperatively.

Discussion/Conclusion: We identified a significant association between larger muscle cross-sectional area and greater lumbar lordosis before and after PLD. These findings suggest a

possible role for paravertebral musculature in the maintenance of spinal sagittal balance, but further research is necessary to better characterize this relationship. Research into interventions that may improve poor muscle quality could be valuable for enhanced preoperative optimization in certain at-risk patients.

Radiographic Parameters by PVM/BMI

	Group A (smallest)	Group B	Group C (largest)	p-value
Preop PT	22.9 (9.69)	22.1 (8.58)	22.3 (9.66)	0.971
Postop PT	22.8 (8.08)	21.3 (8.30)	21.6 (8.61)	0.631
Delta PT	-0.05 (6.76)	-0.83 (7.17)	-0.72 (5.88)	0.827
Preop SS	30.0 (9.13)	32.1 (8.57)	35.2 (6.94)	**0.010**
Postop SS	31.7 (8.61)	33.0 (8.18)	36.1 (7.70)	**0.030**
Delta SS	1.77 (4.91)	0.85 (5.44)	0.92 (5.56)	0.353
Preop LL	43.2 (13.2)	47.9 (12.8)	51.5 (10.2)	**0.005**
Postop LL	45.7 (13.2)	48.9 (12.5)	52.2 (10.9)	**0.043**
Delta LL	2.51 (6.14)	1.04 (8.07)	0.70 (7.09)	0.423
Preop PI	52.4 (11.5)	53.5 (11.3)	56.9 (10.5)	0.136
Postop PI	53.6 (10.5)	53.7 (11.0)	56.2 (11.2)	0.477
Delta PI	1.13 (6.51)	0.20 (7.83)	-0.69 (6.96)	0.464
Preop PI-LL $\geq$10°	25 (52.1%)	17 (35.4%)	14 (29.8%)	0.068
Postop PI-LL$\geq$10°	24 (50.0%)	15 (31.2%)	17 (36.2%)	0.149
Achieved PI-LL<10°	5 (10.4%)	4 (8.33%)	2 (4.26%)	0.625
Lost PI-LL<10°	4 (8.33%)	2 (4.17%)	5 (10.6%)	0.462

PT: Pelvic Tilt. SS: Sacral Slope. LL: Lumbar Lordosis. PI: Pelvic Incidence (PI = SS + PT). PI-LL (Pelvic Incidence – Lumbar Lordosis). Patients were stratified into three groups based on increasing PVM/BMI ratio. Patients in the bottom third were sub-grouped into Group A. Patients in the middle third were sub-grouped into Group B. Patients in the top third were sub-grouped into Group C.

Paper 13

Relationship between Facet Joint Osteoarthritis and Lumbar Paraspinal Muscle Atrophy – a Cross-sectional Study

Guven Ali, MD[1], Schönnagel Lukas, MD[1], Camino-Willhuber Gaston, MD[1], Chiapparelli Erika, MD[1], Amoroso Krizia, MD[1], Zhu Jiaqi, MS[1], Tani Soji, MD[2], Caffard Thomas, MD[3], Arzani Artine, MD[1], Zadeh Arman, BS[4], Shue Jennifer, MS[1], Tan Ek Tsoon, MD[1], Sama Andrew, MD[1], Girardi Federico, MD[1], Cammisa Frank, MD[1], Hughes Alexander, MD[1]
[1] Hospital for Special Surgery, New York, New York, United States, [2] Department of Clinical Oncology, Showa University Hospital, Shinagawa-ku, Tokyo, Japan, [3] Universitätsklinikum Ulm, Ulm1, , Germany, [4] Case Western Reserve University School of Medicine, Cleveland, Ohio, United States

Background/Introduction: The paraspinal muscles play an essential role in the stabilization of the lumbar spine. Atrophy of the paraspinal muscles, characterized by decreased functional cross-sectional area (fCSA) and increased fatty infiltration (FI) has been linked to chronic back pain and degenerative processes of the lumbar spine, including facet joint osteoarthritis (FJOA). However, the relationship between the different paraspinal muscle groups and FJOA has not been fully explored.

Materials/Methods: Adult patients who underwent lumbar spinal surgery between December 2014 and March 2023 for degenerative spinal conditions and had preoperative MRI and CT scans were analyzed. Fatty infiltration (FI) and functional cross-sectional area (fCSA) of the psoas, erector spinae and multifidus muscles were assessed on T2-weighted axial MRIs at the level of the upper end plate of L4. Intervertebral disc degeneration was evaluated using the Pfirrmann grading system. The Weishaupt classification (0-3) was used to assess FJOA at all lumbar levels on preoperative CT scans. The total lumbar FJOA score was determined by adding the grade of both sides at all five levels. Correlation and linear regression analyses were conducted to assess the relationship between FJOA and paraspinal muscle parameters.

Results: A total of 225 patients (49.7% female) were included. After adjustment for age, sex, BMI and disc degeneration, only multifidus fCSA (Est =-4.69, 95% CI = -6.91 – -2.46, $p < 0.001$) and FI (Est = 0.64, 95% CI = 0.33 – 0.94, $p < 0.001$) were independently predicted by the total FJOA score. A similar relation was seen with individual FJOA grades of each lumbar level after controlling for age, sex, BMI and the Pfirrmann grade of the corresponding level.

Discussion/Conclusion: Atrophy of the multifidus muscle is significantly associated with FJOA in the lumbar spine. The absence of such correlation for the erector spinae and psoas muscles highlights the unique link between multifidus muscle quality and the degeneration of the spinal motion segment. Further research is necessary to understand the direction of causality and the clinical implications of these findings.

Table 1: Total FJOA score as a predictor of paraspinal muscle morphology

	Univariable Linear Regression Analysis*		Multivariable Linear Regression Analysis*	
Dependent muscle variable	Estimate (95% CI)	p-value	Estimate (95% CI)	p-value
Multifidus				
fCSA	-7.08 (-8.97 – -5.18)	**<0.001**	-4.69 (-6.91 – -2.46)	**<0.001**
FI	1.24 (0.97 – 1.51)	**<0.001**	0.64 (0.33 – 0.94)	**<0.001**
Erector spinae				
fCSA	-7.02 (-11.97 – -2.06)	**0.006**	-0.61 (-5.15 – 6.36)	0.836
FI	0.50 (0.29 – 0.71)	**<0.001**	0.01 (-0.25 – 0.22)	0.912
Psoas				
fCSA	-5.59 (-10.54 – -0.65)	**0.027**	-2.37 (-7.12 – 2.47)	0.335

*Adjusted for age, sex, BMI and the cumulative lumbar Pfirrmann grade. FJOA = facet joint osteoarthritis, fCSA = functional cross-sectional area adjusted by height in meters squared and reported in mm^2/m^2, FI = percentage fatty infiltration

Paper 14

Higher Opiate Prescribing at Discharge is Associated with Chronic Opioid Usage in Lumbar Decompression Spine Surgery: A MSSIC Study

Kagithala Dheeraj, BS[1], Chaker Anisse, MD[1], Telemi Edvin, MD[1], Deshpande Nachiket, BS[1], Mansour Tarek, MD[1], Kim Enoch, BS[2], Rademacher Anneliese, BS[1], Hu Jianhui, PhD[3], Schultz Lonni, PhD[1], Schwalb Jason, MD[3], Abdulhak Muwaffak, MD[3], Chang Victor, MD[1]
[1] Henry Ford Hospital, Detroit, Michigan, United States, [2] Wayne State University, Detroit, Michigan, United States, [3] Henry Ford Health System, Detroit, Michigan, United States

Background/Introduction: Lumbar decompression spine surgery patients often necessitate postoperative pain management though opioid prescriptions. However, prolonged use following these surgeries has become a concerning issue given the ongoing opioid epidemic. Previous literature has identified that continued opioid use at 90 days is a significant risk factor for prolonged use at one and two years postoperatively. This study specifically investigates risk factors associated with continued opioid use at 90 days postoperatively in opioid naïve patients.

Materials/Methods: The Michigan Spine Surgery Improvement Collaborative (MSSIC) database was used to retrospectively identify opioid naïve patients undergoing lumbar decompression spine surgeries from March 2020 to September 2022. Starting October 2021, MSSIC mandated that 80% of opioid naïve patients receive a discharge script of 225 MME or less (32 MME a day over 1 week). A Poisson regression analysis was performed for 19 variables in our multivariate analysis.

Results: A total of 1543 opioid-naïve patients reported continued opioid use at 90 days postoperatively. The results indicated that discharge MME > 225 was significantly associated with opioid use at 90 days post-surgery (IRR: 1.86; CI: 1.33-2.60; $p< 0.001$). Other significant risk factors for prolonged opioid use included higher baseline EQ-5D score (IRR=1.20; CI: 1.09-1.33; $p < 0.001$), baseline pain scores (IRR=1.32, CI: 1.15-1.52; $p < 0.001$), and African-American race (IRR=4.41; CI: 2.46-7.91; $p < 0.001$). Conversely, a higher baseline PROMIS-PF functional score was protective against opioid use at 90 days (IRR=0.62; CI: 0.50-0.78; $p < 0.001$).

Discussion/Conclusion: Patients undergoing lumbar decompression spine surgery who were discharged with a MME > 225 showed an increased risk of continued opioid use at 90 days postoperatively. Understanding these risk factors, particularly the impact of discharging patients with MME > 225, can aid in the development of targeted interventions to reduce prolonged opioid use following lumbar spine decompression surgeries.

Risk Factors for Continued Opioid use at 90 Days Post-Op in Lumbar Decompression Surgery

	Opioid Use at 90-Days (N=1,543)			
Independent Variables	**IRR**	**[95% Conf.**	**Interval]**	**p-value**
Discharge MME > 225	**1.86**	**1.33**	**2.60**	***<0.001***
Baseline PROMIS functional score	**0.62**	**0.50**	**0.78**	***<0.001***
Baseline EQ-5D score	**1.20**	**1.09**	**1.33**	***<0.001***
Baseline pain score	**1.32**	**1.15**	**1.52**	***<0.001***
PHQ2 depression baseline	1.33	0.77	2.30	*0.310*
Private insurance	0.91	0.70	1.20	*0.513*
Current smoker	0.68	0.44	1.06	*0.089*
Age (ref: 18-64)				
65-69	**0.62**	**0.39**	**0.98**	***0.042***
70-74	0.51	0.20	1.27	*0.147*
75-79	0.37	0.13	1.03	*0.058*
80+	0.25	0.03	1.98	*0.189*
Female	0.72	0.47	1.12	*0.142*
BMI (ref: underweight or normal)				
overweight [25 30)	0.86	0.45	1.68	*0.668*
class I obesity [30 35)	0.94	0.46	1.93	*0.873*
class II obesity [35 40)	1.08	0.51	2.29	*0.849*
class III obesity 40+	0.52	0.19	1.41	*0.199*
Race (ref: White)				
Black	**4.41**	**2.46**	**7.91**	***<0.001***
other	2.05	0.84	4.99	*0.114*
Education (ref: high school)				
less than high school	1.15	0.56	2.39	*0.700*
two years college	0.99	0.57	1.74	*0.983*
four years college +	0.68	0.41	1.11	*0.120*
Symptom duration (ref: < 3 months)				
3-12 months	1.34	0.75	2.40	*0.328*
>= 12 months	1.12	0.66	1.91	*0.679*
ASA >2	1.19	0.78	1.82	*0.418*
Previous spine surgery	1.35	0.94	1.94	*0.109*
Unemployed at baseline	1.43	0.81	2.56	*0.220*
History of depression	1.42	0.79	2.55	*0.235*
History of anxiety	0.90	0.51	1.58	*0.702*
Not achieve MCID: PROMIS at 90-days	**4.29**	**2.66**	**6.92**	***<0.001***

Paper 15

Genotype-Guided Opioid Therapy in Patients Undergoing Lumbar Spine Surgery Results in Lower Rates of Delirium and Superior Pain Control: A Single Institutional Feasibility Study

Adogwa Owoicho, MD[1], *Tao Xu, BS*[1]
[1] *University of Cincinnati College of Medicine, Cincinnati, Ohio, United States*

Background/Introduction: Despite the use of multimodal therapies and widespread adoption of Enhanced Recovery Protocols, 33% - 50% of patients report poor pain control after surgery. The CYP2D6 enzyme metabolizes opioids commonly prescribed for spine-related pain, and CYP2D6 polymorphisms may contribute to variability in opioid response. Thus, while some patients achieve the desired therapeutic response from their drug therapy, others do not; and a subset of patients will experience adverse effects, which can range from bothersome to life threatening. Objective: To determine the effect of a genotype-guided opioid prescribing strategy on pain control after lumbar spine surgery.

Materials/Methods: Study Design: Randomized Control Trial Adult patients were prospectively enrolled into a hybrid implementation-effectiveness clinical trial and randomized to CYP2D6-genotype-guided opioid selection, with clinical recommendations, or usual care. Implementation metrics, including provider response, medication changes consistent with recommendations, and patient-reported pain and symptom scores at baseline and up to 12 weeks, were assessed.

Results: Most (24/25, 96%) patients approached for the study agreed to participate. Of the 24 patients randomized (48% female), 15 were randomized to the genotype guided arm and the rest standard of care. Overall, 50% of patients were normal metabolizers, 25% were intermediate metabolizers, and 25% poor metabolizers. Normal metabolizers were prescribed tramadol for pain control, while intermediate and poor metabolizers were prescribed non-CYP2D6 opioids such as morphine or hydromorphone. At baseline, there were no differences in VAS back pain ($p=0.76$), VAS leg pain(0.51) and ODI($p=0.60$) and EQ-5D($p=0.40$) between the genotype-guided and non-genotype arms. Post-operatively, patients randomized to the genotype-guided opioid arm reported significantly lower VAS back pain ($p=0.04$), VAS leg pain (0.03) and ODI($p=0.02$) scores compared to those in the standard of care arm. Rates of post-operative delirium was 2-fold lower in the genotype-guided cohort. The majority of patients in the genotype-guided opioid cohort(70%) were discharged directly to home. 30-day hospital readmission rates were similar between groups($p=0.85$).

Discussion/Conclusion: A genotype-guided opioid prescribing strategy was associated with lower rates of post-operative delirium, superior pain control and improvement in functional disability. Furthermore, our study revealed high acceptance of pharmacogenetic testing as part of a clinical trial among patients with spine-related pain.

Paper 16

Long Term Feasibility Study: Opiate Reduction Protocol for Common Outpatient Neurosurgical and Spine Procedures - A Single-Center Experience

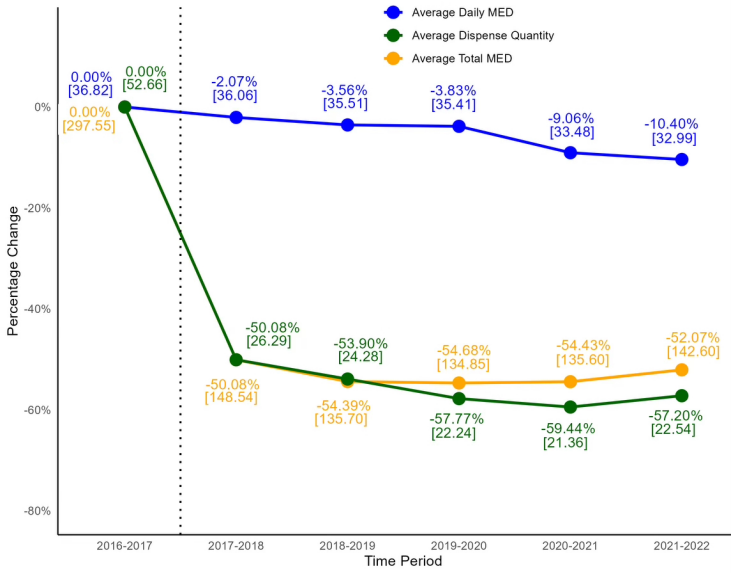
Eley Nicholas, PA-C[1], *Bansal Aiyush, MD*[1], *Alostaz Murad, BS*[1], *Kumar Rakesh, MD*[1], *Leveque Jean-Christophe, MD*[1], *Louie Philip, MD*[1]
[1] *Center for Neurosciences and Spine, Virginia Mason Franciscan Health, Seattle, Washington, United States*

Background/Introduction: A standard protocol for adult opiate-naïve patients undergoing an outpatient neurosurgical and spine procedures at a large urban hospital was introduced in 2017. This change was implemented as a team-based quality initiative in response to the lack of neurosurgical societal consensus regarding opiate prescribing practices for common outpatient procedures. At that time, systematic reviews demonstrated a wide range of practices in the management of perioperative neurosurgical pain. The protocol limited opiate naïve patients undergoing outpatient surgery, mainly cervical and lumbar surgery, to a maximum of 24 tablets of narcotic.

Materials/Methods: This retrospective cohort study aimed to evaluate the long-term impact of an opioid reduction protocol implemented post common outpatient neurosurgical and spine procedures in opiate naïve patients. The protocol limited opiate naïve patients undergoing outpatient surgery to a maximum of 24 tablets of narcotic. Data from over 1,400 cases, primarily cervical and lumbar spine procedures, were analyzed to assess opioid quantities prescribed, readmissions, refill requests, and chronic opioid use conversion following a protocol initiated in 2017

Results: Over a 5-year period, the study observed a consistent decrease in opioid quantities prescribed at discharge, averaging a reduction of 30 tablets per patient. The average discharge quantity aligned closely with the initial target of 24 tablets per discharge, settling at 23.5 tablets. By analyzing the average number of tablets per prescription combined with the total number of patients, a reduction by >25,000 tablets prescribed over 5 years was observed. In the pre-intervention period, the average dispense quantity stood at 53 tablets per prescription. Projecting this rate to the final post op period would have resulted in the hypothetical prescription of approximately 56,975 tablets. With the current rate of 23.5 tablets in the post-operative period, there are a total of 24,725 tablets, resulting in a net decrease of 32,250 tablets.

Discussion/Conclusion: The study demonstrates the sustained effectiveness of a standardized opioid discharge protocol for outpatient neurosurgical and spine procedures. The protocol led to a continual reduction in opioid prescriptions without compromising patient safety or burdening healthcare resources


Average Daily MED
Average Dispense Quantity
Average Total MED
0.00%
[36.82]
0.00%
[52.66]
0.00%
[297.55]
-2.07%
[36.06]
-3.56%
[35.51]
-3.83%
[35.41]
-9.06%
[33.48]
-10.40%
[32.99]
-50.08%
[26.29]
-50.08%
[148.54]
-53.90%
[24.28]
-54.39%
[135.70]
-54.68%
[134.85]
-57.77%
[22.24]
-54.43%
[135.60]
-59.44%
[21.36]
-52.07%
[142.60]
-57.20%
[22.54]
0%
-20%
-40%
-60%
-80%
Percentage Change
2016-2017
2017-2018
2018-2019
2019-2020
2020-2021
2021-2022
Time Period

Paper 17

Risk Factors for Total Hip Arthroplasty Following Lumbar Fusion Surgery: A Large Propensity Matched Study

Wiener Joshua, BS[1], Sanghvi Parshva, BS[1], Meade Seth, BS[2], Shost Michael, BS[3], Steinmetz Michael, MD[4]
[1] Case Western Reserve University, Cleveland, Ohio, United States, [2] Cleveland Clinic Lerner College of Medicine of Case Western Reserve University, Cleveland, Ohio, United States, [3] Case Western Reserve University School of Medicine, Cleveland, Ohio, United States, [4] Center for Spine Health, Cleveland Clinic Foundation, Cleveland, Ohio, United States

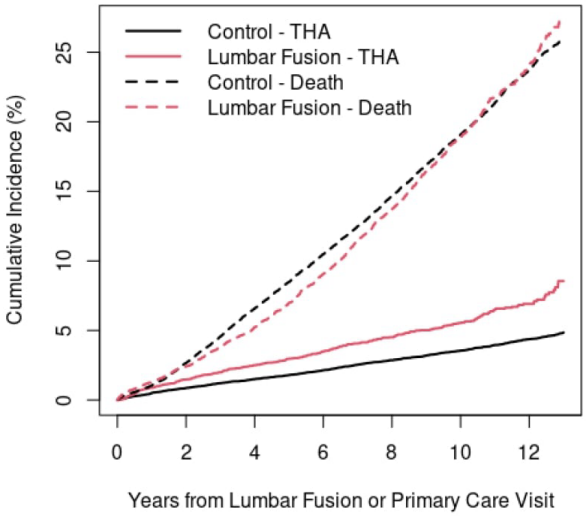
Background/Introduction: Degenerative diseases of the spine and osteoarthritis of the hip are some of the most common causes of disability in the aging population. Both conditions are treated with lumbar fusion and total hip arthroplasty (THA) respectively when conservative management fails. Due to the complex biomechanical interactions of the hip and lower back along with shared clinical risk factors, hip pain can present similarly to lumbar spine pain, creating difficulty when attempting diagnosis. The objectives of this study were to examine the relationship between lumbar fusion and THA, identify clinical and surgical risk factors of the need for and timing of THA in the context of lumbar fusion, and finally explore the association of postoperative outcomes in lumbar fusion and THA.

Materials/Methods: A retrospective cohort study was performed using electronic medical records from a major academic institution between 10/2009 and 10/2015. Cohorts consisted of adult patients undergoing lumbar fusion surgery for degenerative spine disease and a control group of patients seen by primary care physicians at the same time period. Patients were propensity score matched based on age, sex, race, ethnicity, body mass index, smoking status, and 16 other comorbidities. Analytical methods included time-to-event modeling using Cox proportional hazard models and multivariable cause-specific cox proportional hazard models.

Results: The final cohort consisted of 25,379 patients (6,345 experimental, 19,304 controls) after matching. At 10 years post lumbar fusion, 3.54% of controls and 5.54% of lumbar fusion patients had undergone THA. Overall, lumbar fusion patients had a 1.65 times higher risk of THA compared to control patients ($p<0.001$). Age, hip arthritis, and knee arthritis were associated with greater risk of THA in both experimental and control groups. Diabetes was associated with lower risk of THA in both groups. Worse postoperative pain disability questionnaire (PDQ) total scores following lumbar fusion were associated with lower risk of THA.

Discussion/Conclusion: Lumbar fusion is associated with greater risk of later THA. Specific risk factors such as age and arthritis may predispose patients to THA. There is a moderate association between worse lumbar fusion postoperative outcomes and reduced risk of THA.

Figure 1. Cumulative incidence of THA and death, stratified by group (lumbar fusion vs. control group) using the propensity-matched patient sample.



Paper 18

Effect of Preoperative Motor Weakness on Postoperative Clinical Outcomes in Patients Undergoing Lumbar Decompression

Medakkar Srinath, BS[1], Roca Andrea, MS[2], Anwar Fatima, BS[2], Nie James, BS[1], Hartman Timothy, MD[1], Loya Alexandra, BS[2], MacGregor Keith, BS[1], Oyetayo Omolabake, BS[1], Zheng Eileen, BS[1], Federico Vincent, MD[1], Lopez Gregory, MD[2], Sayari Arash, MD[1], Singh Kern, MD[1]
[1] Department of Orthopaedic Surgery, Division of Spine Surgery, Rush University Medical Center, Chicago, Illinois, United States, [2] Midwest Orthopaedics at Rush, Chicago, Illinois, United States

Background/Introduction: Few studies have examined the effect of preoperative motor weakness on postoperative clinical outcomes. This study aims to examine the effect of preoperative motor weakness on clinical outcomes in patients undergoing lumbar decompression.

Materials/Methods: Patients undergoing lumbar decompression were separated into 2 groups based on documented motor weakness and/or foot drop on physical exam versus no motor weakness. Demographics, perioperative characteristics, and preoperative patient-reported outcome measures (PROMs) were compared using univariate inferential statistics. PROMs consisted of Patient-Reported Outcomes Measurement Information System Physical Function (PROMIS-PF), 12-Item Short Form (SF-12) Physical Component Score (PCS), SF-12 Mental Component Score (MCS), Patient Health Questionnaire-9 (PHQ-9), Visual Analog Scale (VAS) Back Pain (VAS-BP), VAS Leg Pain (VAS-LP), and Oswestry Disability Index (ODI). Postoperative PROMs collected at the 6-week, 12-week, 6-month, 1-year, and 2-year time points and minimum clinically important difference (MCID) achievement were compared between cohorts through multivariable linear and logistic regression, respectively, adjusting for significant differences in preoperative characteristics.

Results: A total of 1,463 patients were identified, with 1,218 patients with no preoperative motor weakness and 245 with motor weakness. Mean postoperative follow-up time was 9.03±8.25 months. Preoperatively, patients with no preoperative motor weakness reported inferior VAS-BP ($p=0.002$). Patients with motor weakness demonstrated superior ODI at final postoperative follow-up and in magnitude of postoperative improvement ($p\leq0.049$, both). No significant differences were reported at the 6-week postoperative time point, magnitude of postoperative improvement from preoperative to the 6-week postoperative time point, and MCID achievement.

Discussion/Conclusion: Patients undergoing lumbar decompression reported similar postoperative improvement in all PROMs, except for disability outcomes, regardless of preoperative motor weakness. Patients without preoperative motor weakness reported inferior disability outcomes and postoperative improvement in disability outcomes at the final postoperative follow-up time point. These findings may be useful in managing preoperative expectations for patients.

Table 1. Patient-reported outcomes measures and minimum clinically important difference

	Total (n =1,463)	No Motor Weakness (n =1,218)	Motor Weakness (n =245)	*p-value
Pre-Op				
PROMIS-PF	36.17±6.47	35.91±6.51	37.16±6.23	0.060
SF-12 PCS	31.50±8.08	31.30±8.04	32.67±8.23	0.109
SF-12 MCS	49.05±11.44	48.72±11.43	51.01±11.37	0.058
PHQ-9	5.87±5.65	5.97±5.61	5.53±5.80	0.409
VAS-BP	6.20±2.51	6.29±2.46	5.65±2.73	**0.002**
VAS-LP	6.13±2.64	6.12±2.68	6.16±2.44	0.852
ODI	42.36±18.30	42.64±18.48	41.04±17.43	0.322
6-week Post-Op				
PROMIS-PF	42.21±8.14	42.05±8.25	42.86±7.70	0.674
SF-12 PCS	37.79±10.16	37.35±10.14	41.06±9.77	0.076
SF-12 MCS	52.28±10.71	52.04±10.86	54.01±9.48	0.708
PHQ-9	3.55±4.71	3.64±4.78	3.10±4.41	0.775
VAS-BP	2.89±2.64	2.92±2.65	2.68±2.56	0.852
VAS-LP	2.89±2.84	2.97±2.84	2.45±2.77	0.254
ODI	29.39±19.21	26.91±19.48	23.40±17.31	0.495
Final Post-Op				
PROMIS-PF	45.75±9.94	45.48±9.89	46.71±10.05	0.512
SF-12 PCS	40.66±11.04	40.47±11.16	40.66±11.04	0.394
SF-12 MCS	51.98±10.62	51.69±10.66	54.13±10.15	0.760
PHQ-9	4.00±5.65	4.15±5.63	3.47±5.73	0.487
VAS-BP	2.99±2.74	3.04±2.74	2.59±2.68	0.415
VAS-LP	3.02±2.92	3.12±2.93	2.56±2.84	0.291
ODI	24.97±20.69	26.05±20.96	19.67±18.50	**0.034**
Δ Pre-Op to 6-week Post-Op				
PROMIS-PF	6.35±8.21	6.27±8.37	6.67±7.58	0.807
SF-12 PCS	7.04±10.38	7.03±10.45	7.09±9.96	0.898
SF-12 MCS	3.21±10.62	3.28±10.58	2.69±11.02	0.997
PHQ-9	2.51±5.09	2.54±5.27	2.35±4.07	0.412
VAS-BP	3.40±3.08	3.43±3.10	3.22±2.92	0.852
VAS-LP	3.30±3.32	3.22±3.34	3.79±3.16	0.205
ODI	16.83±20.99	16.49±20.80	18.77±22.11	0.595
Δ Pre-Op to Final Post-Op				
PROMIS-PF	9.96±9.99	9.87±10.10	10.31±9.61	0.536
SF-12 PCS	9.84±11.79	10.07±11.81	8.24±11.64	0.134
SF-12 MCS	3.51±11.17	3.59±11.32	3.01±10.11	0.928
PHQ-9	2.19±5.48	2.24±5.57	2.01±5.12	0.429
VAS-BP	3.29±3.18	3.29±3.19	3.28±3.13	0.415
VAS-LP	3.18±3.53	3.09±3.58	3.69±3.20	0.176
ODI	19.10±22.75	18.36±22.89	22.81±21.75	**0.049**
MCID Achievement				
PROMIS-PF	79.6% (387)	79.1% (303)	81.6% (84)	0.597
SF-12 PCS	81.6% (457)	81.2% (402)	79.7% (55)	0.704
SF-12 MCS	33.3% (186)	34.3% (168)	26.1% (18)	0.135
PHQ-9	41.2% (220)	42.9% (184)	34.3% (36)	0.134
VAS-BP	74.8% (792)	75.4% (700)	70.2% (92)	0.504
VAS-LP	69.3% (507)	69.1% (424)	70.3% (83)	0.960
ODI	64.5% (490)	63.7% (404)	68.3% (86)	0.498

*p-value calculated using Student's t-test for continuous variables at the preoperative time point. At postoperative time points and ΔPROMs, p-values were calculated using multivariable linear regression and logistic regression accounting for preoperative VAS-BP, smoking status, insurance, BMI, CCI score, diagnosis of foraminal stenosis, and diagnosis of central stenosis for continuous variables and categorical variables, respectively.

Bolding denotes statistical significance ($p < 0.05$)

Paper 19

A Comparison of Post-Operative Pain Management Following Lumbar Laminectomy Fusions Utilizing TLIP or Intra-operative Local Anesthesia Block

Eberhardt Lauren, BS[1], Zakko Philip, MD[2], Childers Karen, MS, BS, MA[2], Park Daniel, MD[2]
[1] Oakland University William Beaumont School of Medicine, Rochester Hills, Michigan, United States, [2] William Beaumont Hospital, Royal Oak, Michigan, United States

Background/Introduction: Spinal fusion patients suffer significant acute post-operative pain, potentially leading to chronic pain. Opioids are commonly used for peri-operative pain management despite significant side effects. The thoracolumbar interfascial plane (TLIP) and erector spinae plane (ESP) block, alternative analgesic options with rare side effects, have proven to reduce pain and opioid consumption compared to standard non-block care. This study aimed to determine if a significant difference exists between block groups with multi- and single level laminectomy fusions in post-operative and discharge opioid consumption and length of stay.

Materials/Methods: A retrospective review was performed via data query for lumbar laminectomy fusion patients from 1/2019 through 5/2023. Patients > 18 years of age who underwent a laminectomy fusion were included. Patients were excluded if they were < 18 years of age, required revision within one-month post-op, and/or had tumor involvement, trauma, multistage procedures, or prior history of spine surgeries. Data including age, sex, opioid use within 1 year pre-operatively, smoking, alcohol, surgery levels, estimated blood loss (EBL), length of stay, analgesic block, and opioid and NSAID usage post-op through discharge prescriptions were recorded.

Results: There was a significant difference in age between level groups ($p = 0.033$); mean age for all patients was 68.1+ 9.5 years. There was no significant difference between level groups or block groups for sex, smoking status, and alcohol use ($p > 0.05$). A majority of the study population was female (58.8%, n=275). 42.1% of patients used opioids within 1 year preoperatively without significant differences between level groups ($p = 0.061$) and block groups ($p > 0.05$). EBL was found to have a significant difference between level groups ($p < 0.001$), but not block groups ($P > 0.05$). There was a significant difference between level groups regarding hospital opioid usage ($p = 0.02$); however no significant difference was found between level groups with NSAID usage or block groups with hospital opioid or NSAID usage ($p > 0.05$).

Discussion/Conclusion: Between multi- and single level laminectomy fusions, there is a significant difference in hospital opioid consumption and EBL, yet no difference in hospital opioid or NSAID consumption between block groups.

Table 1. Single and Multi-level Laminectomy Fusion Demographics and Pain Medication Consumption

	Single level (N=232)	Multi-level (N=236)	Total (N=468)	p-value
Age				0.033[1]
Mean (SD)	67.1 (10.4)	69.1 (8.5)	68.1 (9.5)	
Min - Max	31.0 - 89.0	34.0 - 89.0	31.0 - 89.0	
Sex				0.779[2]
Female	138 (59.5%)	137 (58.1%)	275 (58.8%)	
Male	94 (40.5%)	99 (41.9%)	193 (41.2%)	
Smoking Status				0.552[2]
Current	24 (10.7%)	26 (11.5%)	50 (11.1%)	
Former	84 (37.3%)	94 (41.6%)	178 (39.5%)	
Never	117 (52.0%)	106 (46.9%)	223 (49.4%)	
Alcohol Use				0.156[2]
Never	14 (6.3%)	14 (6.3%)	28 (6.3%)	
No	61 (27.4%)	73 (32.9%)	134 (30.1%)	
Not Currently	39 (17.5%)	23 (10.4%)	62 (13.9%)	
Yes	109 (48.9%)	112 (50.5%)	221 (49.7%)	
1 Year Pre-Op Opioid Use				0.061[2]
No	124 (53.4%)	147 (62.3%)	271 (57.9%)	
Yes	108 (46.6%)	89 (37.7%)	197 (42.1%)	
EBL				< 0.001[2]
Minimal (<10ml)	23 (12.5%)	13 (6.7%)	36 (9.5%)	
Small(10-100ml)	83 (45.1%)	47 (24.2%)	130 (34.4%)	
Moderate(100-500ml)	77 (41.8%)	117 (60.3%)	194 (51.3%)	
Large(>500ml)	1 (0.5%)	17 (8.8%)	18 (4.8%)	
Missing	48	42	90	
Post-Op Opioid Doses In-Hospital				0.020[1]
Mean (SD)	14.3 (10.0)	16.7 (13.3)	15.5 (11.8)	
Min - Max	1.0 - 59.0	1.0 - 112.0	1.0 - 112.0	
NSAID Doses In-Hospital				0.224[1]
Mean (SD)	4.9 (4.3)	6.7 (8.0)	6.0 (6.7)	
Min - Max	1.0 - 22.0	1.0 - 46.0	1.0 - 46.0	
Missing	139	109	248	

Note: [1] Kruskal-Wallis rank sum test [2] Fisher's Exact Test for Count Data with simulated p-value based on 2000 replicates

Paper 20

The Impact of Lumbar Spine Sagittal Alignment on clinical outcomes following ACDF

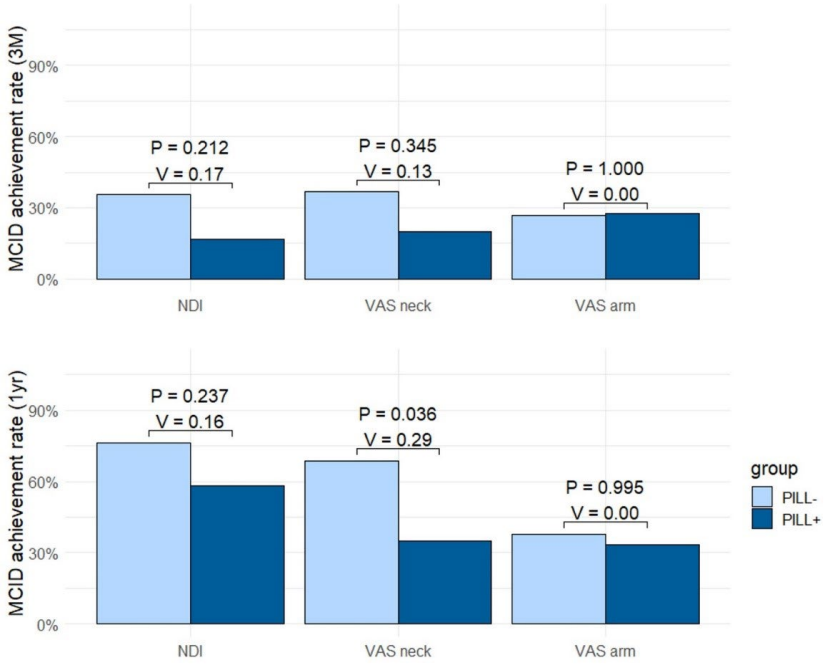
Asada Tomoyuki, MD[1], Adida Samuel, BS[2], Allen Myles, MBChB[1], Simon Chad, BS[1], Singh Nishtha, MBBS[1], Tuma Olivia, BS[1], Araghi Kasra, BS[1], Zhang Joshua, BS[1], Korsun Max, BS[1], Mai Eric, BS[1], Kwas Cole, BS[1], Heuer Annika, MD[1], Vaishnav Avani, MBBS[1], Dowdell James, MD[1], Qureshi Sheeraz, MD[3], Iyer Sravisht, MD[1], Sheha Evan, MD[3], Lovecchio Francis, MD[1]
[1] Hospital for Special Surgery, New York, New York, United States, [2] University of Pittsburgh School of Medicine, Pittsburgh, Pennsylvania, United States, [3] Hospital for Special Surgery/Weill Cornell Medical College, New York, New York, United States

Background/Introduction: The role of sagittal alignment in lumbar spinal surgery outcomes has gained attention recently. While its influence on cervical deformity surgery is known, its impact on cervical degenerative surgery, particularly in relation to thoracolumbar sagittal alignment, remains less explored.

Materials/Methods: This retrospective study analyzed data from a prospectively collected single-center registry, focusing on patients who underwent anterior cervical discectomy and fusion (ACDF) and had preoperative whole spinal alignment assessed by EOS imaging. We examined demographic data, sagittal spinopelvic parameters (Lumbar lordosis, LL; pelvic tilt, PT; pelvic incidence, PI; sacral slope, SS), surgical details, Patient Reported Outcomes and Measures (PROMs) including NDI, VAS neck, and VAS arm. Patients were categorized into PI minus LL $\geq$0 (PILL+ group) and PI minus LL <0 (PILL- group), using age-adjusted optimal spinal alignment. PROMs at 3 months and 1 year postoperative were analyzed for baseline change and MCID achievement, using P-value and effect sizes (standardized mean difference [SMD] and Cramer's V [V]). Age, sex and BMI matched cohorts were compared at each timepoint.

Results: Of 94 patients with preoperative EOS imaging, 32 were in the PILL+ group. Before matching, the PILL+ group had a higher percentage of males (PILL+ 75% vs PILL-: 51.6%) and significantly higher BMI (29.8 vs. 26.2). After variable ratio matching, 69 patients (PILL+ 32) were analyzed, showing balanced demographic including cervical alignment (C2-7 lordosis: 6.8 vs 8.9, P=0.497; T1 slope: 24.4 vs 23.4, P=0.647). At 3 months, the PILL+ group had less improvement in VAS neck (0.3 vs 2.0 points; P=0.037, SMD=0.630) but similar VAS arm improvements. At 1-year postoperative timepoint, the PILL+ group showed less improvement in VAS neck (2.2 vs 3.9 points; P=0.011, SMD=0.793) and lower MCID achievement (35% vs. 69%; P=0.036, V=0.29).

Discussion/Conclusion: Our study revealed a significant relationship between lumbar sagittal alignment and the postoperative outcomes of ACDF. Specifically, patients with the sagittal malalignment experienced less improvement in neck pain and lower rate of achieving MCID compared to those with normal alignment. This underscores the importance of comprehensive preoperative assessment of the whole spinal alignment, particularly the lumbar region, and improved expectations management, leading to better postoperative satisfaction.


MCID achievement rate (3M)
90%
60%
30%
0%
P = 0.212
V = 0.17
P = 0.345
V = 0.13
P = 1.000
V = 0.00
NDI
VAS neck
VAS arm
MCID achievement rate (1yr)
90%
60%
30%
0%
P = 0.237
V = 0.16
P = 0.036
V = 0.29
P = 0.995
V = 0.00
NDI
VAS neck
VAS arm
group
PILL-
PILL+

Paper 21

Classification of Robotic-Assisted Pedicle Screw Errors

Gautam Diwas, BS[1], *Vivekanandan Sheela, MD*[2], *Mazur Marcus, MD*[3]
[1] *University of Utah School of Medicine, Salt Lake City, Utah, United States,* [2] *Neurological Institute, University of Pittsburgh Medical Center, Hershey, Pennsylvania, United States,* [3] *University of Utah, Salt Lake City, Utah, United States*

Background/Introduction: Although the reported accuracy of robotic-assisted pedicle screws is very high, the current literature does not capture near misses or incidental procedural errors that may have been accounted for during surgery or did not alter treatment. Here, we characterize the types of errors encountered during robotic-assisted pedicle screw insertion and suggest best practices to minimize their occurrence.

Materials/Methods: We performed a retrospective review of all cases at our institution in which robotic-guided pedicle screw placement was used. Intraoperative imaging was analyzed to look for evidence of robotic-related errors. Cases where errors occurred were critically appraised to determine the mechanism of complication. We then performed a systematic review to determine the incidence and types of errors in the current literature.

Results: We critically reviewed 75 consecutive surgeries using robotic guidance at the University of Utah. We identified 15 cases where screw placement complications occurred, of which 14 were near misses with no harm to the patient and 1 resulted in neurological injury. Patterns of screw placement complications were classified as errors in: 1) registration, 2) screw planning, 3) procedural interference. Our systematic review yielded 5 relevant citations reporting robotic-assisted screw errors. Four studies reported registration errors, accounting for an average of 48.6% of screw failures. Three studies highlighted screw placement errors, contributing to an average of 45.23% of failures, and interference errors were reported in three studies as well, making up an average of 35.3% of failed screws.

Discussion/Conclusion: The characterization of errors commonly encountered during robotic spine surgery is underreported. We describe a classification scheme to standardize the reporting of robotic guidance-related screw complications. Awareness of how errors occur may increase the safety of this technology.

Paper 22

Do Preoperative Lumbar Transforaminal Steroid Injections Increase the Risk of Infection After Lumbar Decompression Surgery?

Minetos Paul, MD, MBA[1], *Petrone Brandon, DO*[2], *Beutler Graham, MD*[1], *Suryavanshi Joash, MD*[1], *Foley David, MD*[1], *Boody Barrett, MD*[2], *Sasso Rick, MD*[2], *McCarthy Michael, MD*[2]
[1] *Indiana University School of Medicine, Indianapolis, Indiana, United States,* [2] *Indiana Spine Group, Carmel, Indiana, United States*

Background/Introduction: Corticosteroid injections for diagnostic and therapeutic benefit are often used to treat patients with lumbar radiculopathy and spinal stenosis nonoperatively. Preoperative intraarticular steroid injections within three months of surgery are known to be a significant risk factor for prosthetic joint infection within the realm of total joint arthroplasty. The effect of transforaminal corticosteroid injection prior to lumbar spinal surgery on development of postoperative infection, however, is not well-understood.

Materials/Methods: Patients who underwent elective lumbar spine decompression for lumbar radiculopathy or spinal stenosis between 2018 and 2023 were identified by CPT code. Patients who underwent selective nerve root injection (SNI) with corticosteroid were then identified. Baseline demographics were collected. Patients were categorized as having no preoperative SNI or SNI within 30 days, between 30-90 days, or greater than 90 days prior to surgery. The primary outcome was postoperative surgical site infection requiring irrigation and debridement (I&D) within 180 days of index procedure. Patients requiring reoperation for hematoma, trauma, or recurrent disc herniation were excluded. Univariate and multivariate analysis was then performed to determine factors associated with postoperative irrigation and debridement I&D for SSI.

Results: A total of 4223 patient were included, of which 1323 underwent preoperative SNI and 2900 did not. Patients who underwent preoperative SNI were significantly older (59.0 ± 15 vs 54.5 ± 15.7, $p<0.001$), more likely to be smokers (31.1% vs 21.2%, $p<0.001$), and less likely to have private insurance (56.4% vs 66.9%, $p<0.001$). No significant difference was found with regard to I&D and having had an SNI or timing of SNI. BMI (1.001 [1.000, 1.001], $p=0.009$) and self-pay insurance (1.037 [1.010, 1.065], $p=0.006$) were found to be independent predictors of postoperative I&D for SSI.

Discussion/Conclusion: Preoperative SNI at any point prior to elective lumbar decompression for lumbar radiculopathy or spinal stenosis was not found to be associated with postoperative SSI requiring I&D. BMI and self-pay insurance were found to have a significant independent association with postoperative SSI requiring I&D. Further research is needed to characterize the association of preoperative local corticosteroid use and infection following spine surgery.

Table 1: Baseline Demographics

	No TFESI (N=2900)	TFESI (N=1323)	p-value†
Age	54.5 ± 15.7	59.0 ± 15.0	**<0.001***
Sex			**0.003***
Female	1180 (40.7%)	603 (45.6%)	
Male	1717 (59.3%)	719 (54.4%)	
BMI	31.0 ± 7.4	31.0 ± 7.0	0.920
Smoking Status			**<0.001***
Nonsmoker	615 (21.2%)	411 (31.1%)	
Former	346 (11.9%)	228 (17.2%)	
Current	265 (9.1%)	153 (11.6%)	
Unknown	1672 (57.7%)	531 (40.1%)	
Insurance Type			**<0.001***
Private	1934 (66.9%)	745 (56.4%)	
Government-based	831 (28.7%)	502 (38.0%)	
Worker's Compensation	95 (3.3%)	56 (4.2%)	
Self-pay	32 (1.1%)	17 (1.3%)	
Race			0.095
White	1852 (64.8%)	822 (62.8%)	
Black or African American	88 (3.1%)	32 (2.4%)	
Asian/Pacific Islander	16 (0.6%)	3 (0.2%)	
American Indian or Alaska Native	1 (0.0%)	2 (0.2%)	
Multiple/Other	902 (31.5%)	450 (34.4%)	
I&D	28 (1.0%)	11 (0.8%)	0.673

† Pearson's χ^2 or independent t-test to compare between groups
*Indicates statistical significance ($p<0.05$).
Categories do not include patients who declined to answer or where no response was provided.
I&D – irrigation and debridement

Table 2: Days between TFESI and Surgery

	No I&D (N=1312)	I&D (N=11)	p-value†
Timeframe (days)			0.824
<30	467 (35.6%)	3 (27.3%)	
31-60	411 (31.3%)	3 (27.3%)	
61-90	204 15.5%)	2 (18.2%)	
>90	230 (17.5%)	3 (27.3%)	

† Pearson's χ^2 to compare between groups
I&D – irrigation and debridement, TFESI – transforaminal epidural steroid injection

Table 3: Factors Associated with I&D

	B	95%CI	p-value[†]
Age	1.000	1.000, 1.000	0.239
Sex			
Male		*ref*	
Female	1.002	0.997, 1.008	0.404
BMI	1.001	1.000, 1.001	**0.009***
Smoking Status			
Never		*ref*	
Former	0.998	0.989, 1.008	0.740
Current	0.993	0.982, 1.003	0.167
Insurance type			
Private		*ref*	
Government-based	1.003	0.995, 1.012	0.425
Worker's Compensation	1.005	0.989, 1.021	0.564
Self-pay	1.037	1.010, 1.065	**0.006***
Race			
White		*ref*	
Black or African American	0.993	0.976, 1.010	0.419
Asian/Pacific Islander	0.999	0.957, 1.042	0.961
American Indian or Alaska Native	0.999	0.901, 1.108	0.986
Multiple/Other	1.004	0.997, 1.011	0.317
TFESI			
No		*ref*	
Yes	0.998	0.992, 1.004	0.521

[†]Multiple variable linear regression analysis
*Indicates statistical significance ($p<0.05$).
I&D – irrigation and debridement, TFESI – transforaminal epidural steroid injection

Paper 23

Skin Closure Using Skin Staples May Have Higher Risk for Wound Infection Compared to Running Subcuticular Stitch with Absorbable Suture in Posterior Lumbar Surgery

Kim Saechin, MD, PhD[1], *Schillinger Amanda, BS*[1], *Zotter Serafina, BS*[1]
[1] *Massachusetts General Hospital/Harvard Medical School, Boston, Massachusetts, United States*

Background/Introduction: In contrast with the literature in general, evidence in the spine literature suggests increased risk for surgical site infection (SSI) when the skin is closed with skin staples (SS) compared to other methods. In our Spine Division, two most common methods for skin closure for posterior lumbar surgery are SS or running subcuticular stitch with absorbable suture (RSAS). Our hypothesis was that the rate of return to the OR for SSI within 1-year of index procedure (ROR) is lower in the RSAS group (RSASG) compared to the SS group (SSG).

Materials/Methods: After IRB approval, a retrospective review of billing and hospital records was used to obtain all spine surgeries done between 7/1/2018 to 6/30/2020. Inclusion criteria were posterior lumbar surgeries closed with RSAS or SS, and age > 18. Exclusion criteria were oncologic condition and previous infection in the surgical site. We used operative notes, the Supplies Section in the electronic medical record (EMR) that listed the sutures/staples used during the surgery, and progress notes to determine the skin closure method for each case. We obtained demographics, clinical history, and surgical characteristics from the EMR. Rotating residents, fellows, and advanced practice providers assist in the procedures and primarily close the wound under the primary surgeon's supervision. Chi Squared and Student's T tests were used for statistical analysis with $p<.05$ set as statistically significant.

Results: Of 857 and 211 cases in the RSASG and SSG, respectively, ROR in RSASG (1.3%, n=11) was less than that in the SSG (5.2%, n=11) (p=.0013). There were no significant differences in the demographics such as BMI, diabetes or smoking history, or in the surgical characteristics such as previous surgery in the same site and the percentage of instrumented fusion cases, between the two groups. There was a greater number of levels fused per instrumented case in the RSASG compared to SSG (p=.0001) (Table 1).

Discussion/Conclusion: In posterior lumbar spine surgery, SS wound closure may have greater risk for SSI compared to RSAS wound closure, a comparison that, to the authors' best knowledge, has not previously been reported. Further work to identify optimal wound closure methods is warranted.

	# ROR for SSI (%)	# Vancomycin powder (%)	% previous surgery in same site	% instrumented fusion	# levels fused/instrumented case
SS Group (n=211)	11 (5.2%)	193 (92%)	25.1	40.7	2.0 +/-2.3
RSAS Group (n=857)	11 (1.3%)	578 (67%)	27.0	45.4	3.9 +/- 4.0
p-value	.0013		.68	.28	<.0001

Table 1: The rate of return to the operating room within 1-year of index surgery for surgical site infection (ROR) was greater in the skin staple group (SSG) compared to running subcuticular stich with absorbable suture group (RSASG). The difference was statistically significant (p=.0013). The percentage of cases with previous surgery in the same site or with instrumented fusion is the same in the two groups. The number of levels fused per instrumented fusion case is greater in the RSASG compared to the SSG. Though SSG was more likely to have intra-wound vancomycin powder than RSASG, the ROR for patients with intra-wound vancomycin powder (4/299) compared to that of patients not treated with intra-wound vancomycin powder (18/778) were not statistically different (p=.31).

Paper 24

Iatrogenic Posterior Translation of the Construct at the UIV is Associated with an Increase in Revision for Alignment and Instrumentation Complications

Diebo Bassel, MD[1], Daniels Alan, MD[2], Lafage Renaud, MS[3], Balmaceno-Criss Mariah, BS[4], Daher Mohammad, BS[4], Hamilton D., MD[5], Smith Justin, MD[6], Eastlack Robert, MD[7], Fessler Richard, MD, PhD[8], Gum Jeffrey, MD[9], Gupta Munish, MD[10], Hostin Richard, MD[11], Kebaish Khaled, MD[12], Kim Han Jo, MD[13], Klineberg Eric, MD[14], Line Breton, BS[15], Nunley Pierce, MD[16], Mundis, Jr. Gregory, MD[7], Passias Peter, MD[17], Protopsaltis Themistocles, MD[18], Buell Thomas, MD[19], Scheer Justin, BS[20], Mullin Jeffrey, MD[21], Lenke Lawrence, MD[22], Bess Shay, MD[15], Shaffrey Christopher, MD[23], Schwab Frank, MD[24], Lafage Virginie, PhD[13], Ames Christopher, MD[25], Burton Douglas, MD[26]

[1] Department of Orthopedic Surgery at SUNY Downstate Medical Center, Brooklyn, New York, United States, [2] Alpert Medical School of Brown University, Department of Orthopaedics, Providence, Rhode Island, United States, [3] Lenox Hill Hospital Department of Orthopaedic Surgery, New York, New York, United States, [4] Alpert Medical School of Brown University, Providence, Rhode Island, United States, [5] Department of Orthopaedic Surgery, University of Pittsburgh School of Medicine, UPMC, Pittsburgh, Pennsylvania, United States, [6] University of Virginia, University of Virginia School of Medicine, Charlottesville, Virginia, United States, [7] Scripps Clinic, La Jolla, California, United States, [8] Rush University Medical Center, Chicago, Illinois, United States, [9] Norton Leatherman Spine Center, Louisville, Kentucky, United States, [10] Washington University in St Louis, St. Louis, Missouri, United States, [11] Southwest Scoliosis Institute, Plano, Texas, United States, [12] Johns Hopkins University, Johns Hopkins University, Baltimore, Maryland, United States, [13] Hospital for Special Surgery, New York, New York, United States, [14] University of California Davis, Davis, California, United States, [15] Denver International Spine Center, Denver, Colorado, United States, [16] Spine Institute of Louisiana, Shreveport, Louisiana, United States, [17] Department of Orthopedic Surgery, NYU Orthopedic Hospital, NYU Langone Health, Albany, New York, United States, [18] Department of Orthopedic Surgery, NYU Langone Health, New York, New York, United States, [19] University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania, United States, [20] UC San Diego / VA San Diego Health Care System, UCSD, San Diego, California, United States, [21] University at Buffalo, Buffalo, New York, United States, [22] New York Presbyterian - Columbia, New York, New York, United States, [23] Duke University Medical Center, Duke University Medical Center, Durham, North Carolina, United States, [24] Hospital for Special Surgery/Weill Cornell Medical College, New York, New York, United States, [25] San Francisco VA Medical Center and UCSF, UCSF/San Francisco VA Medical Center, San Francisco, California, United States, [26] University of Kansas Medical Center, Kansas City, Missouri, United States

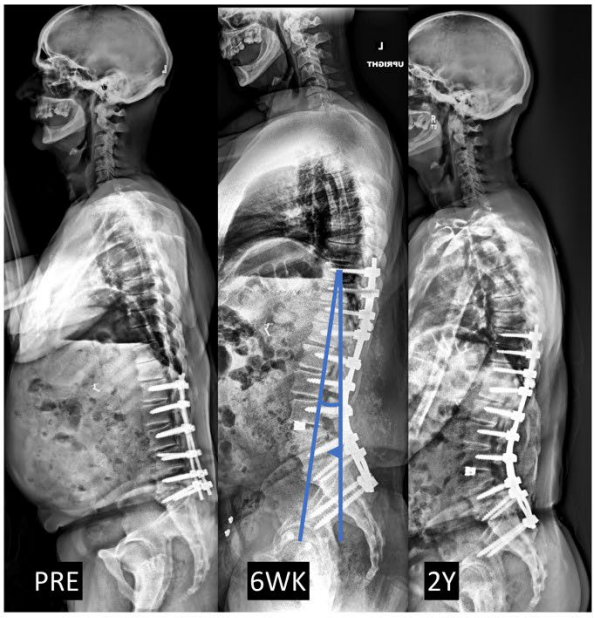
Background/Introduction: Predicting how ASD patients will stand postoperatively is challenging. Construct location at the UIV relative to the hips varies between patients.

Materials/Methods: We included 98 patients who underwent ASD surgery with 1) UIV between T8-L1, 2) LIV at ilium, and 3) baseline (BL), discharge, and 1-year follow up (1yr) radiographs and PROMs. Construct translation was calculated based on UIV spinopelvic

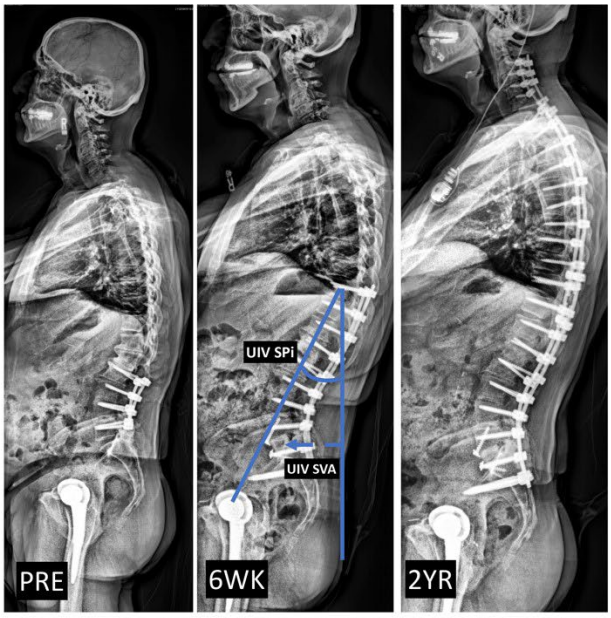
inclination angle and UIV SVA prior to hospital discharge (Figure). Patients were grouped based on magnitude of translation into most translated (Top 40% of cohort, MT: UIVSPi >15°) vs. least translated (Bottom 40%, LT: <10°). Sagittal alignment (at baseline, discharge, 6wks and 1yr follow up), radiographic and implant related complications, and revisions were compared.

Results: Data reported as (MT, LT). MT/LT groups had similar age, gender, frailty scores, and PROMs (ODI, VR12, SRS22) at BL, 6weeks, 1yr. At BL, groups had similar PT (29, 26°), PI-LL (25, 28°), but lower SVA in MT (78, 105mm, $p<0.05$). MT had more grade 3 or 4 hip osteoarthritis (OA) (88, 56%, $p<0.05$). Pre-discharge, MT had higher average posterior translation (UIV SVA: -51 vs. 1 mm; UIV SPi: -20 vs. -6, all $p<0.05$). L1, L4, T9 and T1PA were similar. At discharge, MT had higher radiographic PJK rate (23, 9%), however, rates were similar at 6wks and 1yr (both up to 30%). At 6wks, despite having significantly lower SVA (27, 53mm), the MT group had a higher PT (26, 19°) for a similar PI-LL (6, 4°), all $p<0.05$. At final follow up, MT had more radiographic and implant related complications (17.9, 5.2%, $p<0.05$); including 2 rod breakage, 1 adjacent segment disease, 4 PJK, and 2 pseudoarthrosis. Revision rate for complications was higher in MT group (15.4%, 3.4%, $p<0.05$).

Discussion/Conclusion: Patients with iatrogenic posterior translation of the UIV often stand with high PT, have hip OA, and are at 4.5x higher risk for radiographic and implant related complications. After controlling for intra-op positioning, UIV SVA and UIVSPi are recommended to be < -50mm and <20°, respectively (Figure).

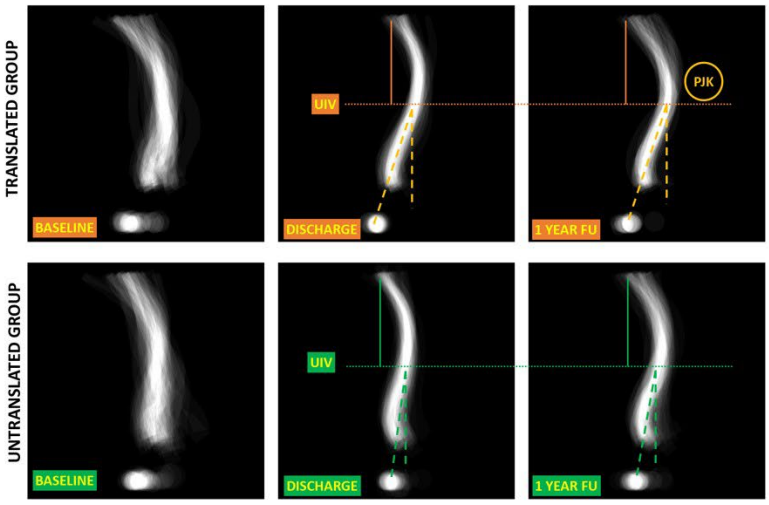


Example of a patient with minimally translated construct
UIV SPi = 10degree, UIV SVA = -2mm



Example of a patient with posteriorly translated construct
UIV SPi = 40degree, UIV SVA = -55mm – Revised

AI generated model for spines shape of the entire cohort in each translation group



Paper 25

Cost-Benefit of Enhanced Recovery After Surgery Protocols in Adult Spine Deformity surgery

Onafowokan Oluwatobi, BMBS[1], Das Ankita, BS[2], Mir Jamshaid, MD[3], Tretiakov Peter, BS[2], Owusu-Sarpong Stephane, MD[2], Lebovic Jordan, MD[1], Buser Zorica, PhD, MBA[4], Lorentz Nathan, MD[2], Galetta Matthew, MD[3], Passias Peter, MD[1]

[1] Department of Orthopedic Surgery, NYU Orthopedic Hospital, NYU Langone Health, Albany, New York, United States, [2] Department of Orthopedic Surgery, NYU Langone Orthopedic Hospital, NYU Langone Health, New York, New York, United States, [3] Department of Orthopedic Surgery, NYU Langone Health, New York, New York, United States, [4] Gerling Institute, Brooklyn, New York, United States

Background/Introduction: Enhanced Recovery After Surgery (ERAS) has been shown to accelerate patient recovery while reducing costs and maintaining high-quality patient care. Their implementation in adult spine deformity (ASD) patients remains under-studied.

Materials/Methods: Patients ≥18yrs undergoing thoracolumbar fusion with complete pre-(BL) and up to 5-year(5Y) radiographic and clinical outcome data were stratified by enrollment in an ERAS protocol (ERAS+ vs ERAS-). Differences in demographics, clinical outcomes, radiographic alignment parameters, peri-operative factors and complication rates were assessed via means comparison analysis. Logistic regression analysed differences while controlling for baseline disability and deformity. Quality gained was calculated from ODI to SF-6D and translated to quality-adjusted life years (QALYs). Cost was calculated using the PearlDiver database and CMS definitions for complications and comorbidities.

Results: 477 patients were included (Age: 59.9 ± 14.4 years, BMI: 27.0 ± 5.5 kg/m2, CCI: 1.64 ± 1.67). 81% of patients were female. 40% of patients were ERAS+. At baseline, ERAS+ patients were older (66.6 vs 60.6 years, $p<0.001$), had higher BMI (28.8 vs 26.8, $p=0.004$) and had worse deformity (PI-LL 22.8 vs 14.8, $p=0.001$, and GAP score 8.9 vs 7.6, $p=0.009$). There were no significant differences in HRQLs at BL. Controlling for baseline deformity and BMI, HRQL metrics, and complication rates were similar at all timepoints. At 2 years, ERAS+ had lower overall cost ($78,599 vs $88,535, $p=0.034$), but equivocal QALYs gained compared to ERAS- (0.174 vs 0.171, $p=0.897$). ERAS+ patients also had lower reoperation rates at 2 years (9.3 vs 23.5%, $p=0.023$). Although less likely to be influenced by ERAS protocols, ERAS+ patients followed up at 5 years still demonstrated lower overall costs ($73,781 vs $84,228, $p=0.032$), lower reoperation rates (9.3% vs 23.5%, $p=0.023$) and lower reoperation costs ($8675 vs $18,834, $p=0.012$); despite similar clinical outcomes between both groups.

Discussion/Conclusion: ASD patients umdergoing surgery with ERAS protocol implementation achieve similar outcomes to their counterparts, while also demonstrating lower reoperation rates and lower healthcare costs at 2 years.

Paper 26

Surgical Correction of the Lumbosacral Hemicurve in Adult Scoliosis

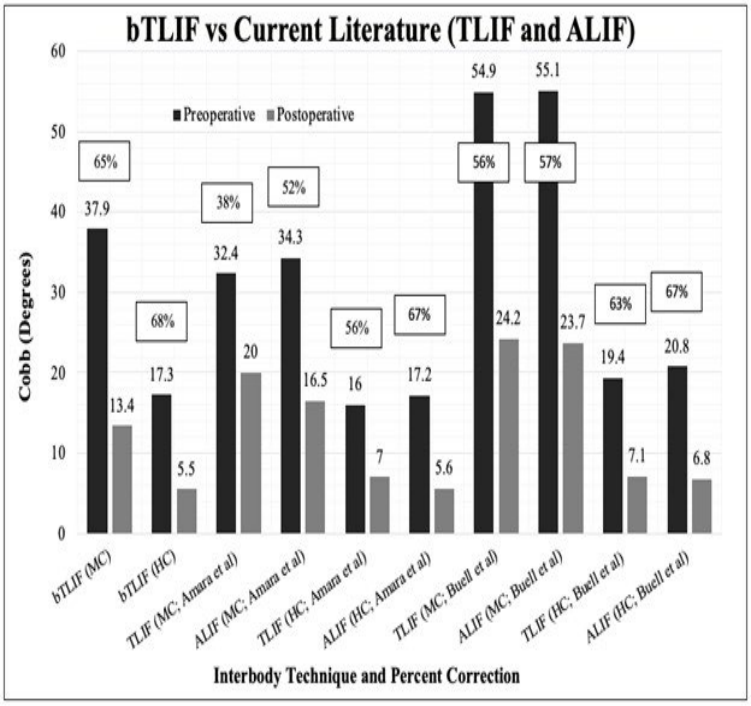
Czulinski Michael, MD[1], Spence Bradley, MD[1], Haselhuhn Jason, DO[2], Kress Dustin, MA[1], Jones Kristen, MD[3], Martin Christopher, MD[4], Sembrano Jonathan, MD[4], Hendrickson Nathan, MD, MS[2], Polly, Jr. David, MD[4]
[1] University of Minnesota Department of Orthopedic Surgery, Minneapolis, Minnesota, United States, [2] University of Minnesota, Department of Orthopedic Surgery, Minneapolis, Minnesota, United States, [3] University of Minnesota, Department of Neurosurgery, Minneapolis, Minnesota, United States, [4] University of Minnesota, Department of Orthopaedic Surgery, Minneapolis, Minnesota, United States

Background/Introduction: The lumbosacral hemicurve in adult spinal deformity (ASD) is a compensatory mechanism to balance the main curve. Previous reports examined hemicurve correction via various interbody techniques. We compared supine curve flexibility and hemicurve correction utilizing a bilateral deformity correcting transforaminal interbody fusion technique (bTLIF).

Materials/Methods: Patients (n=84) who had bTLIF from a single center with scoliosis (Cobb angle >20°), who underwent primary spinal fusion, and had a lumbosacral hemicurve were included in this study. Pre-operative radiographs including full spine (EOS), supine AP radiographs and CT scout films were utilized to quantify curve magnitude, sagittal vertical axis (SVA), coronal vertical axis (CVA) and Qui class. Postoperative correction was compared with the passive correction on preoperative supine AP and CT scout films. A paired samples t-test determined the mean change for the primary and hemicurve Cobb angles. One-way ANOVA was used to examine correction achieved based on the preoperative Bao/Qui class.

Results: The primary Cobb angle demonstrated a mean reduction of 24.5°(65%; p=<.001). The hemicurve Cobb angle demonstrated a mean reduction of 12.1°(68% ; p=<.001). Average surgical correction was greater than observed correction on supine imaging. The main curve reduced on average 7.1°(14.8%); the hemicurve reduced 2.8°(10.1%) on supine imaging. Mean CVA decreased from 3.1cm preoperatively to 1.5 postoperatively (p=<.001) with 31/84 (37%) patients being unbalanced (CVA > 3cm) preoperatively and 9/84 (11%) postoperatively. There was a significant difference between Bao/Qui classification groups on the correction degree for both the post-op primary Cobb angle (p= <.001) and hemicurve Cobb angle (p=.005). Post-hoc analysis revealed Bao/Qui class A (compensated) patients achieved greater Cobb correction (8.3° ± 2.8°, p=.011) than the Bao/Qui class B (>3cm toward concavity) and C (>3cm toward convexity) groups (8.8°± 2.3°, p=<.001). Post-hoc analysis revealed Bao/Qui class A patients achieved greater hemicurve correction compared to the Bao/Qui class C group (3.8°± 1.1°, p=.004).

Discussion/Conclusion: The bTLIF technique improved hemicurve alignment 68%. This is at least comparable to the currently reported literature including ALIF. Better correction was achieved in Bao/Qui class A patients.



bTLIF = bilateral transforaminal interbody fusion; ALIF = anterior lumbar interbody fusion; MC = main curve; HC = hemicurve

Paper 27

Novel Posterolateral Vertebral Tethering Combined with Limited Apical Fusion Decreased the Number of Fusion Levels and Preserved Lumbar Range of Motion

Kim Saechin, MD, PhD[1], Wu Hao-Hua, MD[2], Hanna Philip, MD, MBChB[1]
[1] Massachusetts General Hospital/Harvard Medical School, Boston, Massachusetts, United States, [2] University of California Irvine Medical Center, Orange, California, United States

Background/Introduction: The surgical goals for pediatric scoliosis surgery are to create a balanced, stable spine, to preserve range of motion (ROM) especially in the lumbar spine, and to avoid complications such as revision surgery (RS) or adding on phenomenon (AO). Our hypothesis is that a posterior scoliosis surgical intravertebral interpedicle (IVIP) method for limited apical fusion within the major structural curve(s) with rods and correction of the compensatory deformity with posterolateral vertebral tethering (PLVT) with polyethylene terephthalate bands between constructs (Figure) decreases the number of levels fused and preserves lumbar ROM in patients at or near skeletal maturity.

Materials/Methods: This IRB approved prospective study presents minimum 2-year follow up (f/u) results of the first 10 patients treated with the IVIP method. The number of levels fused for each patient is compared to matched historical standard posterior fusion controls (MHSPFC). Radiographic measurements were made from xrays at pre-op, 3-month and final f/u. SRS 22r Questionnaire was scored pre-op and at f/u.

Results: Average (avg) age was 16.4+/-2.2 years, pre-op main curve was 56o+/-8o, and post-op main curve was 25o+/-8o for avg correction of 55+/-13%. Female to male ratio was 9:1. Risser stages were 3(n=2), 4(n=2) and 5(n=6). The number of levels fused (avg 4.6+/-1.3) with the IVIP method was less than the number of levels fused in the MHSPFC (avg 10.8+/-1.8) ($p<.0001$). At avg of 27-month f/u (min. 24), no PLVT failure, AO, or RS was seen. Eight patients (1 Lenke1B, 2 1C, 2 3C, 1 4C, 1 5C, 1 6C) had PLVT in the lumbar spine and completed pre- and post-op side bending (SB) xrays, post-op flexion/extension (F/E) xrays and had avg 3.3+/-0.9 levels (1.4+/-0.9 in the lumbar spine) of PLVT. Post-op lumbar SB ROM was not statistically different from pre-op lumbar SB ROM (Figure). Post-op F/E ROM was 41o+/-13o. SRS-22r scores (n=9) at final f/u was 4.5/5 and pre-op was 4.0/5 and the increase was statistically significant ($p<.001$).

Discussion/Conclusion: The IVIP method with limited apical fusion and PLVT can result in significantly fewer levels fused compared to MHSPFC and preserved lumbar ROM, SB and F/E, in patients at or near skeletal maturity.

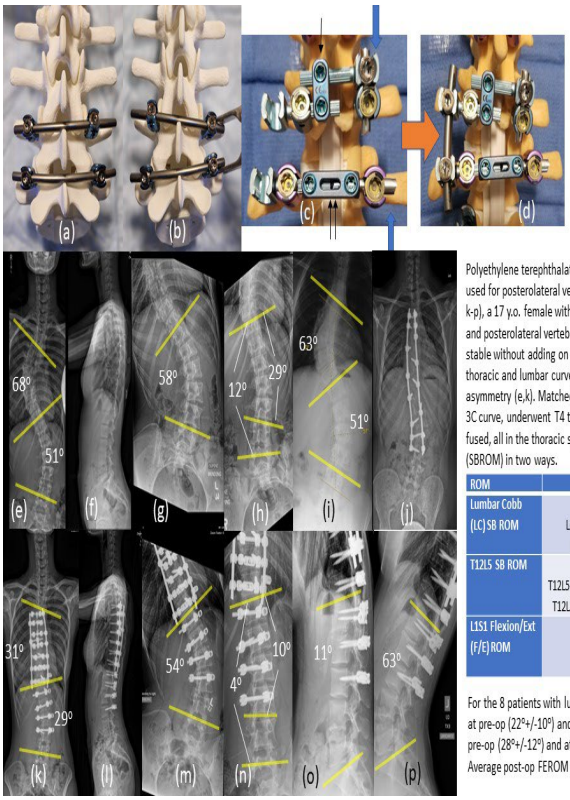


Figure: Intravertebral interpedicle (IVIP) construct method is based on the observation that rods placed intravertebral and interpedicle in adjacent vertebrae (a) and compressed laterally (b) result in a change in the adjoining disc angle. Constructs can be made with as end to end (double black arrows) or side by side connectors (single black arrow) (c,d). Force applied on the convexity of the deformity (thick blue line) (c) can correct a deformed disc angle in spinal deformity that is stabilized with a rod into the tulips of the lateral connectors (d). By using constructs with lateral extenders on both sides of the construct, a dual rod construct can be made for apical fusions.

Polyethylene terephthalate bands placed into closed head lateral extenders are used for posterolateral vertebral tethering (between T11L3 in (k-p)). Patient A (e-h, k-p), a 17 y.o. female with a Lenke 3C curve, underwent T5 to T11 (6 level) fusion and posterolateral vertebral tethering (PLVT) from T11 to L3 (k-p) that has been stable without adding on phenomenon at 37 mo. follow up (f/u) with residual thoracic and lumbar curves of 31° and 29° respectively (k) and improved shoulder asymmetry (e,k). Matched historical control patient (i), a 17 y.o. female with Lenke 3C curve, underwent T4 to L3 (11 level) fusion (j). Patient A had 5 fewer levels fused, all in the thoracic spine. We calculated the side bending range of motion (SBROM) in two ways.

ROM	Pre-op	Post-op
Lumbar Cobb (LC) SB ROM	29° LC w/right SB=58°(g) – LC w/left SB=29°(h)	44° LC w/right SB=54°(m)- LC w/left SB=10°(n)
T12L5 SB ROM	46° T12L5 angle w/right SB=58°(g) – T12L5 angle w/left SB=12°(h)	50° T12L5 angle w/right SB=54°(m) – T12L5 angle w/left SB=4°(n)
L1S1 Flexion/Ext (F/E) ROM	n/a	52° L1S1 angle w/ext=63°(p) – L5S1 angle w/flex=11°(o)

For the 8 patients with lumbar PLVT and with SB and F/E xrays, average LCSBROM at pre-op (22°+/-10°) and at f/u (25°+/-10°) (p=.29), and average T12L5SBROM at pre-op (28°+/-12°) and at f/u (30°+/-10°) (p=.64) were not statistically different. Average post-op FEROM was 41°+/-13°.

Paper 28

The Use of Cranial Aneurysm Clips for Repair of Incidental Lumbar Durotomy

Patel Arpan, MD[1], Davison Mark, MD[2], Lilly Daniel, MD[2], Shost Michael, BS[3], Meade Seth, BS[4], Habboub Ghaith, MD[2], Krishnaney Ajit, MD[2]
[1] Center for Spine Health, Cleveland Clinic Foundation, Cleveland, Ohio, United States, [2] Cleveland Clinic Foundation, Cleveland, Ohio, United States, [3] Case Western Reserve University School of Medicine, Cleveland, Ohio, United States, [4] Cleveland Clinic Lerner College of Medicine of Case Western Reserve University, Cleveland, Ohio, United States

Background/Introduction: Incidental durotomy is a common complication of posterior lumbar spine surgery, however effective and durable methods for primary repair remain elusive. Multiple existing techniques have previously been reported and extensively described including sutured repair and non-penetrating titanium clips. The use of cranial aneurysm clips for primary repair of lumbar durotomy serves as a safe and effective alternative to obtain watertight closure of a dural tear.

Materials/Methods: We performed a retrospective review of all patients at a single institution who underwent primary repair of an incidental lumbar durotomy with use of a brain aneurysm clip during open posterior lumbar surgery between 2012 and 2023. Patient demographics, operative details, and postoperative metrics were collected and examined to evaluate the safety and efficacy of the novel technique. Patient information was compiled and basic descriptive statistics were used to characterize the continuous and categorical data where appropriate.

Results: A total of 51 patients were included for analysis, where 8 underwent a single-level decompression, 18 underwent multi-level decompression, and 25 underwent decompression and fusion. Four patients underwent durotomy repair with aneurysm clip alone, 27 patients were repaired with aneurysm clip and fibrin glue, and 20 patients had repair with aneurysm clip, fibrin glue, and a collagen dural substitute. Three (5.9%) patients reported headaches, 2 (3.9%) with psuedomeningocele, and 1 (2%) with wound leakage. Two (3.9%) patients had treatment failure with return to OR for repair of CSF leak.

Discussion/Conclusion: We report the largest series of lumbar spine patients undergoing primary repair of incidental durotomy with the use of a brain aneurysm clip. Utilization of an aneurysm clip is noted to be a safe, quick and effective method of primary repair when compared to existing repair techniques such as sutured repair or non-penetrating titanium clips.

Operative Details	***n***
Single-Level Decompression	8 (15.7%)
Multi-Level Decompression	18 (35.3%)
Decompression and Fusion	25 (49%)
EBL (cc)	285 ± 265
Operative Time (minutes)	192 ± 90
Length of Stay (Days)	3 ± 3
Durotomies	
1	46 (90.2%)
>1	5 (9.8%)
Durotomy Repair Technique	
Aneurysm Clip	4 (7.8%)
Clip + Fibrin Glue	27 (52.9%)
Clip + Fibrin Glue + Dural Subsitute	20 (39.2%)
Post-Operative Activity Restriction	
No Restriction	35 (68.6%)
Bedrest <24 Hours	16 (31.4%)
CSF-Leak Related Complications	
Headache	3 (5.9%)
Nausea/Vomitting	0
Wound Leakage	1 (2%)
Pseudomeningocele	2 (3.9%)
Meningitis	0
Arachnoiditis	0
Revision Surgery	
Repair of CSF Leak	2 (3.9%)
Other	4 (7.8%)

Paper 29

Evidence-Based Medicine: Does Data Support the "20-Minute Rule"?

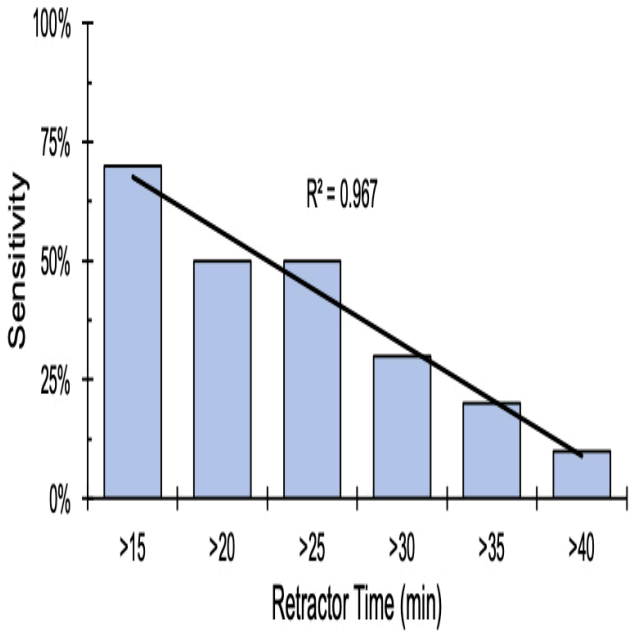
McDermott Michael, DO[1], Tyson Chester, BS[2], Prior Robert, DO[3], Thomas Alex, MD[2], Buckland Aaron, MD[4], Menezes Christiano, MD[5], Patel Ashish, MD[1]
[1] Duly Health and Care, Naperville, Illinois, United States, [2] Atlantic Neurosurgical and Spine Specialists, Wilmington, Delaware, United States, [3] Fransiscan Health, Olympia Fields, Illinois, United States, [4] Melbourne Orthopaedic Group, Spine And Scoliosis Research Associates Australia, Melbourne, Victoria, Australia, [5] HCV Hospital and Columna Institute, Belo Horizonte, , Brazil

Background/Introduction: Lateral lumbar interbody fusions (LLIF) is a treatment option for the correction of lumbar degenerative pathologies that uses a retroperitoneal, transpsoas corridor to the disc space. While attractive, LLIF is not without potential complications, as recent studies have shown a permanent injury rate of 2.8% of cases. Conventional teaching of the LLIF technique has been to perform the procedure 'as efficiently as possible', with a goal of keeping the total retractor time to less than 20 minutes. The purpose of this study is to examine the sensitivity of the "20-minute" rule for predicting postoperative femoral nerve palsy.

Materials/Methods: A multinational, retrospective cohort of patients who underwent an LLIF containing levels L2-5 was established. Retractor time was recorded and compared to postoperative motor exams for its relationship to motor injury. Femoral nerve palsy was defined as a postoperative quadriceps strength of 3/5 or less and/or knee buckling that required treatment with a knee immobilizer.

Results: 462 total patients were included in the study, including 321 single-level cases. The most frequently operated level was L4-5 (60.8% of patients). The average retractor time for the cohort was 16.1 ± 7.3 minutes. The cohort demonstrated an overall injury rate of 2.2% (10/462). Three of these injuries occurred at L3-4, and seven occurred at the L4-5 level. There was no difference in average retractor time for non-injured vs injured patients (16.0 ± 7.0 min vs 17.7 ± 12.7 min, p = 0.461). Analysis of the "20-minute" rule for LLIF revealed a sensitivity of 50% and a specificity of 79.9%. and a positive predictive value of 5.6%. There were 96 patients with retractor times > 20 minutes and five injuries, yielding a false positive rate of 94.8%. Analysis of retractor time sensitivity at different thresholds demonstrated a negative correlation between retractor time and sensitivity (R = 0.967, figure 1).

Discussion/Conclusion: The 20-minute rule is a poor predictor of postoperative femoral nerve palsy, and the sensitivity decreases with increasing retractor times. Postoperative femoral nerve palsy after LLIF is not directly caused by time alone but is likely a multifactorial issue.


100%
75%
50%
25%
0%
Sensitivity
R² = 0.967
>15
>20
>25
>30
>35
>40
Retractor Time (min)

Paper 30

Prone Lateral Interbody Fusion Outperforms TLIF for Achieving L4-5 Segmental Alignment Goals.

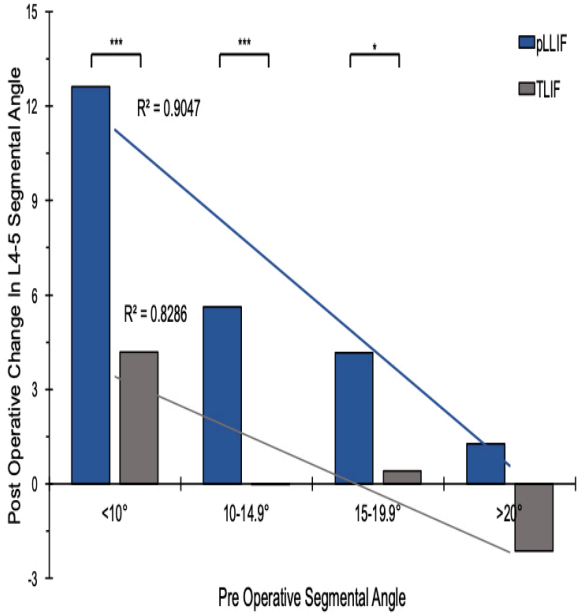
Patel Ashish, MD[1], McDermott Michael, DO[1], Prior Robert, DO[2], Rogers Michael, BS[1]
[1] Duly Health and Care, Naperville, Illinois, United States, [2] Fransiscan Health, Olympia Fields, Illinois, United States

Background/Introduction: Restoration of lumbar lordosis (LL) is a principal objective during spinal fusion procedures, traditionally focusing on achieving a LL within 10° of the pelvic incidence (PI). Recent studies have demonstrated a relatively constant L4-S1 alignment of 35-40° at L4-S1 and roughly 15° at L4-5 regardless of PI. The purpose of this study is to introduce individual segmental angle goals as a lumbar realignment principle and examine the success rate of achieving this goal while evaluating two differing fusion techniques (pLLIF and TLIF)

Materials/Methods: A retrospective cohort of 100 patients was established. Each patient underwent a primary single-level L4-5 interbody fusion. There were 50 patients in the TLIF group and 50 patients in the pLLIF group. Pre and postoperative radiographs were measured to examine the average segmental change at each level in the lumbar spine and calculate the success rate of each technique for achieving an L4-5 segmental lordosis ≥15° at the final follow-up.

Results: The overall success rate of achieving an L4-5 segmental alignment > 15° at the final follow-up was 71%. Prone LLIF was significantly more likely than TLIF to achieve this goal, achieving L4-5 > 15° 86% of the time vs TLIFs 59% ($p = 0.007$). Prone LLIF demonstrated an average L4-5 increase of 5.7 ± 6.1° which was larger than the mean increase for TLIF 0.4 ± 3.4° ($p = 0.030$). In both techniques, there was an inverse correlation between pre-operative L4-5 segmental angle and pre-post L4-5 segmental angle change (figure 1).

Discussion/Conclusion: Prone lateral lumbar interbody fusion demonstrates a high success rate for achieving a postoperative L4-5 segmental angle >15° and achieves this at a significantly higher rate than TLIF. This success rate is independent of preoperative L4-5 SA; considering both techniques, patients with the least pre-operative L4-5 lordosis were more likely to achieve a greater post-operative L4-5 segmental angle change.


15
12
9
6
3
0
-3
***
***
*
pLLIF
TLIF
R² = 0.9047
R² = 0.8286
<10°
10-14.9°
15-19.9°
>20°
Post Operative Change In L4-5 Segmental Angle
Pre Operative Segmental Angle

Paper 31

Outcomes Comparison between Novel Hydroxyapatite Enhanced PEEK and Titanium Implants after Anterior Lumbar Interbody Fusion

Orosz Lindsay, MS, PA-C[1], Jazini Ehsan, MD[2], Passias Peter, MD[3], Roy Rita, MD[1], Haines Colin, MD[2]
[1] National Spine Health Foundation, Reston, Virginia, United States, [2] Virginia Spine Institute, Reston, Virginia, United States, [3] Department of Orthopedic Surgery, NYU Orthopedic Hospital, NYU Langone Health, Albany, New York, United States

Background/Introduction: Interbody implants have evolved to reduce the risk of nonunion with polyetheretherketone (PEEK) and titanium devices. Two novel ALIF implants, hydroxyapatite (HA) infused PEEK (HA PEEK) and titanium alloy with microtextured surface integrated with HA (TiHA) may mitigate this risk. This study compares fusion rates, revision surgery rates, and changes in Oswestry Disability Index (ODI) scores between HA PEEK and TiHA implants.

Materials/Methods: This is a multicenter, retrospective cohort study of prospectively collected data from 27 US centers of adult ALIFs ≤3 levels using HA PEEK or TiHA implants. Pre- and 1-year post-operative ODI scores were recorded. Fusion was analyzed by validated motion detection software and defined as <2° of angular motion. Two sample proportion tests compared fusion and revision surgery rates, and two-way ANOVA compared changes in ODI.

Results: Analysis included 566 patients (78% HA PEEK, 22% TiHA) with mean age of 53.4 years and 1.5 levels of ALIF. There was no significant difference between fusion rates with respect to angular motion (88% HA PEEK, 95% TiHA, p=0.08) at 6 months or at 1 year (92% HA PEEK, 94% TiHA, p=0.8). There was no significant difference in revision surgery rates at 1 year (3.6% HA PEEK, 1.0% TiHA, p=0.2) or in ODI changes at 1 year (-22.7 HA PEEK, -19.7 TiHA, p=0.7). Subanalysis of ALIF-only and ALIF with posterior instrumentation also showed no significant differences in these outcomes between HA PEEK and TiHA groups.

Discussion/Conclusion: HA enhanced PEEK and titanium ALIF implants achieved similarly high rates of fusion, low rates of revision surgery, and improved ODI scores beyond established MCID at 6 months and 1 year. These findings demonstrate the historical nonunion risk with PEEK is mitigated by the novel HA infused PEEK implant with titanium alloy face plate and screws for ALIF.

Paper 32

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

Kazarian Gregory, MD[1], Mok Jung, MD[1], Jordan Yusef, MD[1], Hirase Takashi, MD[1], Kim Han Jo, MD[1]
[1] Hospital for Special Surgery, New York, New York, United States

Background/Introduction: Perioperative infection prophylaxis with cefazolin is an important aspect of infection prevention in spine surgery. However, the relative efficacy of alternative regimens is poorly understood. The purpose of this study was to compare the infection risk associated with cefazolin versus vancomycin as the choice of perioperative infection prophylaxis.

Materials/Methods: 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 between February of 2016 and June of 2020 from an institutional registry. Postoperative infection was defined by the combination three different 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 to determine whether perioperative antibiotic selection impacted the risk of infection.

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%).

Discussion/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 the primary spine surgery population. We recommend the routine use of IV cefazolin for infection prophylaxis in primary spine surgery, and caution against the elective use of alternative regimens like IV vancomycin unless the clinical situation warrants.

	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

Paper 33

ISOVUE Contrast for Intraoperative Assessment of Discectomy Quality in TLIF

Vucicevic Rajko, BS[1], Zavras Athan, MD[2], Federico Vincent, MD[3], Salazar Luis, MD[4], Asher Devin, BS[2], Hermanns Ian, BS[2], Goldsmith Tyler, BS[2], Yazdanbakhsh Kayvon, BS, MPH[2], Colman Matthew, MD[1]
[1] Midwest Orthopaedics at Rush University, Chicago, Illinois, United States, [2] Rush University Medical Center, Chicago, Illinois, United States, [3] Department of Orthopaedic Surgery, Division of Spine Surgery, Rush University Medical Center, Chicago, Illinois, United States, [4] Midwest Orthopaedics at Rush, Chicago, Illinois, United States

Background/Introduction: Transforaminal Lumbar Interbody Fusion (TLIF) relies on interbody arthrodesis as the primary source of fusion, underscoring the importance of quality endplate preparation and discectomy. However, the quality of discectomy /endplate preparation is frequently poor. This study aimed to investigate a novel technique for intraoperative quantitative and qualitative feedback during discectomy and endplate preparation in TLIF.

Materials/Methods: This prospective, randomized, controlled trial enrolled patients undergoing 1-2 level TLIF for low-grade spondylolisthesis with one surgeon. Randomization occurred into observation and feedback groups. In the observation group, after initial discectomy, ISOVUE M300 contrast was administered into the disc space to assess the extent of discectomy by obtaining orthogonal radiographs of the contrast-enhanced space. The case then proceeded with graft/cage insertion without additional excision. In the feedback group, prior to graft/cage insertion, the surgeon used the contrast feedback to enhance the excision/preparation. The surface clearance, both anteroposterior (AP) and mediolateral (ML) directions, and percentage of volume clearance was calculated from intraoperative radiographs. Differences between cohorts in terms of baseline characteristics, radiographic findings, clinical outcomes, and patient reported outcomes were identified using univariate statistics.

Results: 32 patients were randomized into observation and 24 into feedback. Initial preparation showed no differences between cohorts in disc space clearance volume or superior and inferior endplate surface clearance. AP surface preparation was greater in the feedback group compared to observation at the superior ($p=0.002$) and inferior endplates ($p=.002$). ML surface preparation was also greater in feedback compared to observation for both superior ($p<.001$) and inferior endplates ($p=0.001$). Percentage of disc volume clearance was significantly greater in the feedback group ($p=.02$). There were no differences in PROs, estimated blood loss, operative time, or hospital stay. There were no differences in subsidence, spinopelvic correction, occurrence of ASD, screw loosening, or reoperation rates.

Discussion/Conclusion: Additional endplate preparation and discectomy using feedback from contrast enhancement in the disc space during TLIF significantly increased endplate surface preparation and disc volume clearance. Although there were no differences detected in terms of clinical outcomes, this technique is of interest for its ability to enhance disc preparation quality and could lead to the detection of improved outcomes in larger studies.

Table 1

	Observation	***Feedback***	***p-value***
	n=32	n=24	
Patient Demographics			
Age	68.5 ±9.77	64.20 ±9.54	0.105
BMI	30.60 ±7.20	31.39 ±6.21	0.669
Female	72%	58.30%	0.29
ASA ≥3	59.40%	58.30%	0.938
Follow - Up (Months)	14.68 ±14.17	11.02 ±7.04	0.797
Pre-Op Symptoms			
Low Back Pain	93.80%	87.50%	0.642
Radiculopathy	69%	75%	0.608
Leg Pain	81.30%	87.50%	0.718
Discectomy and Endplate Preparation			
Surface AP Prep			
Superior Endplate	59.56±.18.14	74±14.62	**0.002**
Inferior Endplate	63.74±.15.79	75.90±9.39	**0.002**
Surface ML Prep			
Superior Endplate	29.54±12.06	42.74±14.81	**<.001**
Inferior Endplate	34.03±12.22	50.12±12.91	**0.001**
Disc Volume Clearance	45.29±24.46	63.85±28.19	**0.02**
Spinopelvic Alignment			
Pelvic Incidence	59.38±13.78	60.04±14.86	0.993
Pre-Op Segmental Lordosis	16.29±6.47	16.91±8.10	0.755
Final Segmental Lordosis	20.42±5	19.99±8.05	0.81
Pre-Op Lumbar Lordosis	51.13±16.08	45.63±13.04	0.185
Final Lumbar Lordosis	49.99±15.21	48.85±15.12	0.783
Complication/Reoperations			
Reoperation	12.50%	8.30%	0.691
Subsidence > 2mm	38.70%	33.30%	0.681
ASD	34.40%	16.70%	0.139
Screw Loosening	6.30%	8.30%	1.000

Bolding indicates statistical significance (p < 0.05)
BMI, Body Mass Index; ASA, American Society of Anesthesiologists Functional Score; AP, Anteroposterior; ML, Mediolateral; ASD, Adjacent Segment Disease

Paper 34

The Impact of Serum Albumin Levels on Postoperative Outcomes in Lumbar Spine Surgery: A MSSIC study

Chaker Anisse, MD[1], Rademacher Anneliese, BS[1], Telemi Edvin, MD[1], Mansour Tarek, MD[1], Kim Enoch, BS[2], Brennan Matthew, BS[1], Kagithala Dheeraj, BS[1], Schultz Lonni, PhD[1], Hu Jianhui, PhD[3], Abdulhak Muwaffak, MD[3], Schwalb Jason, MD[3], Chang Victor, MD[1]
[1] Henry Ford Hospital, Detroit, Michigan, United States, [2] Wayne State University, Detroit, Michigan, United States, [3] Henry Ford Health System, Detroit, Michigan, United States

Background/Introduction: Serum albumin has been identified as a significant predictor of postoperative complications. Traditionally, patients with serum albumin levels <3.5 g/dL are considered malnourished and are nutritionally optimized prior to surgery. However, there is a paucity of data regarding the outcomes of patients with albumin levels greater than 3.5 g/dL but less than 4.0 g/dL. The objective of this study is to examine whether patients with albumin levels 3.5-4g/dL could also benefit from nutritional optimization prior to lumbar spine surgery.

Materials/Methods: The Michigan Spine Surgery Improvement Collaborative (MSSIC) database contained 15,629 lumbar fusion surgeries between July 1, 2018 and January 15, 2022. Patients were grouped based on serum albumin levels: <3.5g/dL, 3.5-3.7g/dL, 3.8-4g/dL, and >4g/dL. Outcomes measured included urinary retention, surgical site infection (SSI), wound dehiscence, readmission within 30 and 90 days, return to OR, and length of stay (LOS) ≥4 days. Patients with albumin levels >4g/dL comprised the reference group.

Results: This study included a total of 15,393 lumbar cases. Albumin of <3.5 g/dL was associated with an increased risk of urinary retention (Incidence Rate Ratio 1.40, CI [1.08-1.83], p=0.012), Surgical Site Infection (2.35 [1.71-3.23], p<0.001), readmission at 30 days (1.87 [1.49-2.34], p<0.001) and 90 days (1.95 [1.58-2.40], p<0.001), return to OR (2.13 [1.65-2.75], p<0.001), and LOS ≥4 days (1.32 [1.21-1.44], p<0.001). Albumin of 3.5– 3.7 g/dL was associated with increased risk of readmission at 30 days (1.21 [1.001-1.45], p=0.048) and 90 days (1.28 [1.08-1.52], p=0.005), and LOS ≥4 days (1.22 [1.16-1.29], p<0.001). Albumin of 3.8–4.0 g/dL was associated with an increased risk of LOS ≥4 days (1.08 [1.04-1.11], p<0.001).

Discussion/Conclusion: Serum albumin of <3.5 g/dL was strongly associated with increased complications and increased return to OR, length of stay, and 30- and 90-day readmissions in elective lumbar spine procedures. Levels of 3.5-3.7 g/dL had increased risk of readmission and LOS, whereas levels of 3.8-4.0 g/dL did not show increased risk. These findings suggest that a goal albumin of >3.7 g/dL may improve post-operative outcomes in elective lumbar spine surgery.

Multivariate Analysis of Postoperative Complications by Preoperative Serum Albumin

Outcome (ref: > 4)	IRR	Lumbar (N = 15,393) 95% CI		*p-value*
		Lower	Upper	
Urinary Retention				
< 3.5	**1.40**	**1.08**	**1.83**	***0.012***
3.5 - 3.7	1.20	0.90	1.59	*0.208*
3.8 - 4	0.97	0.82	1.15	*0.748*
Readmission: 90 days				
< 3.5	**1.95**	**1.58**	**2.40**	***<0.001***
3.5 - 3.7	**1.28**	**1.08**	**1.52**	***0.005***
3.8 - 4	1.09	0.93	1.28	*0.305*
Readmission: 30 days				
< 3.5	**1.87**	**1.49**	**2.34**	***<0.001***
3.5 - 3.7	**1.21**	**1.00**	**1.45**	***0.048***
3.8 - 4	1.09	0.91	1.30	*0.336*
SSI				
< 3.5	**2.35**	**1.71**	**3.23**	***<0.001***
3.5 - 3.7	1.13	0.77	1.67	*0.524*
3.8 - 4	1.18	0.80	1.74	*0.408*
Return to OR				
< 3.5	**2.13**	**1.65**	**2.75**	***<0.001***
3.5 - 3.7	0.96	0.68	1.35	*0.814*
3.8 - 4	0.94	0.70	1.26	*0.674*
Length of Stay >= 4 days				
< 3.5	**1.32**	**1.21**	**1.44**	***<0.001***
3.5 - 3.7	**1.22**	**1.16**	**1.29**	***<0.001***
3.8 - 4	**1.08**	**1.04**	**1.11**	***<0.001***
Ileus or Dysphagia				
< 3.5	0.50	0.22	1.12	*0.091*
3.5 - 3.7	**0.34**	**0.16**	**0.72**	***0.005***
3.8 - 4	0.96	0.70	1.32	*0.823*

Paper 35

Focused Perioperative Nutritional Supplementation Reduces Wound Complications in Patients Undergoing Spinal Fusion Surgery

Setliff Joshua, BA[1], Como Christopher, MD[1], Tang Yunting, MD[1], Oyekan Anthony, MD[1], Spitnale Michael, MD[1], Dalton Jonathan, MD[1], Wawrose Richard, MD[2], Lee Joon, MD[1], Shaw Jeremy, MD, MS[1]
[1] University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania, United States, [2] Emory Orthopaedic and Spine Center, Atlanta, Georgia, United States

Background/Introduction: Malnutrition is associated with unfavorable outcomes in spine surgery,1,2 with multifactorial causes such as poor diet, advanced age, chronic pain, and extended bed rest.3 Suboptimal nutritional status increases mortality and predisposes patients to complications.4 While perioperative nutritional supplementation has shown promise, its explicit impact on spinal fusion surgery outcomes remains unexplored.5,6 The purpose of this study was to evaluate the impact of focused postoperative nutritional supplementation, on outcomes in spinal fusion surgery.

Materials/Methods: A retrospective cohort study (2019-2022) at a tertiary academic spine center assessed spinal fusion patients. Data included demographics, surgical variables, preoperative prealbumin (PAB), and postoperative Plastic & Reconstructive Surgery (PRS) supplemental diet. The supplemental diet, consisted of once daily administration of a multivitamin tab, vitamin A, vitamin C, and zinc sulfate, Juven nutrition powder, Arginaid, and either Ensure or Glucerna (Table 1A).7-10 The primary endpoint was rate of complications (reoperation, surgical site infection, and wound complications. Secondary outcomes included Oswestry Disability Index (ODI) and PROMIS Physical Health (PH) scores. Analyses compared patients with and without the supplemental diet and subgroups based on malnutrition status. Significance as set at $p<0.05$.

Results: Of 281 patients meeting inclusion criteria (mean age: 61.7±12.5 years, mean BMI: 30.4±6.3), those on the supplemental diet had significantly lower rates of wound complications ($p<0.001$), reoperations ($p=0.002$), and surgical site infection ($p=0.002$) compared to non-supplemental diet patients (Table 1B). In the low PAB subgroup, patients without the diet had higher rates of wound complications (39% vs. 15%, $p=0.013$, Table 1B).

Discussion/Conclusion: Patients receiving the supplemental diet had lower rates of wound complications, surgical site infection, and reoperations, emphasizing its beneficial impact. This effect was particularly notable in malnourished patients (low PAB subgroup), highlighting the significance of targeted nutritional support in mitigating adverse outcomes associated with malnutrition in spinal fusion surgery. This study underscores the potential of a specialized post-operative diet in improving patient outcomes.

Table 1. (A) Supplemental (PRS) diet regimen. (B) Postoperative complication rates and patient reported outcomes across all spinal fusion patients.

A

Once daily	BID	TID
Multivitamin tab	One packet Juven nutrition powder	One serving Ensure (non-diabetic) or one serving Glucerna (diabetic patients)
20,000 units vitamin A	-	One serving Arginaid
500 mg vitamin C	-	-
220 mg zinc sulfate	-	-

B

	Supplement (229)	No Supplement (52)	p-value
Reoperation – n (%)	9 (4%)	9 (17%)	**0.002**
Surgical site infection – n (%)	5 (2%)	5 (10%)	**0.022**
Wound complication – n (%)	18 (8%)	14 (27%)	**<0.001**
Preoperative PROMIS PH – mean (SD)	11.2 (4.2) (n=130)	11.5 (2.2) (n=33)	0.720
Preoperative ODI – mean (SD)	38.5 (16.9) (n=158)	35.0 (18.1) (n=33)	0.276
Postoperative PROMIS PH – mean (SD)	13.2 (6.3) (n=104)	12.7 (4.3) (n=30)	0.699
Postoperative ODI – mean (SD)	30.1 (20.7) (n=155)	32.0 (17.3) (n=36)	0.603

n.s., not significant; SD, standard deviation; PH, physical health; ODI, Oswestry disability index

Paper 36

Cannabis May Reduce Pain Medication Dosage and Improve Patient Satisfaction with Pain Care in Patients with Chronic Back Pain

Sedney Cara, MD[1], Dekeseredy Patricia, RN[2], Haggerty Treah, MD[1], Hodge Johnie, MD, PhD[1], Rudisill Toni, PhD[2]
[1] West Virginia University School of Medicine, Morgantown, West Virginia, United States, [2] West Virginia University, Morgantown, West Virginia, United States

Background/Introduction: Introduction: Cannabis is increasingly utilized and accepted as a treatment for several medical conditions, including back pain, in spite of legal complexities as well as questions regarding negative consequences and efficacy for such use. Cannabis use for chronic back pain has been suggested as a potential alternative to opioid use given the increasingly recognized substantial negative sequela of long-term opioid use. West Virginia experienced high rates of opioid prescriptions for chronic pain for decades, followed by a precipitous decline as restrictive measures were employed. This, in turn, has resulted in difficulties with specialized pain care access in WV and has impacted the satisfaction of patients with back pain who were on chronic opioids, and additionally forced tapering has been linked to transition to illicit substances.

Materials/Methods: Methods: We sought to understand to what extent West Virginia patients utilized cannabis for chronic pain, either de novo or as an alternative for opioid use, and how that impacted their pain care, though a survey of patients with chronic pain within the WVUMedicine system. Descriptive statistics were conducted, as well as individual crude logistic regression models with effectiveness of cannabis binarily coded as the dependent variable with “not effective” as referent.

Results: Results: We received 1351 responses. Of the respondents, 85.9% of patients endorsed chronic back pain. 57.9% had been in pain for over 10 years, and 64.1% had received an opioid prescription at some point for their pain. 319 of the 1351 patients used cannabis for their pain. These patients were more likely to report effectiveness of cannabis for their pain when using cannabis daily (OR 5.71 P<0.0001), several times per week (OR 4.23 P=0.006) or weekly (OR 17.5 P=0.0071) as compared to less than once per week. Patients who felt cannabis was effective for their pain were more likely to report a reduction in their pain medication (OR 7.60 P<0.0001)) and satisfaction with their pain management (OR2.12 P=0.0262).

Discussion/Conclusion: Conclusion: Cannabis may be an important option for patients with chronic pain in terms of reducing opioid use and improving satisfaction with pain care.

Paper 37

PROMIS 10 Global Mental Health T Score: An independent predictor of immediate post-surgical outcomes following single level elective lumbar fusion

Makanji Heeren, MD[1], Solomito Matthew, PhD[1], Antonacci Christopher, MD[2], Zeng Francine, MD[2], Esmende Sean, MD[1]
[1] Hartford Healthcare Bone and Joint Institute, Hartford, Connecticut, United States, [2] University of Connecticut Health Center, Farmington, Connecticut, United States

Background/Introduction: Mental illnesses are known to contribute to poor post-surgical outcomes. However, a patient's mental wellbeing may be just as important, as it too has the potential to influence a patient's recovery from surgery; yet, pre-operative mental wellbeing is rarely assessed as part of the standard of care in patients undergoing elective single level lumbar fusion. The purpose of this study was to determine if the PROMIS-10 Global Questionnaire Mental Health T-score (MHT) could be used to identify patients with poor mental wellbeing and if these patients experienced a different immediate postoperative recovery path compared to those with average to above average MHT scores.

Materials/Methods: This was a retrospective chart review of patients undergoing elective single level lumbar fusions. Patients without a formal diagnosis of a mental illness were divided based on their MHT (Above Average [AA] >50, Average [A] 40-50, Below Average [BA] <40). Postsurgical parameters included total opioid consumption, self-reported pain scores, ambulation distance, and discharge disposition. Differences in outcomes parameters were assessed using multivariate regression models to control for confounding variables (i.e. sex and length of stay).

Results: 319 patients (35.4% [AA], 51.4%[A], 13.2%[BA]) were included in this study. Patients in the AA group reported less pain, consumed less opioids while inpatient, ambulated a greater distance, and were more likely to be discharged home than those in the BA group (Table 1).

Discussion/Conclusion: The PROMIS-10 Global Questionnaire is a valid easily administered tool that can assess an individual's mental wellbeing using the MHT sub score. The results indicated that not only could the MHT score identify patients with poor mental wellbeing, but that those patients identified with poor mental wellbeing followed a different recovery path than those in the AA group. Therefore, BA-MHT was found to be an independent risk factor for increased opioid consumption, pain reporting, discharge to a facility, and post-operative ambulation. Adoption of the PROMIS-10 Global into clinical care can identify patients at risk for challenging immediate post-operative recovery and assist in planning for preoperative interventions such as counseling to improve overall outcomes.

Table 1: Comparison of immediate postsurgical outcomes based on PROMIS 10 MHT.

Outcome	Predictor	Value	P-value	Coefficient
Opioid Use (MME)	Below Average MHT	183.9 ± 219.4	Reference	Reference
	Above Average MHT	103.1 ± 114.4	<0.001	-80.1
	Average MHT	129.3 ± 108.9	<0.001	-54.5
Discharge:	Below Average MHT	2.8 ± 2.1	Reference	Reference
Pain at rest	Above Average MHT	3.9 ± 2.1	<0.001	-1.19
	Average MHT	4.3 ± 2.5	0.374	--
Discharge:	Below Average MHT	4.1 ± 2.3	Reference	Reference
Pain with activity	Above Average MHT	4.9 ± 2.1	<0.001	-1.45
	Average MHT	5.3 ± 2.7	0.197	--
Ambulation	Below Average MHT	70.9 ± 122.6	Reference	Reference
Distance at	Above Average MHT	190.4 ± 251.1	0.029	85.0
Discharge	Average MHT	113.5 ± 183.6	0.031	83.6
Discharge to a	Below Average MHT	15.2% of patients	Reference	Reference
Facility	Above Average MHT	2.6% of patients	0.014	0.158
	Average MHT	7.1% of patients	0.223	--

Paper 38

Predominant Back versus Leg Pain for PROMIS Outcomes Following Lumbar Decompression

Roca Andrea, MS[1], Anwar Fatima, BS[1], Nie James, BS[2], Hartman Timothy, MD[2], Medakkar Srinath, BS[2], Loya Alexandra, BS[1], MacGregor Keith, BS[2], Oyetayo Omolabake, BS[2], Zheng Eileen, BS[2], Federico Vincent, MD[2], Sayari Arash, MD[2], Singh Kern, MD[2]
[1] Midwest Orthopaedics at Rush, Chicago, Illinois, United States, [2] Department of Orthopaedic Surgery, Division of Spine Surgery, Rush University Medical Center, Chicago, Illinois, United States

Background/Introduction: Previous lumbar spine studies have evaluated the effect of predominant pain location on patient-reported outcomes (PROs). However, few studies have examined this effect on newer Patient-Reported Outcomes Measurement Information System (PROMIS) measures. This study aims to evaluate the effect of predominant pain location on PROMIS outcomes in patients undergoing lumbar decompression (LD).

Materials/Methods: Patients undergoing LD were separated into 3 cohorts based on preoperative visual analog scale (VAS) back pain (VAS-BP) and VAS leg pain (VAS-LP) scores. These cohorts were VAS-BP>VAS-LP (predominant back pain [pBP]), VAS-BP<VAS-LP (predominant leg pain [pLP]), and VAS-BP=VAS-LP (equal pain [EP]). PROs of PROMIS physical function (PROMIS-PF), PROMIS anxiety (PROMIS-A), PROMIS pain interference (PROMIS-PI), PROMIS sleep disturbance (PROMIS-SD), Patient Health Questionnaire-9 (PHQ-9),VAS-BP, VAS-LP, and Oswestry Disability Index (ODI) at preoperative and up to 2-year postoperative time points. Minimum clinically important difference (MCID) achievement was determined through comparison of ΔPRO to established values in literature. Univariate analysis of 1-way ANOVA and chi-square were utilized to compare demographic and perioperative characteristics between cohorts. Multivariable linear and logistic regression was utilized to compare postoperative clinical outcomes and MCID achievement, respectively.

Results: Four-hundred and sixty-seven patients were identified, with 194 pBP patients, 213 pLP patients, and 60 equal patients. The mean ± standard deviation (SD) follow-up time was 13.62±8.75 months. At the final postoperative follow-up, EP patients demonstrated superior PROMIS-PI ($p=0.016$). From preoperative to 6-week postoperative time point, pBP patients, pLP patients, and EP patients demonstrated lesser magnitude of improvement in VAS-LP, VAS-LP, and ODI, respectively ($p\leq0.027$, all). From preoperative to final postoperative periods, pBP patients demonstrated lesser improvement in VAS-LP ($p<0.001$). For MCID achievement, EP patients had greater MCID achievement rates, while pBP and pLP patients had lesser MCID achievement rates in VAS-LP and VAS-BP, respectively ($p\leq0.047$, all).

Discussion/Conclusion: Patients undergoing lumbar decompression demonstrated similar improvement in all PROs at final follow-up, except for PROMIS-PI, regardless of predominant pain location. Patients with equal back and leg pain demonstrated higher rates of clinically meaningful improvement. Predominant pain location may not provide prognostic value in

PROMIS measures.

Table 1. Patient-reported outcomes measures and minimum clinically important difference

	Total	pBP	pLP	EP	*p-value
Pre-Op					
PROMIS-PF	36.43±6.65	36.49±6.44	36.73±6.65	35.18±6.12	0.280
PROMIS-A	55.26±10.65	53.56±11.27	54.70±10.07	53.77±10.74	0.282
PROMIS-PI	65.33±6.55	65.62±6.02	64.23±7.03	66.72±6.17	0.256
PROMIS-SD	56.48±10.97	54.72±10.92	55.78±11.52	58.88±10.23	0.327
PHQ-9	5.58±5.41	5.46±5.14	5.65±5.47	5.79±6.26	0.921
VAS-BP	5.91±2.63	6.96±1.90	4.65±2.58	6.97±2.87	**<0.001**
VAS-LP	5.95±2.65	4.63±2.68	6.89±1.93	6.97±2.87	**<0.001**
ODI	41.40±17.90	40.56±17.06	40.74±17.53	46.57±21.12	0.062
6-week Post-Op					
PROMIS-PF	42.81±8.22	42.29±8.85	43.34±7.60	42.64±8.23	0.678
PROMIS-A	50.49±10.77	50.59±10.74	47.94±9.70	54.52±11.66	0.340
PROMIS-PI	54.23±8.22	53.16±10.04	54.59±6.10	54.66±9.12	0.668
PROMIS-SD	48.28±8.97	47.89±9.51	47.70±9.07	49.23±8.72	0.657
PHQ-9	3.10±4.18	3.01±4.17	2.99±3.97	3.72±4.87	0.613
VAS-BP	2.60±2.49	2.84±2.58	2.38±2.34	2.58±2.68	0.154
VAS-LP	2.58±2.68	2.32±2.60	2.76±2.70	2.76±2.83	0.254
ODI	23.27±17.49	23.77±18.23	22.59±16.62	24.07±18.32	0.459
Final Post-Op					
PROMIS-PF	47.04±9.96	46.82±10.56	47.33±9.67	46.71±9.18	0.796
PROMIS-A	44.28±9.36	43.53±9.97	44.34±8.82	46.44±9.13	0.069
PROMIS-PI	45.49±9.89	44.28±10.17	45.63±9.41	48.75±10.11	**0.016**
PROMIS-SD	47.85±9.55	46.76±10.60	48.69±10.21	47.71±7.63	0.766
PHQ-9	3.43±5.29	3.50±5.16	3.10±4.57	4.37±7.65	0.746
VAS-BP	2.70±2.61	2.99±2.68	2.44±2.48	2.72±2.77	0.117
VAS-LP	2.58±2.83	2.52±2.86	2.74±2.87	2.19±2.60	0.459
ODI	21.10±19.58	22.31±21.14	19.49±17.34	22.81±21.60	0.377
Δ Pre-Op to 6-week Post-Op					
PROMIS-PF	6.38±8.38	5.35±8.90	7.16±7.95	7.01±7.89	0.151
PROMIS-A	6.67±10.24	6.04±11.51	7.42±8.50	6.10±11.81	0.922
PROMIS-PI	10.89±8.20	12.38±9.20	10.27±8.33	10.59±7.50	0.644
PROMIS-SD	8.21±10.93	8.18±9.74	7.92±12.22	8.54±10.92	0.869
PHQ-9	2.59±4.68	2.81±4.71	2.44±4.50	2.38±5.42	0.432
VAS-BP	3.26±3.08	4.03±2.84	2.23±2.98	4.48±3.06	**<0.001**
VAS-LP	3.35±3.28	2.23±3.37	4.11±2.87	4.30±3.35	**<0.001**
ODI	18.10±19.67	16.05±18.92	18.06±19.22	25.31±22.45	**0.027**
Δ Pre-Op to Final Post-Op					
PROMIS-PF	6.38±8.38	5.35±8.90	7.16±7.95	7.01±7.89	0.151
PROMIS-A	6.38±8.38	5.35±8.90	7.16±7.95	7.01±7.89	0.818
PROMIS-PI	13.20±12.09	13.19±11.38	12.82±12.94	13.74±11.88	0.866
PROMIS-SD	8.24±12.13	8.16±10.66	6.81±13.80	9.78±11.74	0.923
PHQ-9	2.42±4.95	2.52±4.81	2.30±5.13	2.47±4.80	0.768
VAS-BP	3.15±3.13	3.87±2.86	2.18±3.11	4.34±3.09	0.172
VAS-LP	3.32±3.48	2.00±3.57	4.16±3.14	4.69±2.88	**<0.001**
ODI	20.28±22.27	17.60±21.65	21.90±21.07	23.30±27.38	0.056
MCID Achievement					
PROMIS-PF	79.3% (306)	76.1% (121)	79.2% (141)	89.8% (44)	**0.047**
PROMIS-A	44.3% (31)	42.1% (8)	48.4% (15)	40.0% (8)	0.848
PROMIS-PI	77.3% (68)	90.9% (20)	66.7% (26)	81.5% (22)	0.679
PROMIS-SD	77.3% (58)	81.8% (18)	70.4% (19)	80.8% (21)	0.700
PHQ-9	41.3% (143)	43.7% (66)	39.0% (62)	41.7% (15)	0.360
VAS-BP	68.1% (280)	81.4% (140)	53.8% (99)	74.6% (41)	**0.002**
VAS-LP	66.7% (274)	53.76% (93)	76.5% (140)	74.6% (41)	**<0.001**
ODI	66.2% (274)	63.0% (109)	68.1% (128)	69.8% (37)	0.309

*p-value calculated using ANOVA for continuous variables at the preoperative time point. At postoperative time points and ΔPROMs, p-values were calculated using multivariable regression and logistic regression accounting for BMI, ethnicity, and diabetes diagnosis for continuous variables and categorical variables, respectively.
Bolding denotes statistical significance ($p < 0.05$)

Paper 39

Preoperative Resilience and Improvement in Patient-Reported Outcomes After Lumbar Spinal Fusion

Daher Mohammad, BS[1], Alsoof Daniel, MBBS[1], Balmaceno-Criss Mariah, BS[1], Criddle Sarah, MD[1], Diebo Bassel, MD[2], Daniels Alan, MD[3]
[1] Alpert Medical School of Brown University, Providence, Rhode Island, United States, [2] Department of Orthopedic Surgery at SUNY Downstate Medical Center, Brooklyn, New York, United States, [3] Alpert Medical School of Brown University, Department of Orthopaedics, Providence, Rhode Island, United States

Background/Introduction: Resilience is associated with baseline spinal disability and early outcomes following spinal fusion. Currently, it is incompletely understood how pre-operative resilience affects 1-year post-operative outcomes following lumbar spinal fusion.

Materials/Methods: Patients undergoing open lumbar spinal fusion at a single-center institution were identified between November 2019 to September 2022. Pre-operative resilience was assessed using the Brief Resilience Scale (BRS). Demographic data at baseline including age, gender, comorbidities, and BMI was extracted. Patient reported outcome measures including ODI, PROMIS Global Physical Health (GPH), PROMIS Global Mental Health (GMH), and EuroQol5 scores were collected before the surgery and at 3-months and 1-year post-operatively. Bivariate correlation was conducted between BRS scores and outcome measures at 3-months and 1-year post-operatively.

Results: 93 patients had baseline and 1-year outcome data. Compared to patients with high resilience, patients in the low resilience group had a higher percentage of females (69.4% vs 43.9%, $p=0.02$), a higher BMI (32.7 vs 30.1, $p=0.03$), and lower preoperative GPH (35.8 vs 38.9, $p=0.045$), GMH (42.2 vs 49.2, $p<0.001$), and EuroQol scores (0.56 vs 0.61, $p=0.01$). At 3-months post-operatively, resilience was moderately correlated with GMH ($r=0.39$) and EuroQol ($r=0.32$). Similarly, at 1 year post-operatively, resilience was moderately correlated with GMH ($r=0.33$), and EuroQol ($r=0.34$). Comparable results were seen in multivariable regression analysis controlling for age, gender, number of levels fused, BMI, and CCI.

Discussion/Conclusion: Low pre-operative resilience can negatively affect patient reported outcomes 1-year after lumbar spinal fusion. Resiliency is a potentially modifiable risk factor, and surgeons should consider targeted interventions for at-risk patient groups.

Paper 40

Determination of Substantial Clinical Benefit (SCB) and Patient Acceptable Symptomatic State (PASS) in Lumbar Spine Surgery

Makanji Heeren, MD[1], Solomito Matthew, PhD[1], Antonacci Christopher, MD[2], Zeng Francine, MD[2], Esmende Sean, MD[1]
[1] Hartford Healthcare Bone and Joint Institute, Hartford, Connecticut, United States, [2] University of Connecticut Health Center, Farmington, Connecticut, United States

Background/Introduction: The Oswestry Disability Index (ODI) is a clinical research tool to assess the impact of a patient's lumbar pathology and assess post-treatment function. As the United States healthcare system transitions from a fee for service based model to a value based model, ODI scores are becoming increasingly important. With the greatest importance placed on whether a patient reaches the minimal clinically important difference (MCID), a calculated value to indicate a clinically meaningful change. However, understanding a patient's postoperative satisfaction is equally important, and developing threshold values to indicate substantial clinical benefit (SCB) and a patient acceptable symptomatic state (PASS) are necessary. Therefore, the purpose of this study was to calculate the MCID, SCB, and PASS for the ODI.

Materials/Methods: Patients undergoing single level elective level lumbar fusions between January and May 2023 that also completed their preoperative and 6 month postoperative ODI were included in this study. Patients were also asked to complete two anchor questions describing their improvement in function and if their current state was acceptable. MCID, PASS, and SCB values were calculated using previously described methods based on receiver operator curves and the Youden index.

Results: 159 patients (76 females) with an average age of 64.5±13.3 were included in this study. Patients were grouped based on their indicated change in function (Table 1). The MCID for this cohort was 11.1, the SCB was 18.5, and the PASS value was calculated as a score of 28.5 on the patient's 6 month post-op ODI. A total of 63% of patient reached MCID by 6 months, 48.9% indicated SCB, and 62.8% indicated their current state was acceptable.

Discussion/Conclusion: Results indicated that while 85.5% of patients indicated that their current function improved, only 63% of patients reached MCID and found their current state acceptable. Less than half of patients indicated that they had a substantial clinical benefit 6 months after surgery. Additional research is warranted to investigate the mismatch between stated improved function and statistically derived clinical cutoff values, especially in the era of value-based care.

Table 1: Average ODI scores based on patient indicated level of improvement. A negative value in the change indicates improvement.

Patient indicated change in function	N	Pre-op ODI Score	6 month post-op ODI Score	Average Change in Score
Substantial Improvement	79	42.0 ± 15.2	15.1 ± 12.3	-26.9 ± 18.4
Some Improvement	57	46.9 ± 16.1	32.0 ± 13.7	-14.9 ± 16.8
No Change	15	41.3 ± 15.3	37.7 ± 12.6	-3.6 ± 18.2
Worse	4	34.5 ± 13.4	34.0 ± 8.0	0.5 ± 9.6
Substantially worse	4	46.0 ± 10.7	49.5 ± 18.1	3.5 ± 16.1

Paper 41

Cannabinoid Use Impact and Post-Lumbar Surgery Pain Management in Opioid Naïve Patients

Shahzad Hania, MD, MBBS[1], Rodriguez Gerardo, BS[2], Hussain Nasir, MD[3], Yu Elizabeth, MD[4], Singh Varun, MD[1]
[1] Wexner Medical Center, The Ohio State University, Columbus, Ohio, United States, [2] Ponce Health Sciences University, Ponce, Puerto Rico, United States, [3] Beth Israel Deaconess Medical Center, Beth Israel Deaconess Medical Center & Harvard Medical School, Boston, Massachusetts, United States, [4] Ohio State University Wexner Medical Center, Columbus, Ohio, United States

Background/Introduction: Medical cannabis is a subject of ongoing debate for chronic low back pain, with increasing interest in its potential alternative to traditional pain management methods. This study explores the impact of cannabinoid use, both prescribed and associated with use disorder, on pain outcomes following a lumbar spine surgery.

Materials/Methods: Utilizing the PearlDiver patient record database, our investigation focused on opioid-naïve patients undergoing lumbar surgery. Patient records were categorized based on cannabinoid use, distinguishing between prescribed and use disorder cases. Outcomes assessed encompassed 90-day post-operative continuous opioid use, continuous nonsteroidal anti-inflammatory drug (NSAID) use, and emergency department admissions due to pain. Data analysis was conducted through chi-square analysis and R Statistical Software within the PearlDiver platform.

Results: Among the 704,396 patients undergoing various lumbar surgeries, 1.2% recorded cannabinoid use. Significantly, 70.1% displayed cannabinoid use disorder, while 29.1% had a medical prescription for cannabinoid use. Cannabinoid use patients, comprising use disorder and prescription use, exhibited heightened postoperative opioid use (OR 2.43, $p < 0.05$) compared to those without cannabinoid association. Patients with use disorder demonstrated lower post-operative NSAID use (OR 0.60, $p < 0.05$), while prescription cannabinoid use did not significantly correlate with NSAID use (OR 0.97, $p = 0.88$). Furthermore, cannabinoid users had a higher likelihood of emergency department admissions for pain within 90 days post-surgery.

Discussion/Conclusion: Irrespective of type, cannabinoid use was associated with heightened postoperative opioid utilization. Notably, patients with use disorder exhibited lower NSAID use, suggesting a compensatory increase in opioid consumption. The heightened likelihood of emergency department admissions for pain within 90 days post-surgery underscores the need for further investigation into causal or confounding relationships with pain outcomes. This study, centered on opioid-naïve patients and nuanced distinctions between prescription and use disorder categories, offers novel insights, emphasizing its relevance to advancing spine surgery pain management strategies.

Paper 42

Preoperative Opioid Use is a Robust Predictor of Increased Healthcare Utilization Following 1- and 2-Level Elective Lumbar Spine Surgery

Chandrasekar Shyam, BS[1], *Staub Jacob, BS*[1], *Riccobono Giancarlo, BS*[1], *Bajaj Pranav, BA*[1], *Hsu Wellington, MD*[1], *Patel Alpesh, MD, MBA*[1], *Divi Srikanth, MD*[1]
[1] *Northwestern University Department of Orthopaedic Surgery, Chicago, IL, , United States*

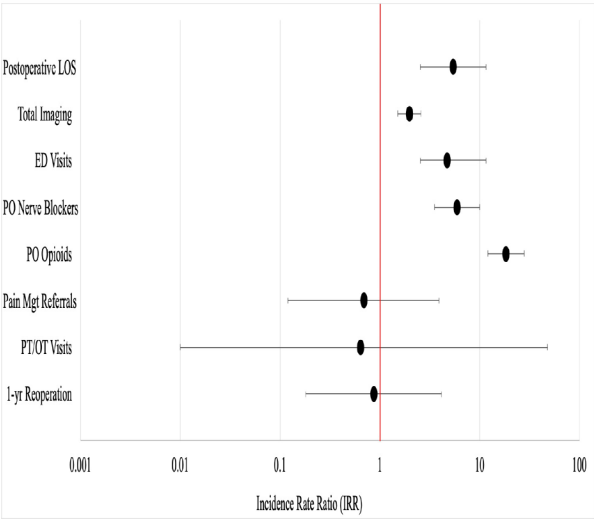
Background/Introduction: Preoperative analgesia is an important consideration in patient optimization for spine surgery. Current evidence suggests that pre-operative opioid usage prior to lumbar fusion serves as an independent predictor of decreased improvement in patient reported outcomes, increased postoperative opioid usage, and decreased chances of return to work; however, there is a relative paucity of studies with regards to overall health utilization. This study aims to analyze this relationship following 1- and 2-level elective lumbar spine surgery, and we hypothesize that patients taking opioid prescriptions prior to surgery will have increased healthcare utilization.

Materials/Methods: Patients who underwent elective spine surgery for lumbar degenerative pathology at a single, tertiary academic center were retrospectively identified. Patients were divided into 2 cohorts: patients with and without opioid use 60-days before operation – opioid-experienced and opioid-naïve, respectively. Patient demographics, comorbidities, intraoperative variables, and healthcare utilization metrics (e.g. postoperative acute care unit length-of-stay (LOS), emergency visits, imaging studies, etc.) were compared between opioid-naïve (ON) and opioid-experienced (OE) cohorts.

Results: A total of 426 patients met inclusion criteria, of which 106 (24.9%) were opioid-experienced and 320 (75.1%) were opioid-naïve. OE was significantly associated with higher rates of healthcare utilization metrics (Fig. 1), including a 5.42-fold increase in LOS ($p<0.001$), a 1.97-fold increase in total imaging ($p=0.008$), and a 4.71-fold increase in ED visits ($p<0.001$). Additionally, OE patients received 18.32 times more postoperative opioid prescriptions ($p<0.001$) and 5.93 times more nerve blocker prescriptions ($p<0.001$) compared to opioid-naïve patients despite controlling for covariates including preoperative pain levels. In addition, ASA class was also discovered to be an independent predictor of increased LOS, ED visits, and postoperative opioid usage.

Discussion/Conclusion: Preoperative opioid experience is a strong predictor of increased healthcare utilization following elective lumbar decompression/fusion surgery. These findings suggest that preoperative opioid screening and intervention strategies may be crucial for optimizing postoperative outcomes and reducing healthcare costs in this population.

Figure 1: Incidence Rate Ratios of Healthcare Utilization between Opioid Experienced and Naive Cohorts



Paper 43

The Effect of NSAID contraindications on pre and postoperative opioid use among patients undergoing lumbar fusion

Carter Michael, BS[1], Narayanan Rajkishen, MD[1], Toci Gregory, BS[2], Lee Yunsoo, MD[3], Hassan Waqaas, MD, MPH[1], Tewell Nick, BA[1], Sabitsky Matthew, BS[1], Fras Sebastian, BS[1], Bowen Grace, BS[1], Toth Allison, BS[1], Von Suskil Max, BS[1], Canseco Jose, MD, PhD[4], Vaccaro Alexander, MD, PhD, MBA[4], Hilibrand Alan, MD[4], Kepler Christopher, MD, MBA[4], Schroeder Gregory, MD[4]

[1] Department of Orthopaedic Surgery, Rothman Institute, Thomas Jefferson University, Philadelphia, Pennsylvania, United States, [2] Rothman Institute, Thomas Jefferson University Hosptial, Philadelphia, Pennsylvania, United States, [3] Rothman Institute, Philadelphia, Pennsylvania, United States, [4] Rothman Institute at Thomas Jefferson University, Philadelphia, Pennsylvania, United States

Background/Introduction: NSAIDs have long been first line therapy for management of acute and chronic low back pain. There is a paucity of research examining pain medication trends among patients unable to take NSAIDs. This study sought to assess preoperative and postoperative opioid use among patients undergoing lumbar fusion with five medical contraindications to NSAIDs (NSAID allergies, peptic ulcer disease, chronic kidney disease, prior gastric bypass surgery and use of blood thinners) compared to a cohort of patients without any contraindications.

Materials/Methods: Patients aged 18 years or older who underwent lumbar fusion from 2018-2019 were analyzed. Those with an NSAID contraindication (see "Introduction") were compared to those without any NSAID contraindications. Opioid utilization, including the total number of prescriptions and morphine milligram equivalents (MME) per day, was tracked for both sets of patients from one year prior to the surgery up to two years post-surgery, utilizing data from the Pennsylvania Prescription Drug Monitoring Program (PDMP). Opioid-related data was further categorized by time intervals (60-30 days and 30-0 days before surgery, 0-30, 30-90, 90-365, and 365-720 days after surgery). Preoperative and postoperative benzodiazepine, muscle relaxant and pregabalin/gabapentin usage was recorded.

Results: 216 patients had at least one NSAID contraindication, while 639 did not have any contraindications. Preoperatively, more patients with NSAID contraindications consumed opioids within one year of surgery ($p=0.008$) and these patients reported higher MME at 30-60 days ($p<0.001$) and 0-30 days ($p=0.034$). Postoperatively, more patients with NSAID contraindications consumed opioids 0-30 days ($p=0.027$), 30-90 days ($p=0.032$), 90-365 days ($p=0.005$) and 1-2 years ($p=0.004$) postoperatively. Patients with NSAID contraindications also reported higher MMEs from 30-90 days ($p=0.034$), 90-365 days ($p=0.003$), and 1-2 years ($p=0.001$) postoperatively. Additionally, patients with NSAID contraindications reported higher gabapentin/pregabalin usage preoperatively and postoperatively, both of which were statistically significant.

Discussion/Conclusion: Patients with NSAID contraindications are prescribed significantly more opioids than those with no NSAID contraindications and also consumed opioids for longer periods of time; these trends are in spite of increased utilization of gabapentin/pregabalin. It is therefore critical for healthcare providers to prioritize regular check-ins and follow-ups with these patients to enable timely intervention for those experiencing increased pain.

Pre and Post-Operative Opioid Consumption			
	No NSAID Contraindication (N=639)	NSAID Contraindication (N=216)	P Value
Number of Patients Using Opioids 1 Year Pre-Op	346 (54.1%)	140 (64.8%)	**0.008**
Number of Patients Using Opioids 30-60 Days Pre-Op	163 (25.5%)	88 (40.7%)	**<0.001**
Number of Patients Using Opioids 0-30 Days Pre-Op	171 (26.8%)	70 (32.4%)	0.132
Total Prescriptions Pre-Op	3.34 (5.53)	5.35 (7.05)	**<0.001**
Total MME 1 Year Pre-Op	156 (477)	244 (634)	0.060
MME 30-60 Days Pre-Op	15.1 (41.6)	27.1 (62.5)	**<0.001**
MME 0-30 Days Pre-Op	13.6 (35.7)	21.0 (49.1)	**0.034**
Number of Patients Using Opioids 0-30 Days Post-Op	597 (93.4%)	191 (88.4%)	**0.027**
Number of Patients Using Opioids 30-90 Days Post-Op	241 (37.7%)	100 (46.3%)	**0.032**
Number of Patients Using Opioids 90-365 Days Post-Op	242 (37.9%)	106 (49.1%)	**0.005**
Number of Patients Using Opioids 1-2 Years Post-Op	229 (35.8%)	102 (47.2%)	**0.004**
Total Prescriptions Post-Op	7.12 (9.41)	10.0 (12.2)	**0.003**
Total MME 0-90 Days Post-Op	161 (192)	218 (355)	0.344
MME 0-30 Days Post-Op	117 (125)	142 (196)	0.086
MME 30-90 Days Post-Op	43.6 (102)	76.3 (194)	**0.034**
Total MME 0-1 Year Post-Op	285 (586)	380 (730)	0.141
MME 90-365 Years Post-Op	124 (447)	161 (449)	**0.003**
Total MME 0-2 Years Post-Op	393 (829)	566 (1256)	0.060
MME 1-2 Years Post-Op	108 (305)	187 (590)	**0.001**
Data listed as either: mean (SD) or n (%)			

Paper 44

Lumbar Facet Arthroplasty for Degenerative Spondylolisthesis with Stenosis: Interim Analysis of Three-Year Outcomes from a Prospective Randomized Clinical Trial

Pinter Zachariah, MD[1], Steinmetz Michael, MD[2], Nassr Ahmad, MD[1], Freedman Brett, MD[1], Sebastian Arjun, MD[1], Potts Eric, MD[3], Arnold Paul, MD[4], Coric Domagoj, MD[5]
[1] Mayo Clinic College of Medicine and Science, Rochester, Minnesota, United States, [2] Center for Spine Health, Cleveland Clinic Foundation, Cleveland, Ohio, United States, [3] Goodman Campbell Brain & Spine, Indianapolis, Indiana, United States, [4] Carle Neuroscience Institute, Urbana, Illinois, United States, [5] Carolina Neurosurgery and Spine Associates, Charlotte, North Carolina, United States

Background/Introduction: Though lumbar facet arthroplasty has demonstrated superior outcomes compared to decompression and fusion in patients with symptomatic lumbar spinal stenosis and grade I degenerative spondylolisthesis at 24 months postoperatively, the durability of lumbar facet arthroplasty remains unknown.

Materials/Methods: In this randomized, controlled, FDA IDE trial, we assigned patients, 35 to 80 years of age, who had lumbar spinal stenosis and grade I degenerative spondylolisthesis to undergo decompression and lumbar facet arthroplasty (arthroplasty group) or decompression and transforaminal lumbar interbody fusion (fusion group). We performed an interim analysis of this trial when greater than 120 patients had achieved three years of clinical follow-up. The arthroplasty and fusion groups were compared based upon reoperation rates and patient reported outcomes (PROs), including ODI, VAS leg, and VAS back pain.

Results: A total of 302 patients were randomized in a 2:1 fashion, with 207 patients assigned to undergo facet arthroplasty and 95 patients assigned to undergo fusion. There were no differences in baseline ODI, VAS leg, or VAS back scores between the arthroplasty and fusion groups. The arthroplasty group demonstrated superior ODI and VAS back scores at all postoperative time points (Table 1). At 36 months postoperatively, the arthroplasty group demonstrated superior ODI (9.2 ± 13.7 vs 17.6 ± 19.4; P<0.001) and VAS back scores (10.8 ± 18.5 vs 24.5 ± 29.8; P<0.001). A higher proportion of arthroplasty patients achieved MCID in both ODI (94.8 vs 81.8%; P=0.03) and VAS back (84.4 vs 69.7%; P=0.07) at 36 months postoperatively, though this did not reach the level of statistical significance for VAS back. There were no statistically significant differences between groups in VAS leg scores or reoperation rates between groups.

Discussion/Conclusion: Lumbar facet arthroplasty was associated with superior back pain and disability indices at 36 months postoperatively when compared to decompression and fusion for the treatment of grade 1 spondylolisthesis with lumbar spinal stenosis. There was no statistically significant difference in reoperation rates between subgroups. Lumbar facet arthroplasty appears to be a viable treatment option for low-grade lumbar spondylolisthesis with stenosis, but long-term follow-up will be necessary to determine the durability of arthroplasty.

Table 1: Patient Reported Outcomes

	Arthroplasty (N= 206)		Fusion (N=93)		P Value	MCID		P Value
	N	Mean	N	Mean		Arthroplasty	Fusion	
Oswestry Disability Index								
Preoperative	207	56.6 ± 12.1	95	55.9 ± 13.0	0.75			
Week 6	201	23.1 ± 16.4	90	30.3 ± 17.1	0.001	84.1%	72.2%	0.03
Month 3	199	15.2 ± 16.4	89	22.2 ± 17.5	0.02	89.9%	84.3%	0.17
Month 6	196	12.8 ± 15.1	84	16.8 ± 15.5	0.01	92.9%	91.7%	0.81
Month 12	190	11.1 ± 13.2	82	15.7 ± 16.1	<0.001	95.3%	90.2%	0.17
Month 24	146	10.5 ± 14.8	59	18.2 ± 20.0	<0.001	95.2%	83.1%	0.009
Month 36	96	9.2 ± 13.7	33	17.6 ± 19.4	<0.001	94.8%	81.8%	0.03
P Value*		<0.001		<0.001				
Visual Analog Scale - Low Back								
Preoperative	207	68.6 ± 23.3	95	69.8 ± 22.1	0.75			
Week 6	201	18.1 ± 17.8	90	27.9 ± 25.6	0.001	84.1%	70.0%	0.007
Month 3	199	15.6 ± 20.7	89	23.3 ± 24.2	0.02	84.4%	80.9%	0.49
Month 6	196	14.2 ± 20.4	84	21.9 ± 23.7	0.01	86.7%	82.1%	0.36
Month 12	190	12.8 ± 19.0	82	23.0 ± 26.2	<0.001	87.4%	81.7%	0.26
Month 24	146	13.1 ± 20.6	57	27.0 ± 39.3	<0.001	83.6%	66.7%	0.01
Month 36	96	10.8 ± 18.5	33	24.5 ± 29.8	<0.001	84.4%	69.7%	0.07
P Value*		<0.001		<0.001				
Visual Analog Scale - Worst Leg								
Preoperative	207	82.7 ± 13.4	95	84.8 ± 11.1	0.13			
Week 6	201	12.6 ± 20.3	90	18.1 ± 25.5	0.09	93.0%	92.2%	0.81
Month 3	198	12.8 ± 22.2	89	16.2 ± 23.7	0.38	94.4%	93.3%	0.79
Month 6	196	11.8 ± 21.6	84	16.5 ± 24.7	0.21	93.4%	91.7%	0.62
Month 12	190	11.2 ± 20.4	82	17.4 ± 25.9	0.04	95.8%	92.7%	0.37
Month 24	146	13.4 ± 22.9	57	21.7 ± 30.3	0.02	92.5%	89.5%	0.57
Month 36	96	8.9 ± 17.0	33	14.5 ± 22.7	0.08	96.9%	90.9%	0.17
P Value*		<0.001		<0.001				

*These P values reflect within group comparisons from preoperative to 24 months postoperatively.
Continuous variables are displayed as mean ± standard deviation.

Table 2: Reoperations

	Arthroplasty (n=206)	Fusion (n=93)
Wound complication	3 (1.0%)	0 (0.0%)
Pseudarthrosis	0 (0.0%)	1 (1.0%)
Pedicle Screw Misplacement	1 (0.5%)	0 (0.0%)
Screw Loosening	3 (1.4%)	1 (1.0%)
Adjacent Segment Disease^	3 (1.4%)	5 (5.2%)
Unresolved Pain	1 (0.5%)	3 (2.1%)
TOTAL*	11 (4.8%)	10 (9.4%)

*10 arthroplasty patients underwent a total of 11 reoperations. 9 fusion patients underwent a total of 10 reoperations.
^Defined as symptomatic stenosis at a motion segment adjacent to the index surgical level requiring reoperation for symptom relief.

Paper 45

Long-term Outcomes of Lumbar Facet Arthroplasty versus Spinal Fusion in Young (<65 years) and Old (>65 years) Patients for the Treatment of Degenerative Spondylolisthesis and Stenosis

Shaffer Annabelle, MS[1], Yu Alexander, MD, MS[2], Huesmann Graham, MD, PhD[3], Arnold Paul, MD[4]

[1] Carle Illinois College of Medicine, Urbana, Illinois, United States, [2] Allegheny Health Network, Pittsburgh, Pennsylvania, United States, [3] Carle Foundation Hospital, Champaign, Illinois, United States, [4] Carle Neuroscience Institute, Urbana, Illinois, United States

Background/Introduction: Facet arthroplasty is a proposed alternative to lumbar fusion for treating degenerative lumbar spondylolisthesis and stenosis. Facet arthroplasty provides stabilization and preserves range of motion. This subanalysis compared facet arthroplasty, using the TOPS device, with a standard single-level transforaminal lumbar interbody fusion (TLIF) in patients stratified by age with symptomatic grade 1 degenerative spondylolisthesis with moderate to severe spinal stenosis at L3-5.

Materials/Methods: Patient sample is from the TOPS IDE trial (FDA #G160168). Patients were stratified by age (<65 or over 65 years). Patient-reported outcomes (PROMS), including Oswestry disability index (ODI), visual analog pain scales (VAS), and Zurich claudication questionnaires (ZCQ), were assessed at baseline and at multiple timepoints postoperatively. Flexion/extension range of motion (ROM) were radiographically evaluated at baseline, 12 months, and 24 months. Data were analyzed following an intention-to-treat model. Differences in continuous variables were calculated with Student's T-Test, and differences in categorical variables were calculated with Chi-Square or Fisher's exact test. P-values <0.05 are considered significant.

Results: A total of 299 patients were included (TOPS = 206, TLIF = 93). There were no significant differences at baseline. At 2 years, the TOPS group had a significantly greater proportion of patients report >15-point improvement for ODI (93.8% versus 77.1%, p = 0.011) and >20-point improvement for VAS back (84.4% versus 61.8%, p = 0.014). At 1 year, TOPS group had a significantly greater proportion of patients report clinically significant improvements in all ZCQ categories (91.6% versus 78.5%, p = 0.012). In patients <65 years, the TOPS group had significantly improved PROMS compared to TLIF at 2 years; however, these differences were less pronounced in patients >65 years old. The TOPS groups preserved significantly more ROM at 12 (2.8 degrees 95%CI[1.87; 3.74], p<0.0001) and 24 (2.99 degrees 95%CI[1.82; 4.15], p<0.0001) months postoperatively compared to TLIF. ROM was similarly preserved in patients aged <65 and >65. The rate of adverse events did not differ significantly between groups (65.2% TOPS versus 61.5% TLIF).

Discussion/Conclusion: Facet arthroplasty preserves significantly more ROM in all ages and leads to improved PROMS compared to TLIF, particularly in younger patients.

Paper 46

Clinical Utility of an Intervertebral Motion Metric for Deciding on the Addition of Instrumented Fusion in Degenerative Spondylolisthesis.

van Susante Job, MD, PhD[1], Reijmer Joey, MD[1], Kempen Diederik, MD, PhD[2], Arts Mark, MD, PhD[3], de Jong Lex, PhD[1]
[1] Rijnstate Hospital, Arnhem, Arnhem, Netherlands, [2] OLVG Hospital, Amsterdam, Noord-Holland, Netherlands, [3] Haaglanden MC, Den Haag, , Netherlands

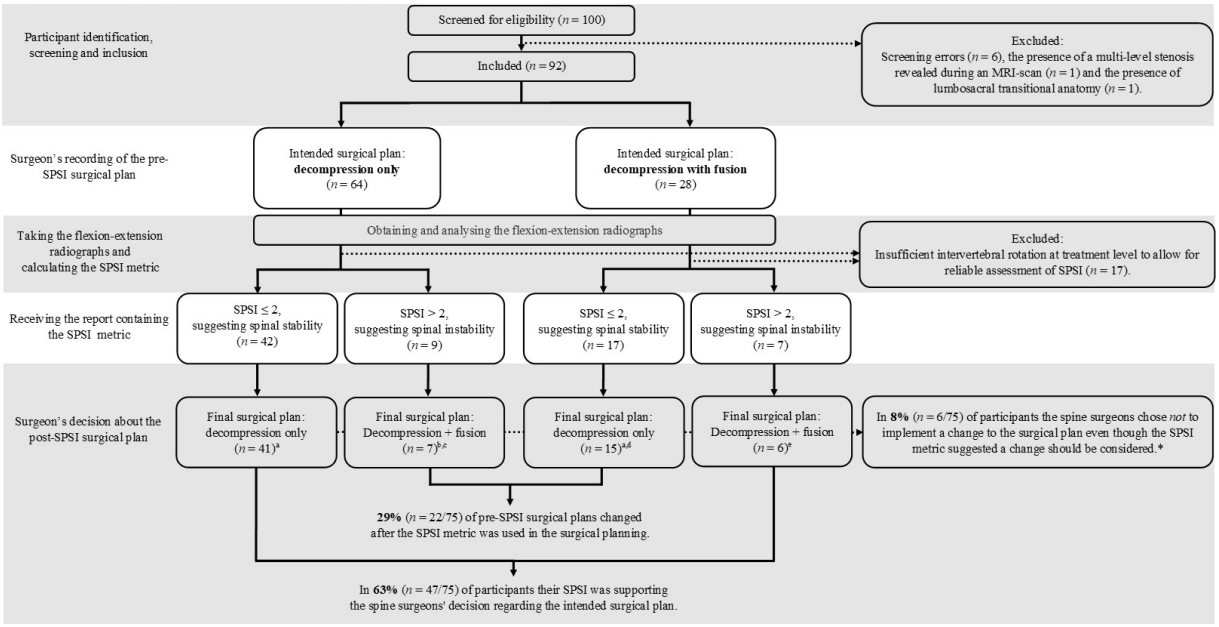
Background/Introduction: Lumbar spinal stenosis (LSS) from degenerative spondylolisthesis is commonly treated with decompression only or decompression with additional instrumented fusion. An objective diagnostic tool capable of establishing abnormal motion between lumbar vertebrae to guide decision-making between surgical procedures is needed. To this end a metric, based on the vertebral sagittal plane translation-per-degree-of-rotation (TPDR) calculated from flexion-extension radiographs, was developed and validated. The clinical utility of this metric was explored by determining the proportion of LSS patients for whom its outcome changed their original surgical treatment plan from decompression only to decompression with fusion or vice versa.

Materials/Methods: In this prospective single-arm clinical study, spine surgeons first documented their intended surgical plan for patients with symptomatic LSS from degenerative spondylolisthesis. Subsequently, additional flexion-extension radiographs were taken. From these the TPDR was calculated and reported as a Sagittal Plane Shear Index (SPSI) per level. SPSI levels >2 indicated stability and decompression only whereas SPSI<2 lead towards additional fusion. The SPSI value was used to determine the actual surgical treatment plan.

Results: After the final inclusion SPSI was determined for 75 participants and over 50 percent had reached a two year follow-up (Figure 1). Initially, 51(68%) had an intended surgical plan of decompression only and 24(32%) decompression with fusion. In 63% of participants the SPSI confirmed the intended surgical plan. For 29% of participants the surgical plan was changed according to the SPSI metric. A suggested change was overruled in 8% of participants. The final surgical performed was decompression only for 59 (79%) and decompression with fusion for 16 (21%) participants.

Discussion/Conclusion: The 29% change in intended surgical plans suggested that the use of an intervertebral motion metric may indeed improve tailoring surgical treatment of degenerative spondylolisthesis patients between decompression only or with additional instrumented fusion. In addition, the use of this metric lead to 11% decrease in the number of instrumented fusions performed. Meanwhile >50% improvement in disability index and leg pain scores were still encountered up to two years follow-up which matches with anticipated improvements from earlier studies. These findings encourage further investigation of the clinical value of this novel metric.

Figure 1 The flow of the participants and their SPSI metric and surgical planning results in the different stages of the study



Paper 47

What Factors Predict the Best Outcomes for Elderly Patients Operated for Grade 1 Degenerative Lumbar Spondylolisthesis? A Machine Learning Analysis from the Quality Outcomes Database

Chan Andrew, MD[1], Yang Eunice, BS[2], Mummaneni Praveen, MD, MBA[3], Bydon Mohamad, MD[4], Bisson Erica, MD, MPH[5], Shaffrey Christopher, MD[6], Glassman Steven, MD[7], Potts Eric, MD[8], Shaffrey Mark, MD[9], Coric Domagoj, MD[10], Knightly John, MD[11], Park Paul, MD[12], Virk Michael, MD, PhD[13], Michalopoulos Giorgos, MD[4], Haid Regis, MD[14], Chou Dean, MD[1]

[1] New York Presbyterian The Daniel and Jane Och Spine Hospital, New York, New York, United States, [2] Columbia University College of Physicians and Surgeons, New York, New York, United States, [3] Department of Neurological Surgery, UCSF Medical Center, San Francisco, California, United States, [4] Mayo Clinic College of Medicine and Science, Rochester, Minnesota, United States, [5] University of Utah, Salt Lake City, Utah, United States, [6] Duke University Medical Center, Duke University Medical Center, Durham, North Carolina, United States, [7] Norton Leatherman Spine Center, Louisville, Kentucky, United States, [8] Goodman Campbell Brain & Spine, Indianapolis, Indiana, United States, [9] University of Virginia Neurosurgery, Charlottesville, Virginia, United States, [10] Carolina Neurosurgery and Spine Associates, Charlotte, North Carolina, United States, [11] Atlantic Neurosurgical Specialists, Morristown, New Jersey, United States, [12] The University of Michigan Health System, Ann Arbor, Michigan, United States, [13] New York Presbyterian Hospital/Weill Medical College of Cornell University, New York, New York, United States, [14] Atlanta Brain and Spine Care, Atlanta, Georgia, United States

Background/Introduction: The prevalence of degenerative lumbar spondylolisthesis in the elderly population is increasing, yet factors influencing surgical outcomes remain undefined. Our study uses machine learning to identify unique outcome clusters among elderly patients operated for grade 1 lumbar spondylolisthesis.

Materials/Methods: Data was obtained from the prospective Quality Outcomes Database cohort, including patients over 65 with grade 1 degenerative lumbar spondylolisthesis. Principal components analysis was used to generate a composite operative outcome score based on patient-reported outcomes (PROs) after 24-months. We used a k-means clustering approach to differentiate patients by composite outcome, and logistic regression to assess variable importance.

Results: Of 608 patients, a total of 233 patients over 65 were included with 24-month follow-up. Our approach stratified patients into two clusters, with cluster 1 corresponding to optimal outcomes (less back and leg pain, lower levels of disability, and higher quality of life) and cluster 2 to suboptimal outcomes. Clusters did not differ significantly by age (cluster 1: 72.5±5.6 vs cluster 2: 73.4±6.0, p=0.24), though patients in the optimal outcomes cluster did report lower baseline NRS-BP (5.5±3.2 vs 6.3±2.7, p=0.041) and NRS-LP (5.9±3.1 vs 6.8±2.3, p=0.011). The optimal-outcomes cluster exhibited greater improvements for all PROs ($p < 0.001$). Notably, patients in the optimal-outcomes cluster were significantly more likely to have received fusion

than were patients in the suboptimal cluster (70.7% vs 51.2%, p=0.004). In logistic regression predictor analysis, addition of a fusion procedure was the most significant independent predictor of optimal outcomes (OR=1.57; 95% CI 1.12-2.19; p=0.008), followed by lower baseline NRS-BP (OR=0.71 per unit lower, 95% CI 0.51-0.99, p=0.046).

Discussion/Conclusion: Our analysis of elderly patients undergoing surgery for grade 1 degenerative lumbar spondylolisthesis reveals two distinct clusters: one with optimal and another with suboptimal outcomes. Among various patient and surgical characteristics, addition of fusion to a procedure was associated with superior outcomes, with patients receiving a fusion having over 1.5 times the odds of reaching an optimal outcome. There was no evidence that age was significantly different between clusters—failing to support an age cutoff for surgery. These findings may be especially informative to surgeons choosing between decompression versus decompression and fusion approaches for elderly patients.

Figure 1. K-means clustering of outcome metrics. Plot depicts separation of elderly patients into those with optimal (red) and suboptimal (green) outcomes following surgery.

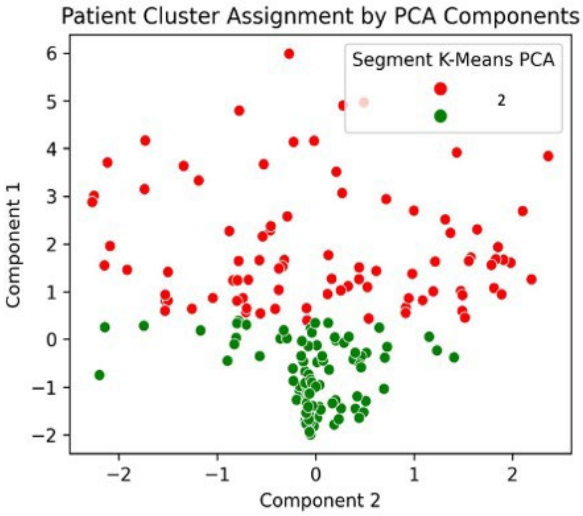
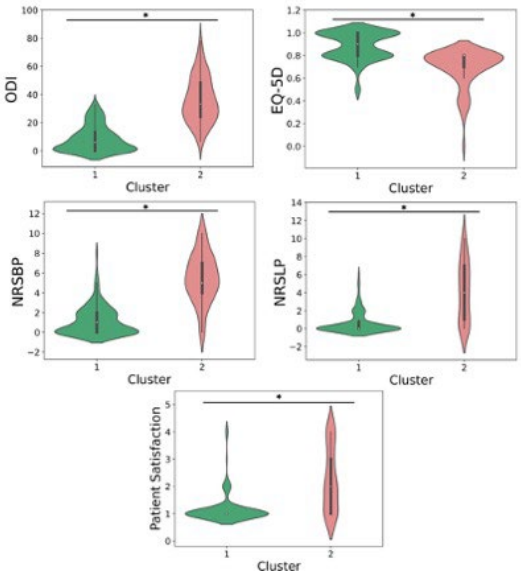


Figure 2. Outcome distributions of K-means clusters. Violin plots show differences in validated scoring metrics between elderly patients in optimal (green) and suboptimal (red) clusters.



Paper 48

Nonoperative Management of Three-column Ankylosed Spine Fractures: Is it Possible?

Pinter Zachariah, MD[1], Nassr Ahmad, MD[1], Sebastian Arjun, MD[1], Elder Benjamin, MD, PhD[1], Freedman Brett, MD[1]
[1] Mayo Clinic College of Medicine and Science, Rochester, Minnesota, United States

Background/Introduction: The purpose of this study was to further investigate the outcomes of operative versus non-operative treatment following 3-column fractures of the ankylosed spine.

Materials/Methods: A retrospective review of patients with ankylosing spondylitis (AS) or diffuse idiopathic skeletal hyperostosis (DISH) who sustained trauma resulting in an unstable 3-column spinal fracture from 1999-2020 was performed. Patient demographics, Charleston comorbidity indices and injury specific data were collected. Radiographic inputs included identification of the ankylosed segment, initial fracture displacement, identification of epidural hematoma or cord compression. Clinical outcomes included neurologic deficit and mortality. Radiographic outcomes included fusion status and progressive deformity. Each clinical and radiographic input was analyzed to determine if there was a correlation with treatment modality chosen. Outcomes were compared based on treatment modality chosen (operative versus non-operative).

Results: A cohort of 138 ASD patients with 153 fractures was identified. The majority of injuries occurred in the thoracic spine (50%) following a ground level fall (67%). One-hundred sixteen (76%) fractures were treated operatively, while 37 (24%) were treated non-operatively. When comparing treatment groups, the non-operative group was found to be older with a higher Charleston comorbidity index ($p<0.0001$). There was no significant difference between groups in terms of injury severity score ($p=0.26$). Significantly more AS cases were treated surgically compared to DISH cases (81% vs. 59%, $p=0.01$). Displaced fractures were more likely to be treated surgically ($p=0.04$) and those that were displaced and treated non-operatively had a trend towards increased risk of progressive deformity (RR=2.67, 95% CI 1.09-6.52, $p=0.07$). There was no significant difference in rate of failed fusion, or rate of neurologic sequelae between treatment groups but there was a higher 90-day mortality and decreased survival rate in patients treated non-operatively. 17% of patients undergoing surgery had wound complications, but there was no difference in rate of blood clots or respiratory complications between treatment groups.

Discussion/Conclusion: This study highlights that non-operative treatment of non-displaced three-column fractures of the ankylosed spine can allow for successful clinical and radiographic outcomes, although patients treated non-operatively had higher mortality rates independent of injury severity score.

Table 3: Survival and functional outcomes.

	Overall	Operative	Non-operative	p-value
90-day mortality rate	15% (95% CI=10%-22%)	11% (95% CI=7%-19%)	30% (95% CI=17%-46%)	**0.0008**
1-year survival	75% (95% CI = 67%-81%)	80% (95% CI = 72%-87%)	57% (95% CI = 40%-73%)	**0.0008**
Neurologic sequelae	21 (15%)	16 (14%)	5 (17%)	0.77
Nonunion/Revision	11 (11%)	9 (10%)	2 (13%)	0.66
Worsening PI-LL Mismatch	20 (47%)	16 (80%)	4 (20%)	0.64

Table 4: Complications.

	Overall	Operative	Non-operative	p-value	§Relative Risk
DVT/PE	9 (6%)	6 (4%)	3 (2%)	0.45	1.57 (0.41-5.96)
Wound Complication	20 (13%)	20 (17%)	0 (0%)	**0.004**	N/A
Pneumonia/ARF	33 (22%)	22 (19%)	11 (30%)	0.17	1.58 (0.84-2.92)

§Relative risk of non-operative to operative treatment.

Paper 49

Predictors of Reoperation in Thoracolumbar Burst Fractures

Zakieh Omar, MBBS[1], Wong Benjamin, BS[2], Locascio Logan, BS[2], Rekulapelli Akhil, BS[2], Bakle Curtis, BS[2], Croft Andrew, MD[1], Zhang Derick, BS[2], Gardocki Raymond, MD[1], Lugo-Pico Julian, MD[1], Zuckerman Scott, MD, MPH[3], Stephens Byron, MD[1], Abtahi Amir, MD[1]
[1] Department of Orthopaedics and Rehabilitation, Vanderbilt University Medical Center, Nashville, Tennessee, United States, [2] Vanderbilt Univeristy, Nashville, Tennessee, United States, [3] Department of Neurological Surgery, Vanderbilt University Medical Center, Nashville, Tennessee, United States

Background/Introduction: Surgical management of spinal burst fractures is frequently required to restore spinal alignment, decompress neural elements, and provide stability. However, there exists a relative paucity of documentation regarding risk factors for reoperation following surgical treatment. We present a cohort of patients with vertebral burst fractures, where we sought to determine the predictors of reoperation.

Materials/Methods: A retrospective cohort study was undertaken of patients undergoing surgical treatment of thoracic and lumbar vertebrae burst fracture from a single institution between 2010-2021. The primary outcome was reoperation within 12 months. Patients with less than 12 month follow-up and without revision surgery were excluded. Bivariate analysis was conducted to compare basic demographics, clinical characteristics and perioperative variables between patients who required reoperation and patients who did not. Univariate and multivariable regression models were performed controlling for age, BMI, ASA grade and smoking status.

Results: Of 91 burst fracture patients included in this study, the mean age was 43.0±17.9 and 60 (65.9%) were male. There were 27 (29.7%) patients who underwent reoperation within 12 months, for reasons including hardware failure, infection and pain. On comparison of patient demographics and clinical characteristics, patients requiring reoperation had higher proportions of active smokers (44.4% vs. 23.4%, p=.045) and ASA grades 3 or 4 (81.5% vs. 50%, p=.005) than patients without reoperation. There was no difference in age, sex, BMI, comorbidities, type of insurance, prior spine surgery, injury severity score, presenting ASIA score, number of vertebrae or vertebral level fractured between the cohorts. Perioperatively, there no difference in estimated blood loss, postoperative complications, length of stay or discharge ASIA score between the two cohorts. On multivariable regression, ASA grade of 3 or 4 (OR=3.934, 95%CI=1.169-13.235, p=.027) and smoking (OR=3.208, 95%CI=1.100-9.355, p=.033) were found to be the strongest predictors of reoperation.

Discussion/Conclusion: In a cohort of patients with vertebral burst fractures, smoking and ASA grades of 3 or 4 independently increased the odds of requiring reoperation. Smoking disrupts blood flow and oxygenation at the surgical site, impairing bone regeneration and wound healing. Higher ASA grades reflect more severe systemic health conditions, which can compromise postoperative recovery, leading to a higher likelihood of reoperation.

Paper 50

The Modified Spinal Instability Neoplastic Score (mSINS): An Updated Classification for Identifying Patients with Spinal Instability in the Setting of Metastatic Disease

Pinter Zachariah, MD[1], Sullivan Mikaela, MD[2], McMaster Brandon, MD[2], Wright Breydan, MD[2], Goh Brian, MD[3], Bernatz James, MD[4], Freedman Brett, MD[1], Elder Benjamin, MD, PhD[1], Sebastian Arjun, MD[1], Nassr Ahmad, MD[1], Currier Bradford, MD[2]
[1] Mayo Clinic College of Medicine and Science, Rochester, Minnesota, United States, [2] Mayo Clinic College of Medicine, Rochester, Minnesota, United States, [3] Johns Hopkins University School of Medicine, Baltimore, Maryland, United States, [4] Mayo Clinic, Rochester, Minnesota, United States

Background/Introduction: The purpose of the present study was to perform an external validation of the SINS score using a contemporary cohort of patients with metastatic disease of the spine.

Materials/Methods: We performed a retrospective review of the prospectively maintained cancer registry at a single quaternary referral center. We identified 125 patients (375 metastatic lesions) who were diagnosed with spinal metastases between 2013 and 2019, survived greater than 1 month after identification of the spinal metastasis, and had advanced imaging studies of the spinal metastasis. The external validity of SINS to predict indication for surgery as per spine surgeons was measured via Mc-Fadden's Pseudo-R2 score. The SINS score was then modified utilizing linear regression analyses to optimize the Mc-Fadden's Pseudo-R2 score.

Results: A total of 125 patients with 375 metastatic lesions were included in this cohort. The unstable (13-18) SINS lesions were indicated for surgery within 12 months in all cases (100.0%), which was substantially higher than in the potentially unstable (22.6%) or stable (1.1%) subgroups ($p<0.001$)(Figure 2). The Mc-Fadden's Pseudo-R2 score was 0.590, demonstrating that the SINS score has excellent performance for predicting spinal instability that necessitates surgical intervention. Mc-Fadden's Pseudo-R2 score was optimized by adding neurologic deficit as a variable (0 = no deficits, 2 = radiculopathy, and 4 = myelopathy) and altering the weight of the pain and posterolateral involvement components of the SINS score. The modified SINS (mSINS) score demonstrated an appropriate balance between sensitivity and specificity when cutoffs were established as 0-7 (stable, 0.4% rate of surgery offered), 8-11 (potentially unstable, 1.4% rate of surgery offered), and 12-24 (unstable, 40.7% rate of surgery offered).

Discussion/Conclusion: Modification of the SINS score to include neurologic deficit, reweight components of the SINS score (pain and posterolateral involvement), and establish new cutoffs between subgroups led to exceptionally strong performance in predicting which spinal metastases induce instability necessitating surgical intervention. The modified SINS (mSINS) score can be used as a tool to guide referrals from non-surgical medical providers and to support surgeons in their prognostication and surgical decision-making.

Table 3. Comparison between lesions that were offered surgery within 12 months from imaging and lesions that were not.

	Not offered surgery (N=348)	Offered surgery (N=28)	p value
Location			0.42[1]
0 - Rigid (S2-S5)	7 (2.0%)	0 (0.0%)	
1 - Semi-rigid (T3-T10)	114 (32.8%)	12 (42.9%)	
2 - Mobile (C3-C6, L2-L4)	99 (28.4%)	8 (28.6%)	
3 - Junctional (O-C2, C7-T2, T11-L1, L5-S1)	128 (36.8%)	8 (28.6%)	
Bone lesion type			< **0.01**[1]
0 - Blastic	103 (29.6%)	0 (0.0%)	
1 - Mixed	52 (14.9%)	6 (21.4%)	
2 - Lytic	193 (55.5%)	22 (78.6%)	
Alignment			< **0.01**[1]
0 - Normal alignment	343 (98.6%)	22 (78.6%)	
2 - De novo deformity (kyphosis/scoliosis)	1 (0.3%)	0 (0.0%)	
4 - Subluxation/translation present	4 (1.1%)	6 (21.4%)	
Vertebral body collapse			< **0.01**[1]
0 - No collapse, <50% body involvement	212 (60.9%)	4 (14.3%)	
1 - No collapse, >50% body involvement	76 (21.8%)	7 (25.0%)	
2 - <50% collapse	56 (16.1%)	8 (28.6%)	
3 - >50% collapse	4 (1.1%)	9 (32.1%)	
Posterolateral involvement			< **0.01**[2]
0 - None of the above	265 (76.1%)	6 (21.4%)	
1 - Unilateral	65 (18.7%)	10 (35.7%)	
3 - Bilateral	18 (5.2%)	12 (42.9%)	
Pain			< **0.01**[2]
0 – Pain-free	253 (72.7%)	5 (17.9%)	
1 - No mechanical pain	29 (8.3%)	5 (17.9%)	
3 – Mechanical pain	66 (19.0%)	18 (64.3%)	
SINS score	4.9 (2.5)	10.0 (3.7)	< **0.01**[3]
Neurological deficit at baseline	55 (15.8%)	18 (64.3%)	< **0.01**[2]

1. Fisher's Exact Test for Count Data
2. Pearson's Chi-squared test
3. Student's t-test

RF01

Immediate Postoperative Changes in Global Lordosis Following Placement of TOPS Predicts 2-year Changes in Global Lordosis Correlating with Improved Pain, Disability, and Quality of Life by PROs

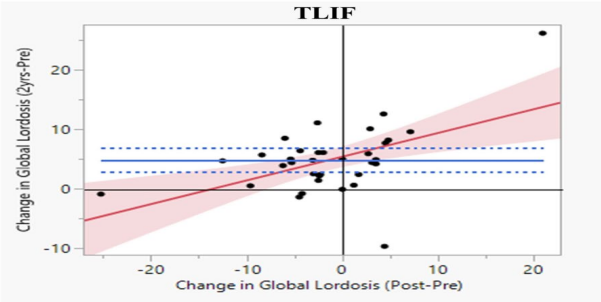
Meade Seth, BS[1], *Shost Michael, BS*[2], *Steinmetz Michael, MD*[3]
[1] *Cleveland Clinic Lerner College of Medicine of Case Western Reserve University, Cleveland, Ohio, United States,* [2] *Case Western Reserve University School of Medicine, Cleveland, Ohio, United States,* [3] *Center for Spine Health, Cleveland Clinic Foundation, Cleveland, Ohio, United States*

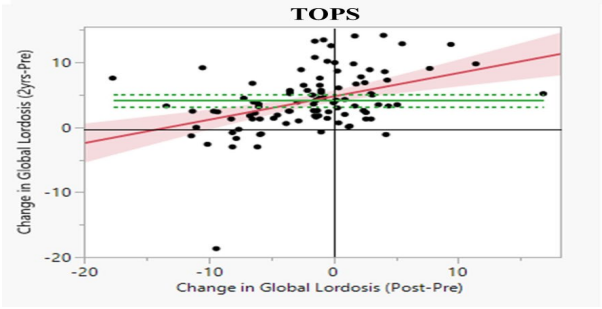
Background/Introduction: The Total Posterior System (TOPS) device is a novel dynamic stabilization device used in the treatment of grade I degenerative lumbar spondylolisthesis. Early randomized data suggests that the TOPS device may achieve improved outcomes over traditional fusion with posterior or transforaminal interbody fusion (PLIF/TLIF) through the addition of lordosis via preserved motion. However, this claim has yet to be substantiated. Further, it's thought that the specific placement of TOPS may impact long-term gains in global lordosis potentially impacting outcomes. This study aimed to assess whether immediate post-operative changes in global lordosis influence either long-term changes in global lordosis or patient-reported outcomes (PROs) following placement of the TOPS device for single-level spinal fusion for grade I spondylolisthesis.

Materials/Methods: 137 patients underwent spinal fusion with either the TOPS device (n=101) or PLIF/TLIF (n=36). PROs were collected pre-operatively and at multiple timepoints postoperatively. X-rays were taken perioperatively and 2 years postoperatively to examine changes in global lordosis. Univariate and multivariate analyses were performed to identify factors associated with long-term changes in global lordosis and PROs, with specific attention to the impact of immediate post-operative changes.

Results: Immediate postoperative changes in global lordosis were significantly associated with long-term alterations in global lordosis in both the TOPS (0.416, 95%CI (0.237,0.568)) and PLIF/TLIF (0.514, 95%CI (0.213,0.726)) groups. However, large losses in immediate post-operative lordosis (> 9º) are necessary to lose global lordosis after TOPS placement ($p<0.001$). Further, long-term increases in global lordosis were weakly associated with long-term improvements in some but not all measures of pain, disability, and quality of life scores in both the TOPS[(VAS-Low Back Pain: -0.22; 95%CI(-0.40,-0.03)), (ODI: -0.29, 95%CI(-0.46,-0.10)), (SF-12 Physical Functioning: 0.27 95%CI(0.07,0.44))] and PLIF/TLIF [(VAS-Low Back Pain: -0.36; 95%CI(-0.62,-0.02)), (SF-12 Social Functioning: 0.37 95%CI(0.04,0.63))] groups.

Discussion/Conclusion: Our study shows that TOPS placement, unlike traditional fusion, need not establish large increases in global lordosis in the perioperative period to attain long-term increases in global lordosis and associated improvements in patient-reported outcomes. These results offer valuable insights for surgical planning & and technique, patient counseling, and future research endeavors into novel dynamic stabilization techniques.


TLIF
Change in Global Lordosis (2yrs-Pre)
20
10
0
-10
-20
-10
0
10
20
Change in Global Lordosis (Post-Pre)


TOPS
Change in Global Lordosis (2yrs-Pre)
10
0
-10
-20
-20
-10
0
10
Change in Global Lordosis (Post-Pre)

RF02

Assessment of the Change in Degree of Segmental and Global Lordosis in Prone and Lateral Decubitus Patient Positioning in Lateral Interbody Fusion Techniques: A Systematic Review of Literature and Meta-Analysis

O'Malley Geoffrey, BS[1], *Sturgill Drew, BS*[1], *Blajda Timothy, BS*[1], *Sarwar Syed, BS*[1], *Boparai Saurav, BS*[1], *Goldstein Ira, MD*[1]
[1] *Hackensack University Medical Center, Hackensack, New Jersey, United States*

Background/Introduction: In lumbar fusion surgery, restoration of optimal lumbar lordosis is recognized as an important goal of the procedure. Attaining sagittal balance and matching lumbar lordosis to pelvic parameters leads to improved postural efficiency and to reduced back pain, fewer post-surgery disabilities, decreased adjacent segment degeneration, and enhanced surgical outcomes. Traditional fusion techniques often struggle to achieve optimal segmental lordosis. The emerging prone-positioned lateral lumbar interbody fusion technique facilitates increased lordosis through positioning on open-top surgical tables and through the simultaneous manipulation of the spinal column via osteotomies, posterior instrumentation, and large lordotic spacers. The authors aimed to elucidate the differences in segmental lordosis outcomes between the prone and lateral decubitus positioning.

Materials/Methods: The authors performed a PRISMA guidelines-based systematic review of the literature. Only articles that compared pre and postoperative degrees of segmental and global lordosis with patient positioning in prone lateral (PL) and extreme lateral lumbar interbody fusion (XLIF) were included. Statistical analysis was performed using python (Python Software Foundation, Wilmington, DE).

Results: The search resulted in 442 studies, 6 were included. In total, 262 patients were identified with 133 treated with XLIF and 129 with PL. Mean operative time in the XLIF group was significantly shorter than in the PL group (188.7 v. 171.35, $p<0.01$). Estimated blood loss was also significantly lower in the XLIF group than the PL group (69.95 v. 93.25, $p<0.001$). The average degree of improvement in segmental lordosis from the XLIF group was 2.86°, compared with 4.08° in the PL group ($p<0.001$). Similarly, the improvement in global lordosis was 2.74° in the XLIF compared to 6.18° in the PL group ($p<0.001$). No significant differences in complication or re-operation rates were found.

Discussion/Conclusion: Prone positioning in lateral lumbar interbody fusion provides greater postoperative segmental and global lumbar lordosis than lateral decubitus positioning. However, it shows longer surgery times and more intraoperative blood loss, which may reflect the learning curve of surgeons adopting this relatively new technique. Further data on postoperative outcomes is required to ascertain the superior technique between the two.

RF03

ALIFs in Revision Surgery: Assessment of Sagittal Parameters

Zakieh Omar, MBBS[1], Croft Andrew, MD[1], Waddell William, MD[1], Lugo-Pico Julian, MD[1], Gardocki Raymond, MD[1], Zuckerman Scott, MD, MPH[2], Stephens Byron, MD[1], Abtahi Amir, MD[1]

[1] Department of Orthopaedics and Rehabilitation, Vanderbilt University Medical Center, Nashville, Tennessee, United States, [2] Department of Neurological Surgery, Vanderbilt University Medical Center, Nashville, Tennessee, United States

Background/Introduction: Anterior Lumbar Interbody Fusion (ALIF) is popular in spinal deformity revision surgery due to the high rates of fusion as well as its potential to restore spinal alignment. We sought to compare preoperative and postoperative radiographic variables, and determine the correlation between cage lordosis and segmental lordosis achieved.

Materials/Methods: Spinal deformity patients undergoing revision ALIF surgery were retrospectively studied. Patients were categorized for having ALIF A=through a nonunion, B=adjacent to previously fused segment, or C=both. Preoperative and postoperative radiographic variables were collected, including lumbar lordosis (LL), L4-S1 lordosis, segmental lordosis, and pelvic incidence (PI). Preoperative and postoperative comparisons were conducted assessing the number of patients achieving ideal LL, PI-LL ratio, and lumbar distribution index (LDI). Secondary analysis assessing the correlation of cage lordosis with segmental lordosis achieved was conducted.

Results: Of 50 patients included (mean age=58.7±10.8, 48% male), there were 22 patients in group A, 18 in B and 10 in C. Postoperatively group A achieved no significant difference in deviation from ideal LL (12.9±10.3 vs 12.5±17.5º, p=.934), PI-LL (55.6%vs50.0%, p=.310) or LDI (35.0%vs.40.0%, p=.839) than preoperatively. Postoperatively, group B achieved no significant difference in deviation from ideal LL (18.5±11.7 vs 13.9±12.3º, p=.271), PI-LL (70.6% vs.35.3%,p=.714) or LDI (41.1%vs.35.5%, p=.724) than preoperatively. Postoperatively, group C achieved no significant difference in deviation from ideal LL (11.6±7.1 vs 27.6±40.6º, p=.260), PI-LL (77.8%vs.55.6%, p=.317) or LDI (33.3%vs.11.1%, p=.257) than preoperatively. 57 cages were included in subanalysis. Individually, cage lordosis was plotted against the segmental lordosis achieved. Spearman rank determined weak correlation between cage lordosis and segment lordosis achieved (ρ=0.183,p=.173). There was no difference in the deviation between cage lordosis and segmental lordosis achieved (17.8±10.0 vs. 12.2±8.4,p=.057) between groups A and B.

Discussion/Conclusion: In a cohort of spinal deformity patients undergoing ALIF, the proportion of patients in each group achieving ideal radiographic parameters did not change significantly postoperatively. Further, cage lordosis alone was not a good predictor of segmental lordosis achieved. These results highlight potential pitfalls of assuming, based on preoperative templating, that cage lordosis will produce an equivalent amount of postoperative segmental

lordosis. A comprehensive surgical approach is necessary including using posterior column osteotomies when necessary.

RF04

Impact of Decompression Location in MIS Decompression Alone: Focusing on Severe Degenerative Scoliosis with Cobb Angles Above 20 Degrees

Asada Tomoyuki, MD[1], Simon Chad, BS[1], Singh Nishtha, MBBS[1], Heuer Annika, MD[1], Subramanian Tejas, BE[2], Tuma Olivia, BS[1], Araghi Kasra, BS[1], Durbas Atahan, MD[1], Zhang Joshua, BS[1], Korsun Max, BS[1], Lu Amy, BS[2], Mai Eric, BS[1], Kwas Cole, BS[1], Allen Myles, MBChB[1], Vaishnav Avani, MBBS[1], Dowdell James, MD[1], Sheha Evan, MD[2], Qureshi Sheeraz, MD[2], Iyer Sravisht, MD[1]

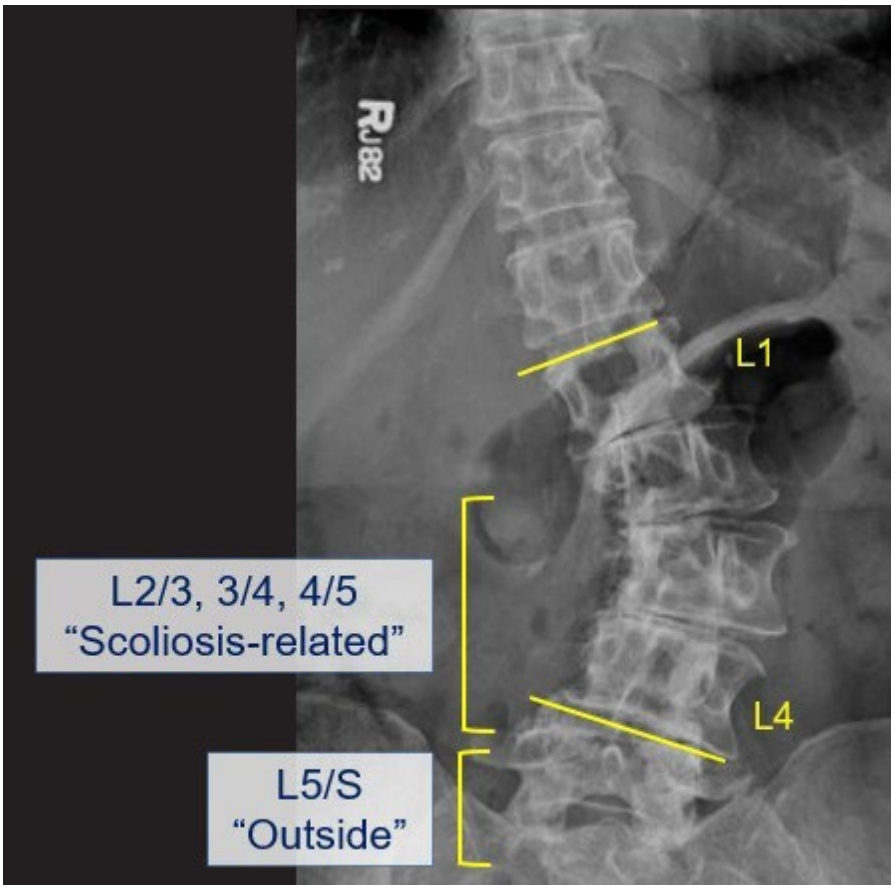
[1] Hospital for Special Surgery, New York, New York, United States, [2] Hospital for Special Surgery/Weill Cornell Medical College, New York, New York, United States

Background/Introduction: Minimally invasive spinal (MIS) decompression, applied in lumbar central stenosis and degenerative scoliosis (DS) treatments, aims to reduce harm to the posterior ligamentum complex and paravertebral muscles. Yet, its effectiveness in severe DS cases (Cobb angle exceeding 20 degrees) and the determinants of adverse outcomes remain inadequately studied. This research focuses on assessing the clinical results of MIS decompression in DS patients with a Cobb angle over 20 degrees.

Materials/Methods: A retrospective analysis was conducted to evaluate the outcomes of MIS decompression in DS patients, categorizing them into DS and control groups based on a Cobb angle of 20 degrees. We collected data on demographics, comorbidities, spinal alignment, normalized total psoas area (NTPA), and surgical levels were collected. Decompression was classified as "scoliosis-related" when the decompression levels included the range of end vertebrae of the Cobb angle, and "outside" when the decompression operative levels did not include the end vertebrae (Fig). Using variable-ratio greedy matching, we formed matched cohorts for comparison. A multivariable regression analysis was performed to identify factors hindering Minimum Clinically Important Difference (MCID) achievement in ODI among DS patients 1 year postoperatively.

Results: A total of 253 patients were included in the study, with 41 patients in the DS group and 212 in the control group, all of whom underwent MIS decompression. After matching for age, gender, osteoporosis status, NTPA, and preoperative ODI, the matched cohort included 33 DS and 58 control patients. At ≥1 year postoperatively, the DS groups exhibited a significantly lower rate of MCID achievement in ODI (DS: 45.5% vs. control 69.0%, P=0.047) and SF-12 PCS (DS: 41.4% vs. control 70.6%, P=0.020). In the DS group, multivariable analysis identified scoliosis-related decompression as an independent predictor of failure to achieve MCID in ODI at the ≥1-year postoperative time point (Odds ratio: 9.9, P=0.028).

Discussion/Conclusion: Our results indicate that MIS decompression in DS patients with a Cobb angle >20 degrees may lead to limited improvements in disability and physical function. This highlights the importance of precise surgical planning, especially concerning decompression at the end vertebrae of the Cobb angle.


RJ 82
L1
L4
L2/3, 3/4, 4/5
"Scoliosis-related"
L5/S
"Outside"

RF05

Do Obese Patients Benefit as Much as Non-Obese Patients After Lumbar Surgery for Grade II Spondylolisthesis? A QOD Study

Dada Abraham, BA[1], Say Irene, MD[2], Coric Domagoj, MD[3], Virk Michael, MD, PhD[4], Shaffrey Christopher, MD[5], Gottfried Oren, MD[5], Potts Eric, MD[6], Bydon Mohamad, MD[7], Park Paul, MD[8], Glassman Steven, MD[9], Mummaneni Praveen, MD, MBA[10], Chou Dean, MD[11], Shaffrey Mark, MD[12], Bisson Erica, MD, MPH[13]

[1] Department of Neurological Surgery, UCSF Medical Center, San Francisco, California, United States, San Francisco, California, United States, [2] UCSF Spine Center University of California, San Francisco, San Francisco, California, United States, [3] Carolina Neurosurgery and Spine Associates, Charlotte, North Carolina, United States, [4] New York Presbyterian Hospital/Weill Medical College of Cornell University, New York, New York, United States, [5] Duke University Medical Center, Duke University Medical Center, Durham, North Carolina, United States, [6] Goodman Campbell Brain & Spine, Indianapolis, Indiana, United States, [7] Mayo Clinic College of Medicine and Science, Rochester, Minnesota, United States, [8] The University of Michigan Health System, Ann Arbor, Michigan, United States, [9] Norton Leatherman Spine Center, Louisville, Kentucky, United States, [10] Department of Neurological Surgery, UCSF Medical Center, San Francisco, California, United States, [11] New York Presbyterian The Daniel and Jane Och Spine Hospital, New York, New York, United States, [12] University of Virginia Neurosurgery, Charlottesville, Virginia, United States, [13] University of Utah, Salt Lake City, Utah, United States

Background/Introduction: The impact of obesity on postoperative complications and functional outcomes following treatment for grade II spondylolisthesis remains unknown.

Materials/Methods: The Quality Outcomes Database (QOD) was used to compare obese (BMI≥ 30) and non-obese (BMI<30) patients who underwent lumbar surgery for Meyerding grade II spondylolisthesis. Baseline demographics, clinical variables, and surgical parameters were collected. Patient reported outcomes (PRO) included health status (EQ-5D), Oswestry Disability Index (ODI), and visual analogue scale (VAS) for leg pain (VAS-LP) and back pain (VAS-BP), PROs were administered at baseline and collected at 24 months post-operatively, along with patient satisfaction (NASS) scores.

Results: 400 patients from the prospective registry with complete baseline and 24-mo PRO data were included. Obese patients (185 patients, 46.3%) were compared to nonobese patients (215 patients, 53.8%). Obese patients were younger, (59.5 ± 11.9 vs 63.3 ± 12.3 p=0.002), had a lower level of education (p=0.02), diabetic (23.8% vs. 8.4% p<0.001) and ASA class III/IV (60.0% vs. 39.1% p<0.001) at baseline. At baseline, no differences were observed between obese and nonobese patients in all PROs. Postoperatively, obese patients had higher rates of 30-day reoperation (6.5% vs. 0% p<0.001) and 3- month readmissions (9.2% vs. 1.2% p<0.001). At 24 months, multivariate analyses revealed obese patients had lower rates of achieving MCID in EQ-5D (OR: 0.44, CI:0.25-0.77, p=0.004). Nonetheless, satisfaction was equivalent at 24 months between both groups (NASS, p=0.76).

Discussion/Conclusion: Obese patients undergoing surgery for grade II spondylolistheses have higher short term complication rates. By 24 months, obese patients have lower rates of achieving MCID in EQ-5D, but are just as satisfied as non-obese patients

RF06

The Impact of Ketorolac Utilization on Outcomes in Spine Surgery: A Systematic Review and Meta-Analysis of Randomized Controlled Trials

Baumann Anthony, DPT[1], Fiorentino Andrew, MS, BS[1], Sidloski Katelyn, MS, BS[1], Fiechter Jay, BS[2], Uhler Mathias, [3], Calton Tyler, MD[4], Hoffman Cassandra, MD[5], Hoffmann Jacob, MD[6]
[1] Northeast Ohio Medical University, Rootstown, Ohio, United States, [2] Indiana University School of Medicine, Indianapolis, Indiana, United States, [3] The University of Akron, Akron, Ohio, United States, [4] Cleveland Clinic Akron General Medical Center, Akron, Ohio, United States, [5] Akron Children's Hospital, Akron, Ohio, United States, [6] Center for Spine Health, Cleveland Clinic Foundation, Cleveland, Ohio, United States

Background/Introduction: Ketorolac is one of the most potent non-steroidal anti-inflammatory drugs (NSAIDs) commonly used in spine surgery. The purpose of this study is to examine the impact of ketorolac utilization with or without other medications on a patient's post-operative course following spine surgery.

Materials/Methods: A systematic review and meta-analysis of randomized controlled trials (RCTs) was performed using PubMed, CINAHL, MEDLINE, and Web of Science in July 2023. Inclusion criteria were RCTs that utilized ketorolac for spine surgery.

Results: Fourteen RCTs were included (n=1,137 patients; mean age of 53.9 ± 7.6 years; 610 patients in the ketorolac group; 13 RCTs involved lumbar surgery). There was no significant difference in the 24-hour and total postoperative morphine utilization (p=0.185 and p=0.109), 24-hour and final postoperative Visual Analog Scale (VAS) scores (p=0.065 and 0.582), and length of stay (LOS) at the hospital (p=0.990) between patients in the ketorolac group as compared to patients in the non-ketorolac group who underwent lumbar surgery. Overall, patients had similar rates of major complications (3.7% versus 5.4%) and minor complications (42.1% versus 51.7%) between groups after lumbar surgery. However, patients in the ketorolac group had a significantly lower rate of nausea and/or vomiting as compared to the non-ketorolac group after lumbar surgery (21.6% versus 37.1%; p=0.018).

Discussion/Conclusion: There is no significant difference in 24-hour and total postoperative morphine utilization, VAS scores, or LOS with similar complication rates after lumbar surgery between patients receiving ketorolac as compared to patients not receiving ketorolac via meta-analysis of RCTs.

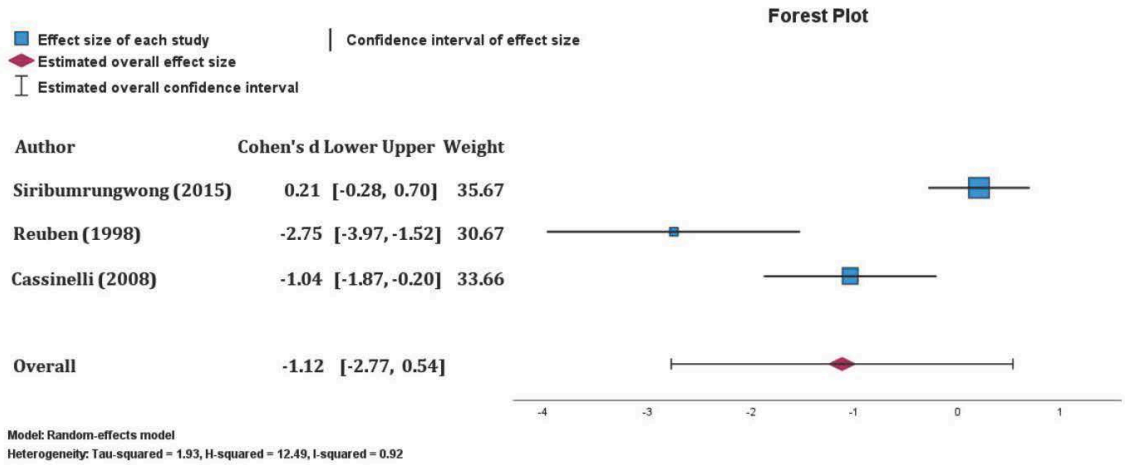


Figure 5: 24-hour postoperative morphine utilization between the patients in the ketorolac group versus patients in the non-ketorolac group.

RF07

Utilization Trends and Outcomes in Treatment of Recurrent Lumbar Disc Herniation: Revision Microdiscectomy Versus Spinal Fusion

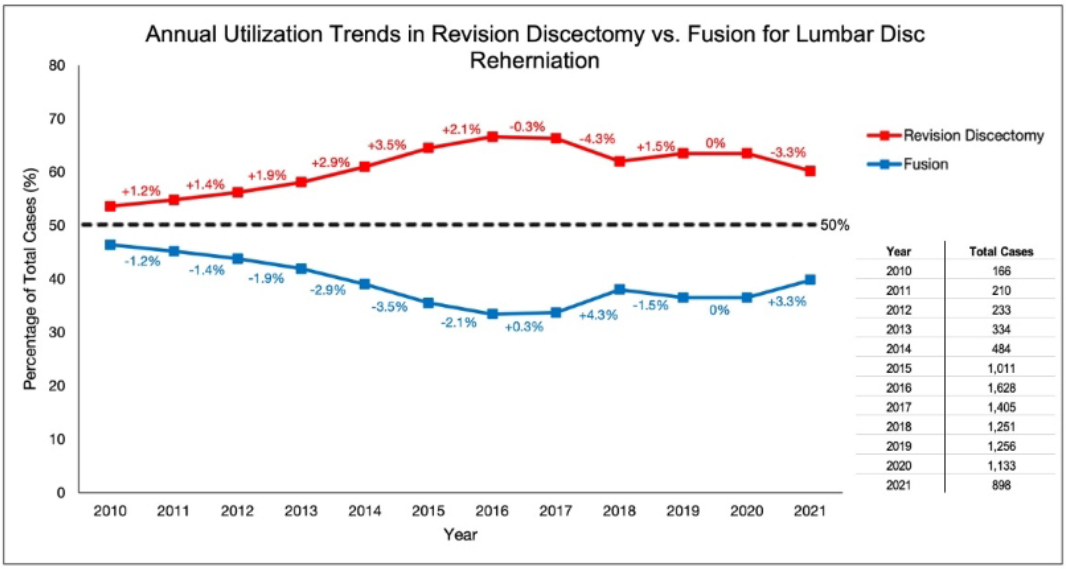
Sathialingam Mayilone, BS[1], Shah Ishan, BS[1], Ton Andy, BS[1], Wang Jeffrey, MD[2], Hah Raymond, MD[2], Alluri Ram, MD[1]
[1] University of Southern California Keck School of Medicine, Los Angeles, California, United States, [2] Keck Medical Center of USC, Los Angeles, California, United States

Background/Introduction: Recurrent lumbar disc herniation is a common complication following primary discectomy, of which operative cases are treated with revision discectomy or fusion. While certain clinical features may favor selection of procedure type, variations in practice are further driven by surgeon preference, which are influenced by normative cultural practices and evolving perspectives. This study evaluates trends across the United States (US) in utilization and outcomes between revision discectomy versus fusion for treatment of lumbar disc reherniation following primary discectomy.

Materials/Methods: Using the PearlDiver national database, patients who underwent primary lumbar discectomy with either subsequent revision discectomy or fusion for disc reherniation from 2010-2021 were retrospectively identified via ICD-9/ICD-10 and CPT coding. Patients with history of other lumbar spine surgery, multilevel pathology, or indications for cauda equina, trauma, malignancy, or infection were excluded. Procedural volume and percentage of total cases were recorded annually (Figure 1). Chi-squared analysis was performed to compare complication rates between 1:1 propensity-matched cohorts accounting for age, sex, Elixhauser comorbidity index, spinal instability, far lateral herniation, and pre/postoperative opioid use.

Results: 5,931 patients with disc reherniation following primary lumbar discectomy were identified, of which 65.1% (n=3,860) underwent revision discectomy (mean age = 47.7+/-13.2, 50.2% female) and 34.9% (n=2,071) fusion (mean age = 50.2+/-13.5, 54.1% female). On average, utilization of revision discectomy relative to fusion increased by 1.2% annually. Patients with far lateral herniations (OR=0.29), spinal instability (OR=0.15), and persistent postoperative opioid use following primary discectomy (OR=0.37) were significantly less likely to undergo revision discectomy than fusion (all $p<0.001$). Fusion was associated with greater 30-day readmission rates (OR=1.48, $p=0.01$), and conferred greater risk of spinal instability out to three years postoperatively (all $p<0.001$) and increased need for additional decompression out to five years postoperatively (all $p<0.001$). No other significant differences in perioperative complications were seen.

Discussion/Conclusion: Although certain clinical features were more likely to predispose patients to fusion, findings herein demonstrate a continued preference across the US for revision discectomies over fusions for lumbar disc reherniations. While short-term complications did not vary significantly, patients who underwent fusion were notably more likely to develop spinal instability or need for future additional lumbar decompression.



Year	Total Cases
2010	166
2011	210
2012	233
2013	334
2014	484
2015	1,011
2016	1,628
2017	1,405
2018	1,251
2019	1,256
2020	1,133
2021	898

RF08

Risk Factors Associated with Minimal Response to Erector Spinae Plane Block Following Minimally Invasive Lumbar Fusion

Mai Eric, BS[1], Zhang Joshua, BS[1], Lu Amy, BS[2], Bovonratwet Patawut, MD[1], Kim Eric, BS[1], Simon Chad, BS[1], Kwas Cole, BS[1], Allen Myles, MBChB[1], Tuma Olivia, BS[1], Vaishnav Avani, MBBS[1], Heuer Annika, MD[1], Singh Nishtha, MBBS[1], Kim Ashley Yeo Eun, BS[3], Korsun Max, BS[1], Araghi Kasra, BS[1], Asada Tomoyuki, MD[1], Qureshi Sheeraz, MD[2], Iyer Sravisht, MD[1]
[1] Hospital for Special Surgery, New York, New York, United States, [2] Hospital for Special Surgery/Weill Cornell Medical College, New York, New York, United States, [3] Weill Cornell Medical College, New York, New York, United States

Background/Introduction: Erector spinae plane (ESP) block is an emerging opioid-sparing regional anesthetic that has been shown to reduce immediate postoperative pain and opioid demand following minimally invasive transforaminal lumbar interbody fusion (MI-TLIF)—however, not all patients who receive ESP blocks perioperatively will experience a reduction in immediate postoperative pain. The purpose of this study is to identify risk factors for failure to respond to ESP block after MI TLIF.

Materials/Methods: This was a retrospective review of consecutive patients undergoing 1-level MI TLIF who received ESP blocks by a single anesthesiologist perioperatively at a single institution. ESP blocks were administered in the OR following induction. Failure to respond to ESP block was defined as patients with a first numerical rating scale (NRS) score post-surgery of >5.7 (mean immediate postoperative NRS score of control cohort undergoing MI TLIF without ESP block). Multivariable logistic regressions were performed to identify predictors for failure to respond to ESP block.

Results: A total of 134 patients were included (mean age 60.6 years, 43.3% females). The median and interquartile range (IQR) first pain score post-surgery was 2.5 (0.0-7.5). Forty-nine (36.6%) of patients failed to respond to ESP block. In the multivariable regression analysis, several independent predictors for failure to respond to ESP block following MI TLIF were identified: female sex (OR 2.33, 95% CI 1.04-5.98, P=0.040), preoperative opioid use (OR 2.75, 95% CI 1.03- 7.30, P=0.043), anxiety requiring medication (OR 3.83, 95% CI 1.27-11.49, P=0.017), and hyperlipidemia (OR 3.15, 95% CI 1.31-7.55, P=0.010).

Discussion/Conclusion: ESP block is an emerging safe and reliable component of multimodal analgesia for MI-TLIF that has been shown to reduce immediate postoperative pain and opioid requirement. As such, it has become increasingly important to understand the risk factors for failure to respond to ESP blocks following MI-TLIF. Our study identified preoperative opioid use, anxiety, and hyperlipidemia as independent predictors for failure to respond to ESP block following MI-TLIF. These findings may help clinicians to better work closely with patients to address any modifiable risk factors preoperatively and inform their approach to counseling patients on realistic postoperative pain expectations based on their risk factors.

Table 1. Multivariable Analysis: Risk Factors for Failure to Respond to ESP Block Following MI TLIF

Factor	Odds Ratio	95% CI		P-value
Patient Characteristics				
Age	0.97	0.94	1.01	0.095
Female Sex	2.33	1.04	5.98	0.040
Comorbidities / Preoperative Medication Use				
Preoperative Opioid Use	2.75	1.03	7.30	0.043
Anxiety	3.83	1.27	11.49	0.017
Hyperlipidemia	3.15	1.31	7.55	0.010

ESP, Erector Spinae Plane; MI TLIF, Minimally Invasive Transforaminal Lumbar Interbody Fusion.

RF09

Bertolotti's Syndrome: An evidence-based approach to diagnosis and treatment

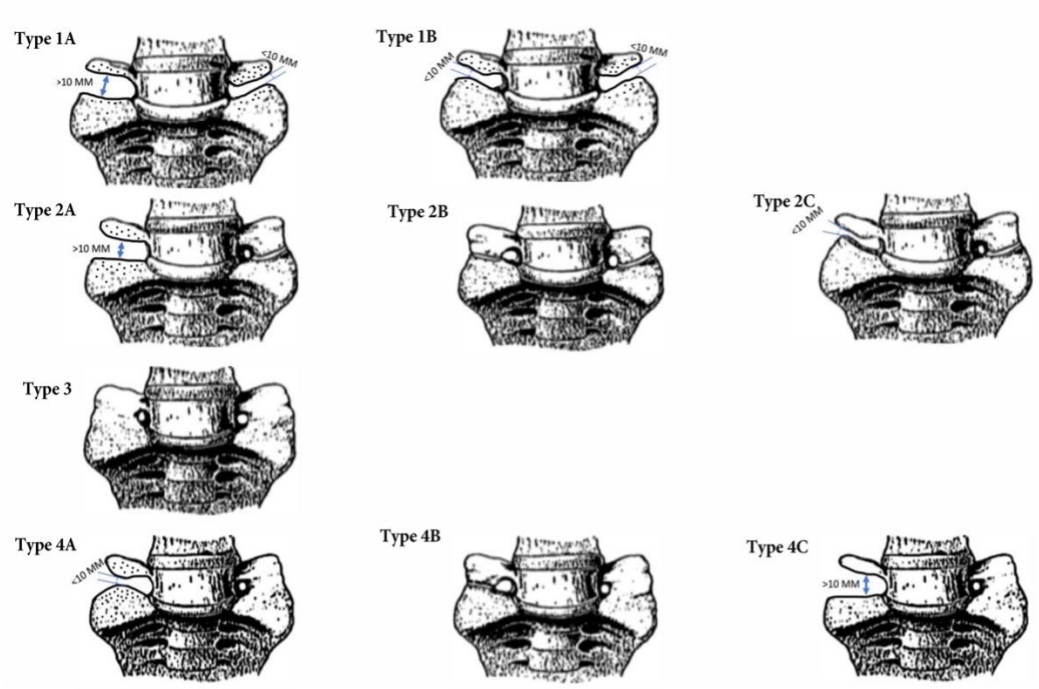
Jenkins Arthur, MD[1], O'Donnell John, BS[2], Harvie Camryn, BS[2], Chung Richard, BS[2]
[1] Icahn School of Medicine at Mount Sinai, New York, New York, United States, [2] Jenkins NeuroSpine, New York, New York, United States

Background/Introduction: Lumbosacral transitional vertebrae (LSTV) are increasingly recognized as a common anatomical variant and is the most common congenital anomaly of the lumbosacral spine, with incidence between 4 and 35% and many practitioners describing an overall 10-12% incidence.1,2 Patients can have symptomatic LSTV, known as Bertolotti's Syndrome, where transitional anatomy can cause back, L5 distribution leg, hip, and groin pain. Bertolotti's syndrome is a potential etiology which is commonly overlooked in the evaluation and treatment of back pain.1 Bertolotti's Syndrome has a reported prevalence to be 4.6% to 7% of adults with lower back pain.3 With the Jenkins Classification (Figure 1) and the combination of our experience in non-surgical and surgical outcome we propose an outline for diagnosis and treatment of Bertolotti's Syndrome.4

Materials/Methods: A retrospective review of our 99 surgically confirmed Bertolotti's Syndrome patients by the presenting author from 2018 to 2023. Using Magnetic Resonance Imaging (MRI), Computed Tomography (CT), and X-Ray imaging, patients with radiographic finding of LSTV, appropriate clinical presentation, and identification of LSTV as the primary pain generator via diagnostic injections were diagnosed with Bertolotti's syndrome. Patients who failed conservative treatment and underwent surgery to address their Bertolotti's syndrome were included.

Results: In 88 patients (89%) using CT and 11 patients (11%) using MRI, a LSTV was found and classified. A diagnostic injection in the transverse ala junction was found to be their first short-term relief in all 99 patients (100%). This confirmed the patients Bertolotti's Syndrome. Once patients got confirmation, the decision was made in the type of surgical intervention; resection or fusion (76 Fusions, 16 Decompressions, 7 Decompression and Fusions,) based on our previously published paper.5 After this surgery, we found 81 (82%) patients to have clinically meaningful improvement of their Bertolotti's pain.

Discussion/Conclusion: The best practice for symptomatic patients with pain in this area is as follows. First radiographic imaging of the lumbar region with a preference for CT, then a "Bertolotti Injection" and follow-up with confirmation if patient received temporary relief from injection. Finally, the recommendation is for a minimally invasive surgical resection or fusion based on the anatomy.


Type 1A
<10 MM
>10 MM
Type 1B
<10 MM
<10 MM
Type 2A
>10 MM
Type 2B
Type 2C
<10 MM
Type 3
Type 4A
<10 MM
Type 4B
Type 4C
>10 MM

RF10

Patient Reported Expectations in Elective Lumbar Spine Surgery: Preliminary Results of a Prospective Study

Staub Jacob, BS[1], Gerlach Erik, MD[1], Follett Matthew, MD[1], Arpey Nicholas, MD[1], Divi Srikanth, MD[1], Stricsek Geoffrey, MD[1], Hsu Wellington, MD[1], Patel Alpesh, MD, MBA[1]
[1] Northwestern University Department of Orthopaedic Surgery, Chicago, IL, , United States

Background/Introduction: The shift toward value-based healthcare has placed increased importance on patient perceived care and therefore the use of patient reported outcomes (PROs). As statistical changes in PROs may have little to no correlation with patient satisfaction, the minimal clinically important difference (MCID) has been introduced to quantify a threshold for clinical success. However, this definition of clinical success ignores an individual's expectations, which have been shown to influence perceptions of satisfaction in healthcare. Our goal is to quantify and compare patient reported expectations (PRE) to common values of MCID, with the hypothesis that PRE values will exceed this threshold.

Materials/Methods: Patients undergoing lumbar spine surgery at a single, tertiary academic institution were prospectively enrolled in this study. PROMIS CAT (computer adaptive test) physical function (PF), pain interference (PI), mental health, and physical health questionnaires were administered within 6 months of surgery. Patients were additionally administered these PRO questionnaires and were prompted to answer with their expectations one year following surgery. PROMIS t-scores between baseline values and 1-year expectations were compared across all cohorts (decompressions, fusions, and revision/adjacent segment disease (ASD)) and compared to a MCID of 8.

Results: A total of 144 patients (61 decompressions, 47 fusions, and 36 revisions) met inclusion criteria. While baseline values were statistically similar in all cohorts, patients undergoing decompression reported expectations most likely to meet MCID for PF and patients undergoing fusion reported expectations most likely to meet PI; however, these differences were not statistically significant. Despite similarities in expectations regarding MCID, patients undergoing revision procedures had the lowest expectations of gross PF improvement (12.0 ± 7.2) and patients undergoing fusion had the lowest expectations of gross PI improvement (13.9 ± 6.7); however, these results were only statistically significant in the PF domain.

Discussion/Conclusion: Our study suggests that postoperative expectations for common lumbar spine procedures exceed generally accepted values of MCID for PROMIS Physical Function and Pain Interference. Furthermore, these expected improvements differ across intervention and primary versus revision surgery. Ongoing enrollment will seek to establish relationships between PRE, PRO, and patient satisfaction with goals of better understanding individualized patient success in elective spine surgery.

Table 1. Percentages of patients expecting to meet MCID and expected t-score improvements across lumbar procedure groups.

		% Expecting to Meet PF MCID:	P-Value:	% Expecting to Meet PI MCID:	P-Value:
Procedure Type					
	Decompression	85.2%	0.63	80.3%	0.49
	Fusion	80.1%		87.2%	
	Revision/ASD	77.8%		77.7%	
Procedure Type		Expected Change in PF:	P-Value:	Expected Change in PI:	P-Value:
	Decompression	16.5 ± 8.1	**<0.01**	16.0 ± 8.9	0.42
	Fusion	13.5 ± 6.0		13.9 ± 6.7	
	Revision/ASD	12.0 ± 7.2		14.9 ± 9.0	

RF11

Venous Thromboembolism Chemoprophylaxis Is Not Supported Following Spine Surgery: A Meta-Analysis of Randomized Controlled Trials

Muralidharan Aditya, MD[1], Baumann Anthony, DPT[2], Piche Joshua, MD[3], Gong Davin, MD[1], Walley Kempland, MD[4], Kashlan Osama, MD[4], Patel Rakesh, MD[4], Aleem Ilyas, MD[4]
[1] University of Michigan Department of Orthopaedic Surgery, Ann Arbor, Michigan, United States, [2] Northeast Ohio Medical University, Rootstown, Ohio, United States, [3] USC spine center, Los Angeles, California, United States, [4] University of Michigan, Ann Arbor, Michigan, United States

Background/Introduction: Postoperative venous thromboembolism (VTE) is an overall rare complication following spine surgery. Pharmacologic VTE prophylaxis remains controversial in this patient population, as potential risks associated with anticoagulants, namely epidural hematoma, must be considered.

Materials/Methods: We conducted a systematic search of trusted electronic databases to identify randomized controlled trials (RCTs) that evaluated pharmacologic versus mechanical VTE prophylaxis following spine surgery. Two independent reviewers used the Grades of Recommendation Assessment, Development and Evaluation (GRADE) criteria to assess eligibility and risk of bias, perform data extraction, and rate the quality of evidence. The outcomes of interest were total VTE and bleeding. We conducted meta-analyses of total VTE, deep vein thrombosis (DVT), severe bleeding, and significant bleeding.

Results: After screening 927 articles, a total of 7 studies were eligible for final inclusion. These included 1509 patients, of whom 1,151 received pharmacologic VTE prophylaxis and 358 received mechanical VTE prophylaxis. Moderate-quality evidence demonstrated there was no significant difference between groups in rates of VTE (p=0.639; RR: 1.01; 95% CI: 0.96, 1.06) or DVT (p=0.064; RR: 1.03; 95% CI: 1.00, 1.07). There was also no significant difference between groups in risk of severe bleeding (p=0.377; RR: 1.04, 95% CI: 0.95, 1.14) or significant bleeding (p=0.517; RR: 1.02; 95% CI: 0.96, 1.08).

Discussion/Conclusion: Moderate-quality evidence does not support the routine use of pharmacologic DVT prophylaxis following elective spine surgery. Future high-quality randomized comparative-effectiveness trials with sufficient power to evaluate safety and efficacy given the rarity of complications are warranted.

RF12

Incidental Peritoneal Opening during Anterior Lumbar Interbody Fusion (ALIF) Not Associated with Increased Peri-operative Morbidity

Quevedo Santiago, BS[1], *Reed Donald, MD*[1], *Chavarria Joseph, MD*[1], *Avramis Ioannis, MD*[1], *Rizkalla James, MD*[1]
[1] *Baylor University Medical Center, Dallas, Texas, United States*

Background/Introduction: Incidental peritoneal opening during ALIF is a commonly listed complication in various series. While it is assumed that there is no morbidity associated with an incidental peritoneal opening, no series within the literature has evaluated its association with post-operative flatus, post-operative ileus, or formation of a post-operative hernia.

Materials/Methods: A retrospective, single-surgeon, single-institution cohort analysis was conducted on patients who underwent ALIF between 2020 and 2023 (IRB: 020-457). Operative notes were queried to identify incidental peritoneal opening and repair status. A standardized post-operative bowel regimen was utilized in all patients. Descriptive statistics were used to depict the patient samples on demographic and clinical characteristics, using mean (SD) or median (IQR). Variables were analyzed utilizing two sample T test and Wilcoxon rank sum Test. Associations between peritoneal injury status vs. hernia surgery were evaluated with Fisher Exact Test. P-value less than 0.05 is deemed as statistically significant. Statistical analyses were performed using a software R 4.3.2.

Results: 167 ALIFs were performed (Levels fused: n=399) during the collection window. Incidental peritoneal opening was found in 35.3% (n=59). Mean Post-operative day (POD) flatus showed no statistical difference between cohorts (No peritoneal injury: 2.62 days vs peritoneal injury 2.56 days, p=0.74). POD bowel movement showed no statistical difference between cohorts (No peritoneal injury: 4.62 days vs peritoneal injury 4.20 days, p=0.112). Similar findings seen for median interquartile range. Multi-level ALIF (3-4 Level ALIF) was not associated with increased peritoneal injury, delayed post op flatus, or delayed post-operative bowel movement, compared to 1-2 level ALIF. No association was seen with increased iatrogenic hernia between no peritoneal injury (n=3) versus peritoneal injury (n=0) (p=0.112). No difference identified between repaired and non-repaired incidental peritoneal opening.

Discussion/Conclusion: Our findings are consistent with the assumption that there is limited morbidity after incidental peritoneal opening. This study demonstrated no identified peri-operative morbidity with incidental peritoneal opening during ALIF approach, specifically, regarding delayed flatus, delayed bowel movement, or development of hernia. Surgeons can be reassured that incidental peritoneal opening will not complicate management after ALIF, regardless of the number of anterior levels approached.

Continuous Variable	Mean (SD)		Test Stat	T-test P-value		Median (IQR)		Wilcoxon P-value
	Peritoneal Injury No (n=108)	Peritoneal Injury Yes (n=59)				Peritoneal Injury No (n=108)	Peritoneal Injury Yes (n=59)	
Age	64.10 (13.88)	64.19 (11.92)	0.0413	0.9671		67.5 (57.75,74.25)	67.0 (53.5,74)	0.7707
ALIF Level	2.31(0.88)	2.53(0.70)	1.7623	0.0802		3 (1,3)	3 (2,3)	**0.1381**
Blood loss	655.79 (466.08)	902.54 (899.17)	1.9684	0.0527		500 (343.8,800)	600 (400,1100)	0.1285
LOS	6.92 (4.81)	6.84 (2.58)	-0.0898	0.9286		6 (4,7)	7 (5,7.5)	**0.1101**
POD Flatus	2.62 (1.16)	2.56 (0.90)	-0.3236	0.7468		2 (2,3)	3 (2,3)	**0.8495**
POD 1st BM	4.62 (1.52)	4.20 (1.41)	-1.6017	0.112		4 (4,6)	4(3,5)	**0.1984**
Categorical Variable	**Count (%)**		**Odds Ratio**	**Fisher Exact P-value**				
Peritoneal Repair (Y)	4 (6.8%)	55 (93.2%)	Inf	<0.0001				
Vascular Injury (Y)	7(6.5%)	7 (11.9%)	1.93	0.2522				
Hernia Injury (Y)	3 (2.8%)	0(0%)	0	0.5528				

RF13

Can You Perform an Adequate Discectomy During a Transforaminal Lumbar Interbody Fusion Approach Using an Endoscopic Technique? A Cadaveric Study Comparing Minimally Invasive Versus Endoscopic Approaches

Virk Sohrab, MD[1]
[1] *North Shore University/Long Island Jewish Medical Center, Great Neck, , United States*

Background/Introduction: Performance of an adequate discectomy is essential to obtaining lumbar fusion when performing a transforaminal lumbar interbody fusion (TLIF). Previous cadaveric studies comparing open and minimally invasive techniques have reported 36.6%-80% disc removed (Pumberger et al., 2012 and Rihn et al., 2014). Many surgeons fear that an endoscopic TLIF (E-TLIF) will not allow for an adequate discectomy for lumbar fusion.

Materials/Methods: An E-TLIF was performed on 14 disc spaces from T12-L5 and a minimally invasive TLIF (MIS-TLIF) was performed on 15 disc spaces from T12-S1. Surgeons performing the TLIF were fellowship trained. Each disc was transected after discectomy and a digital image was taken and analyzed using an imaging processing software to determine the percent of the total disc removed during the discectomy. Each quadrant of the discectomy was also compared. Quadrant one was defined as the dorsal left quadrant of the disc, with each quadrant numbered 2-4 clockwise around the disc. All TLIF approaches were from the left. The time to perform the discectomy was compared. Pedicle screws were placed contralaterally to the TLIF approach and the change in interpedicular distance was compared between techniques after expandable cage implantation as a marker for indirect decompression accomplished. A student's t-test was used to determine statistical significance between cohorts.

Results: There was no difference in overall discectomy performance between MIS-TLIF vs E-TLIF (48.86%+/-6.98% for MIS-TLIF vs. 50.26%+/-7.38% for E-TLIF, p=0.61). There was no statistical difference between MIS-TLIF vs E-TLIF at quadrants 1, 3 and 4. There was a difference in discectomy performance at quadrant 2 (39.02%+/-10.18% for MIS-TLIF vs 50.13%+/-14.00% for E-TLIF, p = 0.02). There was no statistical difference between contralateral interpedicular distance created between cohorts (2.20mm+/-1.97mm for MIS-TLIF vs 1.36mm+/-1.82mm for E-TLIF, p = 0.24). E-TLIF took less time than MIS-TLIF (20.00 min+/-7.12 min vs 15.22 min+/-4.42 min, p = 0.048).

Discussion/Conclusion: Our cadaveric study demonstrates that an adequately performed E-TLIF discectomy may be comparable to a MIS-TLIF discectomy. Further research is required to maximize the efficiency and instrumentation of this evolving technique for spinal fusion.

	Endoscopic TLIF Technique	MIS TLIF Technique	p value
Total discectomy percentage	50.26% +/- 7.38% (min = 37.78%, max = 59.12%)	48.86% +/- 6.98% (min = 34.2%, max = 58.94%)	0.61
Quadrant 1 discectomy percentage	63.74 +/- 13.53	62.40% +/- 11.74%	0.77
Quadrant 2 discectomy percentage	50.13% +/- 14.00%	39.02% +/- 10.18%	0.02
Quadrant 3 discectomy percentage	40.99% +/- 12.02%	38.96% +/- 20.71%	0.75
Quadrant 4 discectomy percentage	46.03% +/- 15.46%	44.59% +/- 16.42%	0.81
Time of discectomy	15.22 min +/- 4.42 min	20.00 min +/- 7.12 min	0.048
Change in interpedicular distance after cage placement as a measure of indirect decompression	1.36mm +/- 1.82mm	2.20mm +/- 1.97mm	0.24

RF14

Influence of formal mental health diagnosis on immediate post-surgical outcomes in elective lumbar spine fusion

Stewart Brendan, MD[1], Kostyun Regina, MS[2], Makanji Heeren, MD[2], Esmende Sean, MD[2], Solomito Matthew, PhD[2]
[1] University of Connecticut Health Center, Farmington, Connecticut, United States, [2] Hartford Healthcare Bone and Joint Institute, Hartford, Connecticut, United States

Background/Introduction: Over the last two decades, lumbar spinal fusions have been increasing in prevalence and are indicated for a variety of pathological conditions. Additionally, since the COVID-19 pandemic, there has been a rise in the diagnosis of mental illness in the general population. Most recently, there has been conflicting evidence whether mental illness affects post-operative outcomes in patients undergoing lumbar spinal fusions. The aim of this study was to compare outcomes following lumbar fusion for patients with and without a formal diagnosis of depression and/or anxiety.

Materials/Methods: This is a retrospective review of patients who underwent elective lumbar spine fusion between January 1, 2018 and June 1, 2022. Patients were grouped by the presence or absence of a formal mental illness diagnosis in their medical history prior to their preoperative office visit. The primary outcomes for this study included: self-reported pain, inpatient opioid consumption, post-operative ambulation distance, and discharge disposition. Differences in outcome variables between groups were assessed using Mann-Whitney tests.

Results: 1,283 patients were included in the study; 229 patients were identified as having a diagnosis of major depression and/or generalized anxiety disorder pre-operatively. There were significantly more females with pre-operative mental illness ($p<.001$). Patients with mental illness had a significantly higher level of pain at discharge at rest ($p=0.027$) and with activity ($p=.012$), as well as opioid consumption ($p<.001$). There was not a statistically significant difference in pain immediately following surgery at rest ($p=0.234$), with activity ($p=.413$), or discharge disposition ($p=0.051$).

Discussion/Conclusion: Pre-existing mental illness including major depression disorder and/or generalized anxiety disorder can influence immediate post-operative pain and inpatient opioid consumption following elective lumbar fusion surgery. Preoperative awareness of these conditions and the challenges these patients may face in the immediate perioperative setting may help tailor specific interventions and protocols to optimize outcomes in this often-overlooked population.

RF15

Three-column Fractures in the Ankylosed Spine: A Systematic Approach to Imaging and Assessment

Reed Ryder, MD[1], Pinter Zachariah, MD[2], Nassr Ahmad, MD[2], Sebastian Arjun, MD[2], Elder Benjamin, MD, PhD[2], Freedman Brett, MD[2]
[1] Mayo Clinic College of Medicine, Rochester, Minnesota, United States, [2] Mayo Clinic College of Medicine and Science, Rochester, Minnesota, United States

Background/Introduction: Despite the increased risk of spinal fractures in patients with ankylosing spinal disorders (ASD) following low-energy trauma, there remains no universally accepted imaging protocol and variation in care may occur depending on the healthcare setting. The purpose of the present study was to provide evidence for a systematic approach to imaging the ankylosed spine following trauma.

Materials/Methods: We identified 138 patients with ASD including ankylosing spondylitis (AS) or diffuse idiopathic skeletal hyperostosis (DISH) who sustained trauma resulting in 153 unstable 3-column fractures throughout the thoracolumbar spine from 1999-2020. The primary outcome of interest was the sensitivity of XR, CT and MRI imaging and radiology reports for the identification of 3-column injuries. Functional outcome measures including ambulatory status and neurologic status were correlated with any delay in presentation, diagnosis or treatment. Location of initial presentation was categorized as a primary care center (PCC, Level 2 ER or below) or a tertiary referral center (TRC, Level 1 trauma center). Sensitivity of each imaging modality was assessed for its ability to detect different concerning findings including presence of fracture, ankylosis, cord compression and/or epidural hematoma. These results were compared based on site of initial presentation (PCC vs TRC) and its impact on delay in presentation, diagnosis, and treatment.

Results: A cohort of 138 ASD patients with 153 fractures was identified. The majority of injuries occurred in the thoracic spine (51%) following a ground level fall (66%). 39% initially presented to a tertiary referral center (TRC), while 61% presented to primary care centers (PCC). There was an increased risk of a false-negative CT reading (11% vs. 2%; RR=5.14; p=0.03) when performed at a PCC compared to a TRC. Conversely, MRI had a 0% false-negative rate. The sensitivity to detect a 3-column fracture was 0% for X-rays and 45% for CT. There was a significant difference in diagnostic delay between presentation sites (p=0.03).

Discussion/Conclusion: This study highlights the rate of false-negative imaging with X-rays and CT imaging alone, particularly when patients present to a PCC. MRI imaging demonstrated the highest accuracy in detecting fractures in patients with ASD following trauma.

Table 3: Comparison of imaging modalities.

		Overall	TRC	PCC	*P-value	§Relative Risk
XRay (n=64)	A. States "3-column fracture" (True Positive)	0 (0%)	0 (0%)	0 (0%)	N/A	N/A
	B. States "fracture"	23 (37%)	11 (38%)	12 (35%)	1.00	1.04 (0.71-1.52)
	C. Equivocal statement without explicit diagnosis	14 (22%)	6 (21%)	8 (23%)	1.00	0.98 (0.75-1.28)
	D. States "negative for fracture"	15 (26%)	8 (28%)	7 (24%)	1.00	0.88 (0.37-2.10)
	E. No mention of "fracture" in report	12 (21%)	5 (17%)	7 (25%)	0.53	1.45 (0.52-4.03)
	F. Combined False-negative (D+E) (False-negative)	27 (43%)	13 (45%)	14 (41%)	0.80	0.92 (0.52-1.62)
	G. Mention of ankylosis present	22 (39%)	13 (48%)	9 (30%)	0.18	1.35 (0.88-2.08)
CT Impression Reading (n=153)	A. States "3-column fracture" (True Positive)	47 (39%)	32 (50%)	15 (27%)	0.01	1.45 (1.09-1.96)
	B. States "fracture"	108 (89%)	63 (97%)	45 (80%)	0.006	6.38 (1.48-27.59)
	C. Equivocal statement without explicit diagnosis	38 (32%)	20 (31%)	18 (33%)	0.84	0.96 (075-1.23)
	D. States "negative for fracture"	3 (2%)	0 (0%)	3 (5%)	0.10	N/A
	E. No mention of "fracture" in report	4 (3%)	0 (0%)	4 (7%)	0.04	N/A
	F. Combined False-negative (D+E) (False-negative)	7 (6%)	0 (0%)	7 (13%)	0.004	N/A
	G. Mention of ankylosis present	52 (50%)	34 (60%)	18 (38%)	0.03	1.55 (1.05-2.27)
CT All Findings (n=153)	A. States "3-column fracture" (True Positive)	67 (45%)	43 (48%)	24 (40%)	0.40	1.15 (0.86-1.53)
	B. States "fracture"	138 (90%)	87 (96%)	51 (82%)	0.01	4.04 (1.35-12.10)
	C. Equivocal statement without explicit diagnosis	6 (4%)	4 (4%)	2 (3%)	1.00	1.01 (0.95-1.08)
	D. States "negative for fracture"	2 (1%)	0 (0%)	2 (3%)	0.16	N/A
	E. No mention of "fracture" in report	7 (5%)	2 (2%)	5 (8%)	0.12	3.67 (0.74-18.32)
	F. Combined False-negative (D+E) (False-negative)	9 (6%)	2 (2%)	7 (11%)	0.03	5.14 (1.10-23.91)
	G. Mention of ankylosis present	90 (60%)	59 (66%)	31 (53%)	0.13	1.38 (0.93-2.04)
MRI (n=79)	A. States "3-column fracture" (True Positive)	54 (68%)	50 (69%)	4 (57%)	0.67	1.40 (0.56-3.53)
	B. States "fracture"	78 (99%)	71 (99%)	7 (100%)	1.00	0
	C. Equivocal statement without explicit diagnosis	1 (1%)	1 (1%)	0 (0%)	1.00	1.02 (0.99-1.05)
	D. States "negative for fracture"	0 (0%)	0 (0%)	0 (0%)	N/A	N/A
	E. No mention of "fracture" in report	0 (0%)	0 (0%)	0 (0%)	N/A	N/A
	F. Combined False-negative (D+E) (False-negative)	0 (0%)	0 (0%)	0 (0%)	N/A	N/A
	G. Mention of ankylosis present	48 (70%)	42 (68%)	6 (86%)	0.43	0.44 (0.07-2.82)

*P-value between locations; § Relative Risk of obtaining a false-negative finding at PCC compared to TRC. Relative risk considered N/A when one of the proportions is zero.

RF16

Is MIS-ATP lumbosacral fusion safe in patients with aortoiliac calcification?

Denwood Hayley, BS[1], Khan Rehan, BS[1], Kyada Rutvin, BS, MPH[1], Saade Aziz, MD[2], Tannoury Tony, MD[2], Tannoury Chadi, MD[3]
[1] Boston University School of Medicine, Boston, Massachusetts, United States, [2] Boston Medical Center, Boston, Massachusetts, United States, [3] Boston Medical Center, Boston, Massachusetts, United States

Background/Introduction: The minimally invasive antepsoas (MIS-ATP) lumbosacral fusion approach requires careful manipulation of the abdominal prevertebral major vessels for adequate spine access. Surgeons are often cautious to perform this on patients with aortoiliac calcification due to concerns for perioperative vascular complications. This study aims to analyze the clinical outcomes of patients with aortoiliac calcifications undergoing MIS-ATP lumbosacral fusion.

Materials/Methods: This is a retrospective chart review of adult patients who underwent MIS-ATP at a large tertiary care center between 2014 and 2020 with visible aortoiliac calcification on preoperative lumbar spine radiographs. Abdominal aortic calcification (AAC) score was assessed, a surrogate marker of systemic atherosclerosis, using preoperative lumbar spine radiographs based on Kauppila et al's scoring system. Two authors independently graded anterior and posterior calcification in the abdominal aorta at L1-L4 vertebral levels. Each patient received a score between 0-24 where higher values indicated more extensive calcification. Inter-rater reliability was 97.6% (ICC: 0.976, 95% CI: 0.957-0.985). AAC scores were categorized into published severity categories: low (0-1), moderate (2-5), or extensive (≥6). Intraoperative and postoperative complication data were collected. Statistical analysis was done via Chi-square, Fisher's exact tests and Mann-Whitney t-test. A multivariable logistic analysis was conducted to identify potential confounders.

Results: In this cohort of 123 patients, 47 developed > 1 complication. The complication group was significantly older, overrepresented by Black patients, and had higher rates of hypertension. The mean AAC scores and AAC severity categories did not differ significantly between the complication and no complication groups. The most common complication was ileus (23.6%). Simple logistic regression showed no increase in odds of perioperative complications in either moderate (OR 7.07, 95% CI 0.83-60.11) or extensive (OR 5.54, 95% CI 0.66-46.50) AAC severity categories compared to the low severity group (Table 1). This result was consistent when considering continuous AAC mean scores. Multivariable logistic regression analysis, including AAC severity categories and mean AAC scores, found no association between calcification severity and perioperative complications.

Discussion/Conclusion: In this study, the degree of aortoiliac calcification in MIS-ATP patients did not correlate with a higher risk of intraoperative or postoperative complications.

Table 1: Simple and multivariable logistic regression analysis testing the association between degree of abdominal aortic calcification and the odds of having a perioperative complication

Exposure variable used for regression		Simple regression, OR (95% CI)	Multivariable regression, adjusted OR (95% CI)
Primary Exposure: AAC severity categories	Extensive	7.07 (0.83, 60.11)	10.42 (0.84, 129.06)
	Moderate	5.54 (0.66, 46.50)	9.80 (0.85, 113.60)
Secondary Exposure: mean AAC score		1.04 (0.96, 1.12)	1.02 (0.91, 1.14)

Multivariable regression variables included: age, sex, race/ethnicity, and number of anterior levels operated upon, diabetes, hypertension, chronic kidney disease, hyperlipidemia, smoking status, alcohol use, CAD history, stroke history

RF17

The Utility of the Validated Intraoperative Bleeding Scale in Thoracolumbar Spine Surgery: A Single-Center Prospective Study

Smith Ryan, BS[1], Pease Tyler, BS[1], Chiu Anthony, BS[2], Shear Brian, MD[2], Sahlani Mario, MD[2], Ratanpal Amit, BS[2], Ye Ivan, MD[3], Thomson Alexandra, MD[1], Bivona Louis, MD[2], Jauregui Julio, MD[1], Crandall Kenneth, MD[2], Sansur Charles, MD[1], Cavanaugh Daniel, MD[1], Koh Eugene, MD, PhD[1], Ludwig Steven, MD[1]

[1] University of Maryland School of Medicine, University of Maryland Medical Center, Baltimore, Maryland, United States, [2] University of Maryland Medical Center, Baltimore, Maryland, United States, [3] University of Maryland Medical System, Baltimore, Maryland, United States

Background/Introduction: Until recently, there was no standardized definition or scale for categorizing intraoperative bleeding severity. This previously hindered clinical research on hemostatic agents in spine surgery. In 2016, the validated intraoperative bleeding severity (VIBe) scale was introduced as a Likert-type, clinician-reported scale for measuring intraoperative bleeding severity. It has been previously evaluated to have high intra- and inter-reporter reliability. However, to date, there are no studies evaluating the clinical utility of the VIBe scale. Specifically, it is not known whether VIBe scores correlate with differing clinical outcomes such as perioperative transfusion.

Materials/Methods: Adult patients aged 18 through 88 undergoing elective decompression, instrumentation, and fusion of the thoracolumbar spine were prospectively enrolled. VIBe scores were recorded intraoperatively. Univariate analysis consisted of Student T-tests, Pearson's $\chi 2$ Tests, Fisher's Exact Tests, linear regression, and binary logistic regression. Multivariable regression was conducted to adjust for baseline characteristics and potential confounding variables.

Results: A total of N=121 patients were enrolled and included in the analysis. After adjusting for confounders, VIBe scores were correlated with an increased likelihood of intraoperative blood transfusion (β=2.46, p=0.012), postoperative blood transfusion (β=2.36, p=0.015), any transfusion (β=2.49, p<0.001), total transfusion volume (β=180.8, p=0.020), and estimated blood loss (EBL) (β=409, p<0.001). VIBe scores had no significant association with length of hospital stay, 30-day readmission, 30-day reoperation, 30-day emergency department visit, change in pre- to post-op hemoglobin and hematocrit, total drain output, or length of surgery.

Discussion/Conclusion: The VIBe scale is associated with perioperative transfusion rates and EBL in patients undergoing thoracolumbar spine surgery. Overall, the VIBe scale has clinical relevance in spine surgery and shows potential utility in clinical research and practice.

Regression analysis of outcomes of interest by mean validated intraoperative bleeding severity (VIBe) score, adjusted for confounders[1]

Outcome	*Univariate Regression Coefficient (β)*	*p-value*[2]	*Multivariable Regression Coefficient (β)*	*p-value*
Transfusion (Any)	2.49	**<0.001**	2.89	**0.015**
Intraoperative transfusion	0.30	**0.002**	2.46	**0.012**
Postoperative transfusion	0.29	**0.007**	2.36	**0.015**
Transfusion volume (mL)	180.8	**0.020**	169.33	**0.024**
Estimated blood loss (mL)	415.8	**<0.001**	409.24	**<0.001**
Change in pre- to post-op hemoglobin	-0.99	0.318	-1.19	0.266
Change in pre- to post-op hematocrit	-2.99	0.343	-3.71	0.272
Drain output, postoperative day 1 (mL)	118.6	**0.038**	106.43	0.063
Drain output, total (mL)	173.5	0.162	143.81	0.246
Length of surgery (minutes)	4.37	0.876	11.67	0.993
Length of stay (days)	2.18	0.148	2.06	0.190
30-day readmission	0.05	0.451	0.40	0.805
30-day reoperation	-0.03	0.491	-3.01	0.313
30-day emergency department visit	1.43	0.075	1.38	0.124

VIBe, validated intraoperative bleeding severity scale; mL; milliliters
Bolded values indicated as being under a significance threshold of $p<0.05$
[1] Adjusted for age, biological sex, race, body mass index, smoking status, coagulopathy, number of levels fused, use of intraoperative tranexamic acid (TXA)
[2] Multivariable logistic regression for categorical outcomes, multiple linear regression for continuous outcomes

Poster 01

Performance Comparison between Hounsfield Units and DEXA in Predicting Lumbar Interbody Cage Subsidence after Circumferential Lumbar Fusion

Schuler Kirsten, BS[1], Orosz Lindsay, MS, PA-C[1], Yamout Tarek, MD, BS[2], Allen Brandon, [1], Lerebo Wondwossen, PhD[1], Roy Rita, MD[1], Schuler Thomas, MD[2], Good Christopher, MD[2], Haines Colin, MD[2], Jazini Ehsan, MD[2]
[1] National Spine Health Foundation, Reston, Virginia, United States, [2] Virginia Spine Institute, Reston, Virginia, United States

Background/Introduction: Bone mineral density assessment is essential for spinal fusion surgical planning, but gold standard dual energy x-ray absorptiometry (DEXA) is affected by degeneration often resulting in falsely elevated scores. Studies on opportunistic measurement of computed tomography Hounsfield units (CTHU) suggest lower values predict interbody cage subsidence, yet cutoff values vary and lack standardization. This study aims to determine if cutoff value CTHU<135 is associated with lumbar interbody cage subsidence and to compare the predictive performance of subsidence between CTHU and DEXA.

Materials/Methods: Circumferential lumbar fusions were retrospectively enrolled if DEXA, CT, and x-rays were available, and minimum follow up was one year. Interbody fusions were analyzed for subsidence ≥ 2mm by validated motion detection software. Lowest DEXAany and DEXAspine T-scores were categorized (normal ≥ -1.0, -1.0 > osteopenia> -2.5, osteoporosis ≤ -2.5) and L1 CTHUs were measured. Analysis determined the association between CTHU<135 and subsidence. Univariate and multivariate binary logistic regression compared the predictive performance of subsidence between CTHU and DEXA.

Results: The 127-patient cohort had 96.9% degenerative pathologies, 54.3% females, median age 60 years, 2.4% osteoporosis, 44.1% CTHU<135, and 13.4% subsidence. CTHU<135 (p=0.004) and age (p=0.016) were significantly associated with subsidence; DEXA lowest T-score (p=0.550) was not. The odds of subsidence were statistically significant if CTHU<135 for crude and adjusted (OR=4.0, 95% CI 1.2-13.9, p=0.029) comparisons. The odds of subsidence were not significant if lowest T-score<-1.0 for DEXAany and DEXAspine (OR=1.8, 95% CI 0.6-4.9, p=0.284 and OR=1.1, 95% CI 0.3-4.1, p=0.920, respectively).

Discussion/Conclusion: CTHU<135 was associated with subsidence while DEXA lowest T-score was not in patients with degenerative pathologies. The odds of subsidence were 4.0 times higher for CTHU<135 after controlling for known risks, supporting this cutoff value. This study suggests that CTHU is a more reliable predictor of subsidence than DEXA when assessing degenerative spinal pathologies and is a useful tool for assessing bone quality when planning lumbar surgery.

Poster 02

Combined Anterior-Posterior versus Posterior Only Approach for Surgical Management of Adult Spinal Deformity: A Systematic Review and Meta-Analysis of Comparative Studies

Baumann Anthony, DPT[1], Gong Davin, MD[2], Sleem Bshara, BS[3], Kapoor Neal, MD[4], Talaski Grayson, BS[5], Anastasio Albert, MD[6], Yoder R. Garrett, MD[4], Hoffmann Jacob, MD[7]
[1] Northeast Ohio Medical University, Rootstown, Ohio, United States, [2] University of Michigan Department of Orthopaedic Surgery, Ann Arbor, Michigan, United States, [3] American University of Beirut Medical Center, Beirut, , Lebanon, [4] Cleveland Clinic Akron General Medical Center, Akron, Ohio, United States, [5] University of Iowa, Iowa City, Iowa, United States, [6] Duke University Medical Center, Durham, North Carolina, United States, [7] Center for Spine Health, Cleveland Clinic Foundation, Cleveland, Ohio, United States

Background/Introduction: Numerous surgical techniques and approaches exist for operative management of ASD; however, no systematic review and meta-analysis exists comparing combined anterior-posterior approaches to posterior-only approach, despite significant interest in the current literature. The purpose of this first-time systematic review and meta-analysis is to examine the clinical outcomes and complication rates for surgical fusion procedures of adult spinal deformity (ASD) performed via an anterior-posterior approach as compared to a posterior-only approach to guide surgical decision-making.

Materials/Methods: This study is a systematic review and meta-analysis using PubMed, SPORTDiscus, MEDLINE, CINAHL, and Web of Science from database inception until September 9th, 2023. Inclusion criteria for this study were articles that examined both anterior-posterior or posterior only surgical approach for ASD, adult patients (>18 years old), comparative studies only, and articles in English with full-text.

Results: A total of seven observational comparative articles met the final inclusion criteria from 471 articles. Included patients (n=693; 317 in the Anterior-Posterior group; 376 in the Posterior-Only group) had a frequency weighted mean age of 60.2 ± 5.1 years and a frequency weighted mean follow-up of 40.4 ± 12.5 months. Qualitative data did not favor either group in terms of length of stay, radiographic outcomes, or functional outcomes. There was a total of 306 complications in the Anterior-Posterior group with a complication rate per patient of 1.0 ± 0.9 complications (range: 0.1 – 2.2 complications per patient) whereas there was a total of 380 complications in the Posterior Only group with a complication rate per patient of 1.0 ± 1.2 complications (range: 0.1 – 3.2 complications per patient). Meta-analysis of specific complications found no significant difference in revision rate (p=0.361), dural tear rate (p=0.074), neurological complication rate (p=0.167), infection rate (p=0.351), or pseudoarthrosis rate (p=0.988).

Discussion/Conclusion: Surgical management for ASD may provide comparable results in terms of surgical parameters, radiographic outcomes, functional outcomes, and complication

rates, irrespective of combined anterior-posterior approach or posterior-only approach. More research is needed to determine non-inferiority.

Poster 03

Gender Differences in Preoperative Symptom Severity for Patients Undergoing Lumbar Decompression

Loya Alexandra, BS[1], Roca Andrea, MS[1], Anwar Fatima, BS[1], Medakkar Srinath, BS[2], Wolf Jacob, BS[3], Kaul Aayush, BS[3], Sayari Arash, MD[2], Singh Kern, MD[2]
[1] Midwest Orthopaedics at Rush, Chicago, Illinois, United States, [2] Department of Orthopaedic Surgery, Division of Spine Surgery, Rush University Medical Center, Chicago, Illinois, United States, [3] Rosalind Franklin University of Medicine and Science, Chicago, Illinois, United States

Background/Introduction: The purpose of this study is to investigate the impact of the association of gender differences and symptom severity on patient-reported outcome measures (PROMs) in individuals undergoing lumbar decompression (LD).

Materials/Methods: Patients who underwent LD from 12/2011-04/2023 for reasons outside of infection, trauma, or malignancy were identified from a prospectively-maintained single spine surgeon database. Four groups were created based on gender and symptom severity: Low Severity Male (LSM, Visual Analog Scale-Back (VAS-B) <7 and Oswestry Disability Index (ODI) <50)/Low Severity Female (LSF, VAS-B <7 and ODI<50)/High Severity Male (HSM, VAS-B≥7 and ODI≥50)/High Severity Female (HSF, VAS-B≥7 and ODI≥50). Demographics, perioperative characteristics, and patient-reported outcome measures (PROMs) were collected preoperatively, at six weeks, and at final follow-up up to two years later. PROMs included Patient-Reported Outcomes Measurement Information System (PROMIS)-Physical Function (PF)/Nine-item Patient Health Questionnaire (PHQ-9)/ODI/VAS-B/VAS-Leg (VAS-L). MCID achievement was calculated using established values in the literature (PROMIS-PF = 4.5/VAS-B = 2.1/VAS-L = 2.8/ODI = 14.9/PHQ-9 = 3.0). Inferential statistics were used to analyze demographics, perioperative characteristics, PROMs, and MCID rates. A post-hoc Tukey test was conducted with alpha level at 0.05.

Results: Altogether, 413 patients were selected. Differences between groups were significant across all PROMs preoperatively, at 6-weeks, and at final follow-up ($p<0.05$, all). Except for PROMIS-PF, delta-PROM scores at six-weeks and final follow-up were significant ($p<0.013$, all). MCID achievement rates were significant for PHQ-9, VAS-B, and ODI ($p<0.05$, all).

Discussion/Conclusion: The study suggests that severity affects patient-reported outcomes in individuals undergoing LD, with gender impacting outcomes for patients with more severe symptoms at baseline.

Table 1. Patient-reported outcomes measures and minimum clinically important difference

	Total (n=413)	Low Severity Male (n=183)	High Severity Male (n=101)	Low Severity Female (n=78)	High Severity Female (n=51)	*p-value
Pre-Op						
PROMIS-PF	36.5±6.6	39.9±5.8	31.1±4.7	37.7±5.4	32.1±5.2	**<0.0001**
PHQ-9	5.87±5.7	3.89±4.1	8.46±6.3	4.35±3.9	10.5±7.4	**<0.0001**
VAS-B	5.62±2.8	4.06±1.9	8.44±1.0	3.67±2.0	8.59±0.85	**<0.0001**
VAS-L	5.91±2.7	4.91±2.6	7.40±2.0	5.10±2.5	7.40±2.79	**<0.0001**
ODI	41.3±20	28.2±11	62.3±11	30.2±11	64.0±9.7	**<0.0001**
6-week Post-Op						
PROMIS-PF	42.6±8.5	43.9±8.1	40.2±8.9	44.1±8.5	38.8±7.4	**0.007**
PHQ-9	3.54±4.4	2.62±3.1	4.69±5.3	3.16±4.2	5.59±5.8	**0.002**
VAS-B	2.64±2.5	2.06±2.0	3.88±3.0	2.10±1.99	3.19±2.7	**<0.001**
VAS-L	2.79±2.7	2.38±2.4	3.62±3.18	2.59±2.5	3.01±2.9	**0.018**
ODI	24.2±18	19.2±14	34.3±22	19.6±15	28.1±19	**<0.001**
Final Post-Op						
PROMIS-PF	47.3±9.9	49.7±9.0	44.7±12	47.4±8.9	43.0±9.0	**<0.001**
PHQ-9	3.83±5.3	2.34±3.5	6.40±7.4	3.39±4.0	5.10±5.5	**<0.001**
VAS-B	2.83±2.7	1.96±2.0	4.27±3.1	2.17±2.2	4.15±3.1	**<0.001**
VAS-L	2.72±2.7	2.26±2.4	3.63±3.2	2.34±2.6	3.20±3.1	**0.001**
ODI	21.22±19	15.7±14	31.0±22	17.5±16	27.2±20	**<0.001**
Δ Pre-Op to 6-week Post-Op						
PROMIS-PF	6.12±9.1	4.01±9.4	9.74±9.2	6.93±8.2	6.49±7.5	**0.012**
PHQ-9	2.46±4.8	1.69±3.6	4.42±5.5	1.20±4.6	3.92±6.2	**0.001**
VAS-B	2.96±3.0	1.99±2.4	4.51±3.1	1.62±2.2	5.46±2.9	**0.013**
VAS-L	3.12±3.3	2.69±2.8	3.94±3.4	2.58±3.2	3.96±4.1	**0.013**
ODI	17.40±21	9.34±16	27.72±22	10.12±16	35.7±22	**<0.001**
Δ Pre-Op to Final Post-Op						
PROMIS-PF	10.91±10	9.91±10	13.92±12	10.23±10	10.48±7.8	0.163
PHQ-9	2.17±5.2	2.53±7.8	1.76±3.4	0.896±3.9	5.03±5.9	**0.005**
VAS-B	2.81±3.1	2.16±2.6	4.11±3.3	1.53±2.7	4.49±3.2	**<0.001**
VAS-L	3.19±3.3	2.76±3.0	3.97±3.6	2.72±3.0	3.92±4.1	**0.013**
ODI	20.5±21	12.8±16	31.4±23	13.1±18	37.2±23	**<0.001**
MCID Achievement						
PROMIS-PF	77.42%	71.29%	87.23%	75.61%	85.71%	0.115
PHQ-9	19.68%	12.39%	31.03%	22.92%	20.00%	**0.031**
VAS-B	64.59%	57.59%	77.91%	50.77%	84.09%	**<0.001**
VAS-L	59.71%	55.13%	68.24%	53.97%	68.29%	0.109
ODI	64.97%	53.85%	79.07%	57.58%	86.96%	**<0.001**

*p-value calculated using ANOVA for patient-reported outcome measures and chi-square tests for MCID achievement rates
Bolding denotes statistical significance (p<0.05)

Poster 04

Perioperative Change in Bone Quality After Long Segment Thoracolumbar Fusion and Its Effects on Postoperative Outcomes

Levy Hannah, MD[1], Messer Caden, BS[2], Vallecillo Tissiana, BS[2], Pinter Zachariah, MD[3], Mikula Anthony, MD[3], Allen Tyler, MD[4], Fogelson Jeremy, MD[3], Bydon Mohamad, MD[3], Elder Benjamin, MD, PhD[3], Currier Bradford, MD[1], Nassr Ahmad, MD[3], Freedman Brett, MD[3], Karamian Brian, MD[5], Sebastian Arjun, MD[3]

[1] Mayo Clinic College of Medicine, Rochester, Minnesota, United States, [2] Mayo Clinic Rochester, Rochester, Minnesota, United States, [3] Mayo Clinic College of Medicine and Science, Rochester, Minnesota, United States, [4] Mayo Clinic, Rochester, Minnesota, United States, [5] Rothman Institute at Thomas Jefferson University, Philadelphia, Pennsylvania, United States

Background/Introduction: Preoperative CT vertebral Hounsfield Units (HUs) have been previously associated with adverse outcomes after spinal fusion including pseudoarthrosis, screw loosening, and reoperation. No spine surgery studies have investigated the preoperative to postoperative change in vertebral HUs. Stress shielding may decrease bone quality inside the fusion. Whereas in the terminal levels, altered junctional loading and increased segmental mobility may precipitate bony hypertrophy. The current study investigated the effect of long-segment posterior thoracolumbar fusion on perioperative changes in vertebral HUs and the impact of these changes on postoperative fusion status and proximal junctional complications.

Materials/Methods: All adult patients who underwent posterior thoracolumbar fusion with upper instrumented vertebrae [UIV] T10-L2 to pelvis for deformity at an academic center between 2010-2018 were retrospectively identified. Preoperative and postoperative HUs were assessed on axial CT images in the cranial, middle, and caudal cut of UIV+1, UIV, L3, L4, and L5 vertebral bodies, outside of the region of hardware and artifact in postoperative CTs (6 months- 14 months postoperatively), by two independent reviewers with interrater correlations. Paired t-tests compared pre- to post-operative changes in HUs. Logistic regressions determined if perioperative HU changes (Δ) predicted fusion status on CT and proximal junctional kyphosis (PJK) and failure (PJF) on final XR (>2 years postoperatively). Receiver operating curves (ROC) determined the probability of PJK and PJF based on ΔHUs.

Results: A total of 136 patients were included. The average pre- to post-operative change in HUs in the UIV+1, UIV, L3, L4, and L5 vertebral bodies were 59.2 ($p<0.001$), 83.6 ($p<0.001$), 30.8 ($p=0.005$), 5.0 ($p=0.640$), and 2.5 ($p=0.912$) respectively, with interrater correlations>85%. Cobalt chromium versus titanium rod material predicted perioperative decrease in UIV HUs (Beta=-39.1, $p=0.035$). Decrease in L3 (OR=0.997, $p=0.008$) and L4 (OR=0.998, $p=0.017$) ΔHUs predicted fusion. On logistic regression UIV+1 ΔHUs (OR=1.01, $p<0.001$) predicted PJK and UIV ΔHUs (OR=1.002, $p=0.006$) predicted PJF. ROC identified an optimal UIV+1 ΔHUs cutoff of 73.9 (AUC=0.71) and UIV ΔHUs cutoff of 109.6 (AUC=0.73) to predict PJK and PJF, respectively.

Discussion/Conclusion: Perioperative decreases in mid-construct HUs predicted successful

fusion likely secondary to stress shielding. However, perioperative increases in upper construct and junctional HUs predicted proximal junctional complications.

Poster 05

How Do Functional Comorbidities Affect PROMIS-PF Scores Following Lumbar Fusion Surgery?

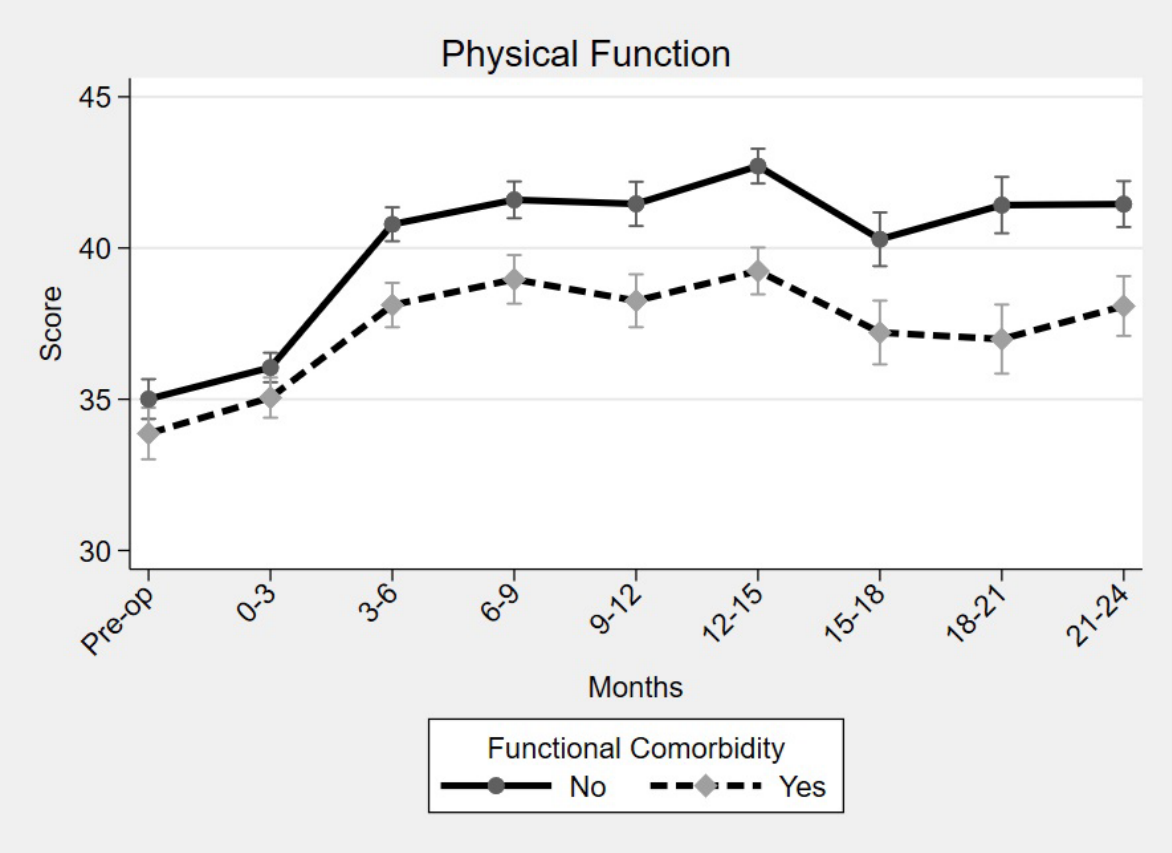
Mizels Joshua, MD[1], Martin Brook, PhD, MPH[2], Karamian Brian, MD[3], Spiker W. Ryan, MD[2], Lawrence Brandon, MD[2], Brodke Darrel, MD[4], Spina Nicholas, MD[5]
[1] Department of Orthopaedic Surgery, University of Utah, Salt Lake City, Utah, United States, [2] University of Utah Orthopaedic Center, Salt Lake City1, Utah, United States, [3] Rothman Institute at Thomas Jefferson University, Philadelphia, Pennsylvania, United States, [4] University of Utah, Salt Lake City, Salt Lake City, Utah, United States, [5] University of Utah - Department of Orthopaedics, Salt Lake City, Utah, United States

Background/Introduction: National Institute of Health's (NIH) Patient-Reported Outcomes Measurement Information System (PROMIS) Physical Function (PF) domain has been validated in spine surgery. However, little is known about how PROMIS-PF scores are affected by functional comorbidities and how these scores change in patients recovering from lumbar fusion surgery over time. In this study, we hypothesize that functional comorbidities negatively affect recovery.

Materials/Methods: We retrospectively identified 1,893 patients who underwent thoracolumbar, lumbar, or lumbosacral fusion for degenerative conditions between 01/02/2014 and 01/07/2022. The collection of PROMIS-PF scores is unstructured and built into the electronic medical record ascertained at the time of follow-up. We summarized PF at 3-month intervals for 2 years following surgery between those with and without functional comorbidity, defined as the presence of congestive heart failure (HF), chronic obstructive pulmonary disease (COPD), cerebrovascular disease (CVD), and/or paraplegia. Mixed effects multivariable regressions were used to model between group trends in PF through 2 years post-operatively controlling for age, sex, race, indication, and surgical invasiveness. The minimally clinically important difference (MCID) was defined as 5+ point improvement from baseline in PF.

Results: The cohort includes 1,224 (65%) patients without functional comorbidity and 669 (35%) with functional comorbidity. The mean age was 63.4 and Charlson index was 1.0 in the cohort without functional comorbidity compared to 64.8 and 3.6 in the cohort with functional comorbidity ($p=0.023$ and $p<0.001$ respectively). The groups were similar with respect to race, ethnicity, surgical invasiveness index, spine diagnosis, or pre-operative PF. At 24 months, the functional comorbidity group had a 2.1 point lower change in PF from baseline (95%CI 3.7; 0.6; $p=0.001$) and only 22.5% achieved MCID compared to 90.2% in patients without a functional comorbidity ($p<0.001$).

Discussion/Conclusion: While PROMIS-PF improved in both cohorts following surgery, patients with functional comorbidities demonstrated significantly less improvement in PROMIS-PF at all timepoints. PROMIS-PF can help benchmark patients along their recovery, and other metrics may be needed to better understand the recovery of patients with functional comorbidities.


Physical Function
45
40
35
30
Score
Pre-op
0-3
3-6
6-9
9-12
12-15
15-18
18-21
21-24
Months
Functional Comorbidity
No
Yes

Poster 06

New-Onset Depression Following Posterior Lumbar Fusion: National Trends and Risk Factors

Day Wesley, BS[1], Gouzoulis Michael, BS[2], Zhu Justin, BS[2], Seddio Anthony, BS[3], Grauer Jonathan, MD[4]
[1] Albert Einstein College of Medicine, Bronx, New York, United States, [2] Yale School of Medicine, New Haven, Connecticut, United States, [3] Loyola University of Chicago, Maywood, Illinois, United States, [4] Yale New Haven Hospital, Department of Orthopaedics and Rehabilitation, New Haven, Connecticut, United States

Background/Introduction: Posterior lumbar fusion (PLF) is an increasingly common surgery that is effective but may have an extended recovery period. Factors associated with patients and their perioperative course have started to receive attention as potential risk factors for postoperative new-onset depression (NOD). These considerations have received limited attention in the PLF population and recognizing predisposing factors may help target risk mitigation strategies.

Materials/Methods: A national administrative claims database was queried for all adult patients undergoing single-level PLF between 2010 and April of 2022. Exclusions included concurrent diagnoses of tumors, trauma, infections, as well as psychiatric history prior to surgery including depression, anxiety, and psychiatric risk factors for depression such as disorders of eating, alcohol/drug abuse, psychoses, bipolar, and PTSD. The percentage of patients developing postoperative NOD (within 1 year following surgery) was identified for this patient population. Patients who did and did not develop postoperative NOD were compared by age, sex, and Elixhauser Comorbidity Index (ECI, a measure of comorbidity burden). The cohorts were then exact matched 1:4 based on age, sex, and ECI, and these matched cohorts were assessed with multivariate logistic regression to determine the potential association of postoperative NOD with a variety of 90-day postoperative complications.

Results: Overall, 97,594 adult patients who underwent single-level PLF were included. Of these, 2,891 (3.0%) were diagnosed with postoperative NOD. Those who developed NOD were more likely to be younger, female, and have greater comorbidity burden ($P < 0.001$ for all). Notably, the percent of patients with postoperative NOD diagnosis grew from 1.8% in 2010 to 11.1% in 2021 ($P < 0.001$). For the matched comparisons, those with postoperative NOD had independently higher odds of experiencing multiple 90-day postoperative complications, visits to the ED, and readmission (Figure 1).

Discussion/Conclusion: Diagnoses of NOD are becoming more prevalent over the years and bear watching. The current study shines a light on variables (demographics, comorbidities, and postoperative courses) of the patients at greatest risk of developing postoperative NOD. Further research may help delineate more resources that can be appropriately considered for these patients following PLF and other related procedures.

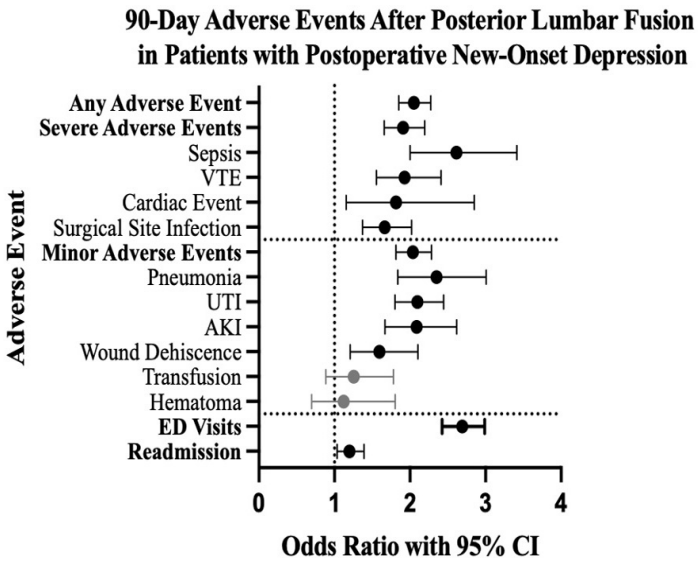


Figure 1. Forest plot demonstrating results of multivariate logistic regression on the odds of suffering various 90-day postoperative complications in patients who develop new-onset depression (NOD) within 1 year following posterior lumbar fusion, compared to those who did not develop NOD.

Poster 07

Renal Transplant Patients have Significantly Increase Odds of Perioperative Adverse Events Following Lumbar Laminotomy/Discectomy

Gouzoulis Michael, BS[1], *Seddio Anthony, BS*[2], *Zhu Justin, BS*[1], *Grauer Jonathan, MD*[3]
[1] *Yale School of Medicine, New Haven, Connecticut, United States,* [2] *Loyola University of Chicago, Maywood, Illinois, United States,* [3] *Yale New Haven Hospital, Department of Orthopaedics and Rehabilitation, New Haven, Connecticut, United States*

Background/Introduction: Lumbar discectomy is a common procedure with good clinical outcomes, and those with renal transplant may be considered for lumbar discectomy. This study aimed to compare ninety-day outcomes and five-year reoperations following lumbar laminotomy/discectomy in those with versus without a history of renal transplant.

Materials/Methods: A retrospective cohort study utilizing the 2015 – Q1 2022 M161Ortho PearlDiver Database was performed. Adult patients undergoing single-level lumbar laminotomy/discectomy (without additional spinal procedures) were identified, and patients were excluded if they presented with concomitant trauma, neoplasm, or infection. The renal transplant cohort was matched 1:4 to a control group based on age, sex, and Elixhauser Comorbidity Index (ECI). The incidence of 90-day adverse events, ED visits, and readmissions were compared using multivariate logistical regression controlling for age, sex, and ECI to determine odds ratios (OR). Five years reoperations rates were compared using Kaplan-Meier analysis.

Results: After matching, there were 2670 patients in the control group versus 686 patients in the transplant group. In the transplant cohort, 559 (81.5%) had at least one medical perioperative complication. The most common adverse events were acute kidney injury (53.1%) and urinary tract infection (43.3%). The most common severe adverse event was sepsis (27.4%). On multivariate analysis, there was increase odds of any adverse events (OR: 5.37), severe adverse events (OR: 2.55), and minor adverse events (OR:5.23) ($p < 0.001$ for each). The highest odds amongst severe events were sepsis (OR: 2.73) and cardiac arrest OR: 2.71), while the highest odds amongst minor events were acute kidney injury (OR: 5.14) and urinary tract infection (OR: 3.16) ($p < 0.001$ for all). There was increase odds of ED visits (OR: 2.57, $p < 0.001$), but no significant difference in readmissions ($p = 0.06$). There was no significant difference in reoperation between the control and transplant cohort (96.8% vs 98.0%, $p = 0.1$).

Discussion/Conclusion: Patients with history of renal transplant have a complicated medical history for surgeons to consider. In this national cohort, we demonstrate that these patients, even after matching, are at significant increase risk of many perioperative medical adverse events, however are at no increased risk of reoperations within five-years.

Poster 08

Results of Biphasic Calcium Phosphate Bone Graft with Submicron Needle-Shaped Surface Topography as Standalone Alternative to Autograft are Favorable in a Prospective, Multi-Center, Randomized, Intra-Patient Controlled Trial

Butrico Casey, PhD[1], Delawi Diyar, MD, PhD[2], Hoebink Eric, MD[3], Kempen Diederik, MD, PhD[4], van Susante Job, MD, PhD[5], Kruyt Kruijt Moyo, MD, PhD[6]
[1] Kuros Biosciences, Atlanta, Georgia, United States, [2] St. Antonius Hospital, Nieuwegein, -, Lithuania, [3] Amphia Hospital, Breda, Breda, Netherlands, [4] OLVG Hospital, Amsterdam, Noord-Holland, Netherlands, [5] Rijnstate Hospital, Arnhem, Arnhem, Netherlands, [6] UMC Utrecht Netherlands, Utrecht, Ut, Netherlands

Background/Introduction: Pseudoarthrosis after spinal fusion is an important complication leading to an estimated 92,000 revision spine surgeries in the United States each year. Iliac Crest Bone Graft is considered the gold standard, but with limited availability and an extra procedure for harvesting, spine surgeons often utilize alternatives. A multi-center trial was established to determine non-inferiority of a submicron-sized needle-shaped surface biphasic calcium phosphate (BCP<µm) compared to autograft in instrumented posterolateral spinal fusion.

Materials/Methods: Adult patients indicated for instrumented posterolateral spinal fusion of one to six levels from T10-S2 were enrolled at five participating centers. The diagnoses included deformity (46%), structural instability (29%), and instability from decompression (23%). In total, 91 patients and 130 levels were treated. After instrumentation and preparation of the bone bed, one side was grafted with 10 cc of autograft per level containing a minimum of 50% iliac crest bone. The other side was grafted with 10 cc of BCP<µm granules standalone. Follow-up included adverse events, the Oswestry Disability Index (ODI), and a fine-cut (<1mm) computed tomography (CT) at one year. Fusion was systematically scored as fused or not fused per level per side by two spine surgeons blinded for the procedure.

Results: The fusion rate determined by fine-cut CT for BCP<µm was 77.8% (101/130 levels), which compared favorably to the autograft fusion rate of 45.4% (59/130 levels). Fusion of the BCP<µm side was not contingent upon fusion of the autograft side, as 42% of levels fused on the BCP<µm side but did not fuse on the autograft side. In contrast, 5% of levels fused on the autograft side but not on the BCP<µm side. 34% of levels had complete fusion of both sides, while 19% did not have fusion on either side. ODI score was analyzed for the first 50 patients in the study. ODI decreased from a mean of 46.0 (±15.0) to a mean of 31.7 (±16.9), and 52.4% of patients improved with at least 15-point decrease.

Discussion/Conclusion: These preliminary data support BCP<µm is not inferior to autograft for posterolateral fusion. Additional analyses assessing the influence of interbody fusion and pre-operative smoking are ongoing.

Poster 09

Risk Factors for Mortality Following Surgical Treatment of Thoracolumbar Burst Fractures

Zakieh Omar, MBBS[1], Locascio Logan, BS[2], Bakle Curtis, BS[2], Wong Benjamin, BS[2], Zhang Derick, BS[2], Rekulapelli Akhil, BS[2], Croft Andrew, MD[1], Lugo-Pico Julian, MD[1], Gardocki Raymond, MD[1], Zuckerman Scott, MD, MPH[3], Stephens Byron, MD[1], Abtahi Amir, MD[1]
[1] Department of Orthopaedics and Rehabilitation, Vanderbilt University Medical Center, Nashville, Tennessee, United States, [2] Vanderbilt Univeristy, Nashville, Tennessee, United States, [3] Department of Neurological Surgery, Vanderbilt University Medical Center, Nashville, Tennessee, United States

Background/Introduction: Vertebral burst fractures are often associated with other life-threatening injuries, underscoring the critical nature of their management and the effect of these other factors on treatment outcomes. While some factors influencing mortality have been elucidated including age, injury severity and neurologic deficit, a complete understanding of the factors influencing mortality has not been reached. Among a cohort of surgically treated burst fractures, we sought to define the factors associated with mortality within 12 months of treatment.

Materials/Methods: A retrospective cohort study was undertaken of patients undergoing surgical treatment of thoracic and lumbar vertebrae burst fracture from a single institution between 2010-2021. The primary outcome was mortality within 12 months. Patients with less than 12 months follow-up were excluded. Bivariate analysis was conducted to compare basic demographics, clinical characteristics, and perioperative variables between the mortality group and survivor group.

Results: Of 86 burst fracture patients included in this study, the mean age was 45.1±18.4 and 58 (67.4%) were male. There were 13 (15.1%) patients in the mortality group (mean days to mortality= 87.4±101.2). On comparison of patient demographics and clinical characteristics, the mortality group were significantly older (60.9±14.1 vs. 42.3±17.7, p=.001), and had a greater proportion of smokers (53.8% vs. 26.0%, p=.044), and thoracic level fractures (84.6% vs. 47.9%, p=.015) than the survivor group. Spinal cord injuries were more prevalent in the mortality group, however, this did not reach statistical significance (p=.056). There was no difference in sex (p=.881), BMI (p=.155), comorbidities (p=.088), insurance type (p=.617), prior spine surgery (p=.244) injury severity score (p=.307), ASA grade (p=.379), or number of vertebrae (p=.330) fractured between the cohorts. On comparison of perioperative variables, there was no difference in estimated blood loss (p=.587), performance of laminectomy (p=.066), postoperative complications (p=.123), or length of stay (p=.837) between the mortality and survivor groups.

Discussion/Conclusion: In patients with surgically treated vertebral burst fractures, patients who did not survive 12 months postoperatively were significantly older, more likely to smoke and have thoracic instead of lumbar fractures. Spinal cord injuries were also more prevalent in the mortality group.

Poster 10

"Time Is Spine": The Impact of Indirect Versus Direct Transfer On Mortality and Non-Neurological Outcomes For Patients With Traumatic Thoracolumbar And Lumbar Spine Injuries

Zeller Sabrina, MD[1], Nolan Bridget, BS[2], Spirollari Eris, BA[2], Merckling Matthew, BA[2], Clare Kevin, BE[2], Vazquez Sima, MS[2], Frid Ilya, MD[3], Kinon Merritt, MD[3], Prabhakaran Kartik, MD[1], Wainwright John, MD[3]

[1] Westchester Medical Center, Valhalla, New York State, United States, [2] New York Medical College, Valhalla, New York, United States, [3] Brain and Spine Institute at Westchester Medical Center, Valhalla, New York, United States

Background/Introduction: Expeditious management after a traumatic spinal cord injury (tSCI) has been shown to lower inpatient death rates, enhance neurological recovery, and improve overall outcomes. Guidelines typically advise that surgery should occur within 24 hours of tSCI. However, despite evidence emphasizing timely treatment and potential worsened neurological outcomes in transferred patients, many regions lack a standard method for triaging and transferring tSCI patients. This project aims to investigate the effect of facility transfer status on patient mortality and non-neurological outcomes in acute management of thoracolumbar or lumbar tSCI.

Materials/Methods: A retrospective review was conducted on 473 tSCI patients admitted to a major Level I trauma hospital in New York. A prospectively maintained institutional trauma database was queried for patients with ICD-9 and ICD-10 codes relevant to thoracolumbar or lumbar tSCI from January 1, 2012 to December 31, 2021. Patients who were transferred from an outside hospital were identified. Outcomes analyzed included in-hospital complications, mortality, length of stay, and discharge disposition.

Results: Of 473 patients with tSCI, 36 (7.3%) had isolated thoracolumbar or lumbar spine injuries. Of these, 18 (50%) were transferred from an outside hospital. The average age was 40 years, and 27.8% of patients were female. There were no significant differences in age, gender, Glasgow Coma Scale (GCS), or Injury Severity Score (ISS) values on arrival between transferred and non-transferred patients. Days on a ventilator, total length of stay (LOS), in-hospital complications, inpatient mortality rate, and discharge disposition were similar between groups. The average time from injury to initial evaluation was significantly longer for the transferred cohort (356.17 min vs. 62.7 min, $p < 0.001$).

Discussion/Conclusion: Transfer status was a critical factor in time to initial evaluation at a comprehensive center for patients with tSCI. As no significant difference was seen in non-neurological morbidity and mortality in transferred patients, this delay in evaluation may account for the previously reported disparity in neurological recovery. To ensure efficient access to appropriate care, patients should be directly transported to a Level I trauma center following thoracolumbar or lumbar tSCI.

Variables	All Patients with Thoracolumbar or Lumbar SCI (36)	Not Transferred (18, 50%)	Transferred (18, 50%)	OR (95%CI)	P value
Demographics and Severity					
Age (years) (mean ± SD)	40.37 ± 15.24	42.25 ±15.14	38.49 ±15.54		0.467
Female (n, %)	10 (27.8%)	4 (22.2%)	6 (33.3%)	1.75 (0.398-7.7)	0.711
GCS (mean ± SD)	14.11 ± 3.20	14 ± 3.46	14.2 ± 3.10		0.876
ISS (mean ± SD)	23.89 ± 11.19	25.94 ± 10.93	21.83 ± 11.38		0.277
Isolated SCI (any level)	8 (22.2%)	3 (16.7%)	5 (27.8%)	1.923 (0.383-9.646)	0.691
Required operating room (OR) for SCI (n, %)	27 (75%)	13 (72.2%)	14 (77.8%)	1.346 (0.296-6.131)	1
Time From Scene*	**All Patients (22)**	**Not Transferred (10, 45.5%)**	**Transferred (12, 22.0%)**	**OR (95%CI)**	**P value**
Time (n, %): Scene to ED <1 hr	**5 (22.7%)**	**5 (50%)**	**0 (0%)**	**0.5 (0.269-0.929)**	**0.01**
Time (n, %): Scene to ED 1-6 hr	11 (50%)	5 (50%)	6 (50%)	1 (0.187-5.357)	1
Time (n, %): Scene to ED >6 hr	**6 (27.3%)**	**0 (0%)**	**6 (50%)**	**2 (1.136-3.522)**	**0.015**
Time (min): Scene to ED (mean ± SD)	**222.8 ± 174.7**	**62.7 ± 32.6**	**356.2 ± 121.3**		**< 0.001**
Time (n, %): Scene to OR <24 hr	7 (31.8%)	3 (30%)	4 (33.3%)	1.167 (0.191-7.116)	1
Hospital Course					
ICU LOS (days)	6.0 ± 11.0	5.6 ± 8.0	6.3 ± 13.6		0.834
Ventilator Days (days)	2.3 ± 8.9	1.9 ± 5.5	2.8 ± 11.5		0.769
Total LOS (days)	15.5 ± 18.2	17.3 ± 21.7	13.7 ± 14.2		0.565
Disposition					
Inpatient Death (n, %)	1 (2.8%)	1 (5.6%)	0 (0%)	0.944 (0.844-1.056)	1
Routine Discharge (n, %)	6 (16.7%)	1 (5.6%)	5 (27.8%)	6.538 (0.679-62.987)	0.177
Discharge to Rehab (n, %)	21 (58.3%)	12 (66.7%)	9 (50%)	0.5 (0.13-1.923)	0.5
Discharge to SCI Rehab (n, %)	3 (8.3%)	2 (11.1%)	1 (5.6%)	0.471 (0.039-5.708)	1
Discharge to SNF (n, %)	3 (8.3%)	1 (5.6%)	2 (11.1%)	2.125 (0.175-25.775)	1
Discharge to Acute Care Facility (n, %)	1 (2.8%)	0 (0%)	1 (5.6%)	1.059 (0.947-1.184)	1
Complications					
DVT/PE (n, %)	1 (2.8%)	0 (0%)	1 (5.6%)	1.059 (0.947-1.184)	1
UTI (n, %)	1 (2.8%)	1 (5.6%)	0 (0%)	0.944 (0.844-1.056)	1
Infection (n, %)	4 (11.1%)	3 (16.7%)	1 (5.6%)	0.294 (0.028-3.138)	0.603
Ulcer (n, %)	1 (2.8%)	1 (5.6%)	0 (0%)	0.944 (0.844-1.056)	1

*Data available from 22 patients

Poster 11

Association Between History of Lumbar Spine Surgery and Paralumbar Muscle Health: A Propensity Score-Matched Analysis

Song Junho, MD[1], Katz Austen, MD[2], Ngan Alex, MD[3], Silber Jeff, MD[4], Essig David, MD[2], Qureshi Sheeraz, MD[5], Virk Sohrab, MD[6], Vatsia Sohrab, MD[7]
[1] Department of Orthopaedic Surgery, Mount Sinai Health System, New York, New York, United States, [2] North Shore LIJ Health System, Manhasset, New York, United States, [3] Zucker School of Medicine at Hofstra/Northwell Orthopedic Surgery, New Hyde Park, New York, United States, [4] Northwell Health, New Hyde Park, New York, United States, [5] Hospital for Special Surgery/Weill Cornell Medical College, New York, New York, United States, [6] North Shore University/Long Island Jewish Medical Center, Great Neck, , United States, [7] Penn State Hershey Medical Center, Hershey, Pennsylvania, United States

Background/Introduction: Prior studies have shown that muscle strength and quality may be associated with lower back pain. Recently, a novel MRI-based lumbar muscle health grade was shown to correlate with HRQOL scores after spine surgery. However, the potential association between history of lumbar spine surgery and paralumbar muscle health requires further investigation. Our study aimed to compare MRI-based paralumbar muscle health parameters between patients with vs. without a history of surgery for degenerative lumbar spinal disease.

Materials/Methods: A retrospective analysis was performed on a consecutive series of patients of a single surgeon, and patients were included based on availability of lumbar MRI. Axial T2-weighted lumbar MRIs were analyzed for paralumbar cross-sectional area (PL-CSA), Goutallier classification, and lumbar indentation value (LIV). Measurements were performed at the center of disc spaces from L1 to L5. Patients with and without history of spine surgery were matched via propensity score matching, and muscle health parameters were compared.

Results: A total of 615 patients were assessed. For final analysis, 89 patients with a history of previous spine surgery were matched with 89 patients without a history of spine surgery. History of spine surgery was generally associated with worse lumbar muscle health. At all 4 intervertebral levels between L1-L5, PL-CSA was significantly smaller among patients with history of spine surgery. At L4-L5, patients with prior spine surgery had significantly smaller PL-CSA/BMI. Patients with prior spine surgery were found to have greater fatty infiltration of the muscles, with higher average Goutallier grades at levels L1-L2, L2-L3, and L4-L5. In addition, history of spine surgery was associated with smaller LIV at L1-L2, L3-L4, and L4-L5.

Discussion/Conclusion: The current study demonstrates that history of lumbar spine surgery is associated with worse paralumbar muscle health based on quantitative and qualitative measurements on MRI. On average, patients with history of spine surgery were found to have smaller cross-sectional areas of the paralumbar muscles, greater amounts of fatty infiltration based on Goutallier classification, and smaller lumbar indentation values.

Table 2. Muscle Health Parameters in Patients With vs. Without History of Spine Surgery

	Total Cohort	History of Spine Surgery	No History of Spine Surgery	*p*-value
Goutallier Grade				
L1-L2	1.2 ± 0.8	**1.4 ± 0.8**	**1.1 ± 0.9**	**0.004**
L2-L3	1.5 ± 0.9	**1.6 ± 0.9**	**1.3 ± 1.0**	**0.013**
L3-L4	1.8 ± 1.0	1.9 ± 1.0	1.6 ± 1.0	0.131
L4-L5	1.9 ± 1.1	**2.1 ± 1.1**	**1.7 ± 1.1**	**0.029**
PL-CSA (mm^2)				
L1-L2	4192.9 ± 1512.6	**4007.2 ± 1651.8**	**4378.5 ± 1343.1**	**0.027**
L2-L3	4298.7 ± 1432.0	**4111.6 ± 1492.7**	**4485.9 ± 1351.1**	**0.035**
L3-L4	4103.9 ± 1336.0	**3888.1 ± 1356.3**	**4319.7 ± 1286.9**	**0.030**
L4-L5	3680.5 ± 1315.7	**3307.7 ± 1282.4**	**4040.8 ± 1251.8**	**<0.001**
PL-CSA/BMI				
L1-L2	143.4 ± 45.5	138.2 ± 47.3	148.6 ± 43.2	0.086
L2-L3	147.4 ± 44.8	142.6 ± 45.8	152.3 ± 43.4	0.123
L3-L4	141.3 ± 43.9	135.4 ± 44.0	147.2 ± 73.3	0.073
L4-L5	127.6 ± 45.5	**116.9 ± 44.0**	**138.0 ± 47.3**	**0.007**
LIV (mm)				
L1-L2	14.0 ± 6.9	**12.5 ± 6.7**	**15.5 ± 6.8**	**0.003**
L2-L3	14.0 ± 6.9	13.1 ± 7.2	14.8 ± 6.6	0.056
L3-L4	15.7 ± 7.5	**14.0 ± 7.5**	**17.3 ± 7.2**	**0.004**
L4-L5	19.0 ± 8.6	**14.3 ± 7.3**	**22.9 ± 7.7**	**<0.001**

Values represented as mean ± standard deviation. Bold indicates statistical significance ($p<0.05$). PL-CSA, paralumbar cross-sectional area. PL-CSA/BMI, PL-CSA normalized by BMI. LIV, lumbar indentation value.

Poster 12

Utilization Trends of Pedicle Subtraction Osteotomy in Adult Spinal Deformity: An Analysis of a Large Insurance Claims Database from 2010-2021

Shelby Hannah, BS[1], Shelby Tara, BS[2], Ball Jacob, MD[3], Kim Michael, BS[1], Wang Jeffrey, MD[4], Alluri Ram, MD[5], Hah Raymond, MD[4]

[1] University of Southern California, Los Angeles, California, United States, [2] Department of Orthopaedic Surgery, Keck School of Medicine, University of Southern California, Los Angeles, California, United States, [3] USC spine center, Los Angeles, California, United States, [4] Keck Medical Center of USC, Los Angeles, California, United States, [5] University of Southern California Keck School of Medicine, Los Angeles, California, United States

Background/Introduction: Despite the prevalence and disabling nature of adult spinal deformity (ASD), there is limited research into the updated utilization trends of its commonly used treatment, pedicle subtraction osteotomy (PSO). The present study aims to characterize PSO use over the 2010-2021 time period in a retrospective trends analysis using a national insurance claims database.

Materials/Methods: Patient data from 2010 to 2021 was accessed through the querying of the national insurance database PearlDiver. After first identifying ASD ICD-9 and ICD-10 codes, patients in this larger cohort who underwent PSO were isolated using codes CPT-22207, CPT-22208, and CPT-22206. Temporal distribution by year and demographic data including gender, age, region, payor type, and service location were extracted. Subsequent analysis included utilization trends of PSO for isolated ASD categories including scoliosis, kyphosis and lordosis.

Results: 4218818 patients with spinal deformity were identified from 2010-2021. Of this cohort, 4749 underwent PSO for treatment. Trend analysis demonstrated an initial rise in utilization, peaking in 2016 and steadily decreasing until the end of the study period. Comparing 2010 to 2013 demonstrated an increase from 295 to 455 patients (+54.24%), subsequently falling to 425 in 2015 (-8.79%) before returning to a peak case volume of 522 in 2016 (+22.82%). Post-2016 demonstrated a decrease in PSO procedures, ultimately ending with 305 patients in 2021 (-41.57% from 2016). This decrease from 2016 to 2021 is also visible across individual deformity diagnoses including scoliosis (-34.38%), kyphosis (-43.90%), and lordosis (-22.22%).

Discussion/Conclusion: The present study demonstrates a decreasing national trend of PSO treatment of adult spinal deformity after 2016. Such findings may reflect a growing surgeon preference for posterior column osteotomy (PCO) over PSO, possibly due to the former's lower labor demands and decreased blood loss, as reported in literature.

Poster 13

Increase in 90-Day Postoperative Adverse Outcomes in Patients With Fibromyalgia Following Lumbar Discectomy

Rancu Albert, BS[1], Sanchez Joshua, BS[1], Jonnalagadda Anshu, BS[1], Katsnelson Beatrice, BA[1], Vasudevan Rajiv, MD[1], Grauer Jonathan, MD[2]
[1] Yale School of Medicine Department of Orthopaedics and Rehabilitation, New Haven, Connecticut, New Haven, Connecticut, United States, [2] Yale New Haven Hospital, Department of Orthopaedics and Rehabilitation, New Haven, Connecticut, United States

Background/Introduction: Lumbar discectomy is a common spine surgical intervention for which patients with fibromyalgia, a musculoskeletal condition associated with abnormal pain perception, may be present. This condition has been identified as a risk factor for poor postoperative outcomes following several other spine/joint-related procedures. However, the correlation of fibromyalgia on postoperative outcomes following lumbar discectomy has not been well described in the literature.

Materials/Methods: The PearlDiver Mariner161 national administrative claims database was queried for patients undergoing single-level lumbar laminotomy/discectomy. Patients were excluded if they underwent concomitant spine procedures on the same day, were <18 years of age, or received a diagnosis of neoplasm, trauma, or infection prior to surgery. Patients were stratified based on preoperative fibromyalgia diagnosis and matched 1:4 to those without fibromyalgia based on age, sex, and Elixhouser Comorbidity Index. Multivariate analyses were performed to determine whether patients with fibromyalgia were more likely to experience 90-day adverse events. Kaplan-Meier survivorship analysis was performed to determine whether patients with fibromyalgia were at increased risk of requiring subsequent lumbar surgery within 5 years.

Results: A total of 244,556 lumbar laminotomy/discectomy patients were identified, of which fibromyalgia was noted for 2,624 (1.2%). After matching, there were 9,886 and 2,495 patients in the study groups. As shown in Figure 1, patients with fibromyalgia were at independently greater odds of multiple adverse events. In decreasing odds ratio (OR), these included: pneumonia (OR: 3.47), urinary tract infection (OR: 2.58), cardiac events (OR: 2.50), acute kidney injury (OR: 2.28), pulmonary embolism (OR: 1.74), sepsis (OR: 1.53), deep vein thrombosis (OR: 1.48), SSI (OR: 1.40), and an emergency department (ED) visit (OR: 3.48) ($p<0.05$ for all). Additionally, these patients were at increased risk for aggregated any event (OR: 2.26), severe event (OR: 1.48), and minor event (OR: 2.50) ($p<0.0001$ for all). Patients with fibromyalgia were more likely to undergo a subsequent lumbar spine procedure within 5 years (16.5% vs. 11.6%, $p<0.0001$).

Discussion/Conclusion: Lumbar discectomy patients with a history of fibromyalgia were found to be at greater odds of multiple 90-day perioperative adverse events, as well as 5-year revisions. This is important to consider with patient counseling and surgical planning.

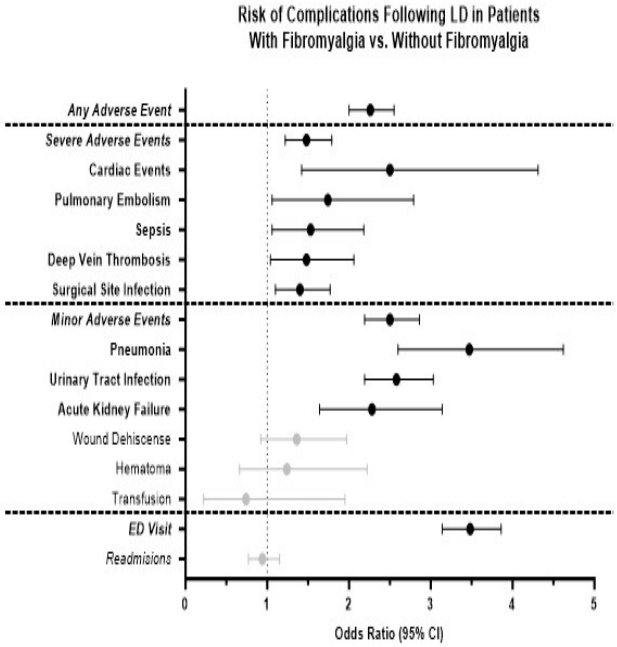


Figure 1. Forest plot of odds ratios with 95% confidence intervals in the matched fibromyalgia cohort relative to the control cohort. Black bars are statistically significant, whereas gray bars are not. LD = lumbar discectomy, CI = confidence interval.

Poster 14

Kinetic Analysis of Structural Parameters in Degenerative Lumbar Spondylolisthesis

Ton Andy, BS[1], Iyer Avinash, BS[2], Hang Nicole, BS[1], Abdou Marc, BS[1], Hah Raymond, MD[3], Wang Jeffrey, MD[3], Alluri Ram, MD[1]
[1] University of Southern California Keck School of Medicine, Los Angeles, California, United States, [2] USC spine center, Los Angeles, California, United States, [3] Keck Medical Center of USC, Los Angeles, California, United States

Background/Introduction: Kinetic magnetic resonance imaging (kMRI) is a novel technique which combines high image resolution with positional variability offered with conventional radiographs to allow characterization of degenerative changes in dynamic pathologies such as degenerative lumbar spondylolisthesis (DLS). This study evaluates the relationship between structural parameters of the lumbar spine and instability in DLS using kMRI.

Materials/Methods: This was a retrospective review of 129 consecutive lumbar spine kMRI images from patients presenting with low back pain from 2015-2017. Patients with history of prior fusion or presenting for trauma, malignancy, or infection were excluded. Segmental lordosis, facet angle, disc height and degeneration, and paraspinal muscle cross-sectional area (CSA) were measured on neutral T2-weighted images. Spondylolisthesis was categorized as stable or unstable at each lumbar segment from L3-S1. Instability was defined as translational motion >3mm and/or angular motion >10 degrees between flexion and extension images. Statistical analysis included independent t-test and chi-squared for continuous and categorical variables. Multivariable logistic regression controlling for age sex, and global lordosis were conducted to identify independent predictors of instability at individual lumbar segments.

Results: Overall, 60 patients had single-level DLS (mean age=44.7+12.3; 46% female), 20 of which were unstable. There were no significant differences in age (p=0.135) or sex (p=0.532) between stable and unstable DLS patients. On average, unstable DLS was associated with greater multifidus CSA (5.29 vs. 8.34cm2 , p=0.005). Increased multifidus CSA was significantly predictive of instability (OR:1.5, 95%CI: 1.20-1.82, p=0.001). At L4-L5 DLS segments, increased translational motion at adjacent L5-S1 non-DLS segments was significantly predictive of instability (OR:2.2, 95%CI: 1.05-4.56, p=0.037).

Discussion/Conclusion: Increased multifidus CSA was found to be an independent predictor of unstable DLS overall, while increased anteroposterior translational motion at adjacent, non-affected L5-S1 segments were predictive of unstable DLS at L4-L5 segments. As a dynamic stabilizer, multifidus hypertrophy is likely a compensatory mechanism to maintain spinal stability, while excessive translational motion at the lumbosacral joint may elicit further segmental instability at adjacent L4-L5 DLS segments where structural integrity is already compromised. Higher powered studies should be conducted to further investigate predictors of instability in DLS.

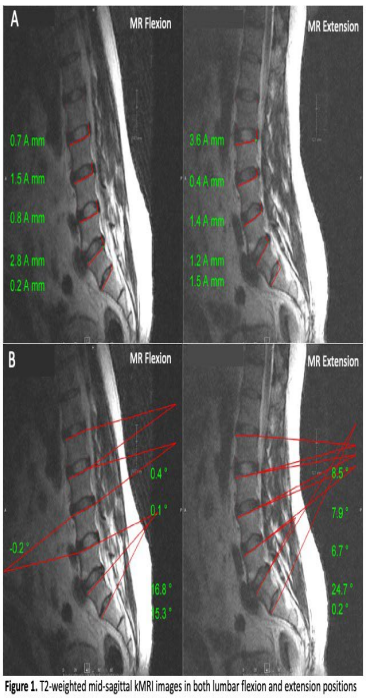


Figure 1. T2-weighted mid-sagittal kMRI images in both lumbar flexion and extension positions with anteroposterior (AP) vertebral translation measurements in **Figure 1A**, and intervertebral angulation measurements in **Figure 1B**.

Poster 15

Extent of Fatty Infiltration of Lumbar Paraspinal Muscles as a Proxy for Frailty and its Relationship with Perioperative Outcomes in Patients Undergoing Elective Spinal Surgery

Kulkarni Ronit, BS[1], Bertolino Melanie, BS[1], Rivas Gabriella, MD[1], Glaser John, MD[1], Reitman Charles, MD[1], Lawrence James, MD, MBA[1], Ravinsky Robert, FRCS(C), MCDM, MPH[1]
[1] Medical University of South Carolina, Charleston, South Carolina, United States

Background/Introduction: Frailty has been studied as a measure of risk assessment in the elderly since it captures patient characteristics that current risk-stratification tools fail to consider. The Goutallier classification has been used with reliability to assess the degree of fatty infiltration in lumbar region. The purpose of this study is to identify the role of fatty infiltration of the lumbar paraspinal muscles using the Goutallier classification to assess perioperative outcomes following elective lumbar surgery and its association with a frailty index.

Materials/Methods: Retrospective review of 301 patients at a single institution who underwent elective spinal surgery in 2021 due to lumbar degenerative pathology. Data were collected on patient demographics, medical history, perioperative outcomes, and post-operative complications. Goutallier scores were classified according to lumbar magnetic resonance images. Cases were excluded due to multilevel fusion, anterior and/or lateral approach, revision cases, or lack of surgical operative note.

Results: 98 patients were included. Average patient age was 65.77±11.9 years. Mean scores included a Goutallier score of 2.57±1.05 and an MFI-5 score of 1.23±1.08 for all patients. Intraclass correlation coefficient (ICC) for Goutallier scores was 0.912. Statistically significant relationships were seen between higher Goutallier scores and women ($p=0.039$), dependent health status ($p<0.001$), and steroid use ($p=0.004$). There was no association between Goutallier and MFI-5 scores ($p=0.228$). Older age was associated with both higher Goutallier ($p=0.022$) and MFI-5 ($p<0.001$) scores. There was no significant association between Goutallier scores and race, BMI, diabetes, CHF, COPD/Pneumonia, HTN, osteoporosis, psychiatric illness, alcohol use, reoperation rate, readmission rate, length of hospital stay ($p>0.061$). Multivariable ordinal regression analysis demonstrated only increased patient age ($p=0.003$) and the female sex ($p=0.014$) were significant predictors of higher Goutallier scores.

Discussion/Conclusion: Despite its use in shoulder pathology, the Goutallier score has not demonstrated to be relevant to lumbar spinal pathology. In patients undergoing elective spinal surgery for lumbar degenerative pathology, there appears to be no association between the Goutallier and MFI-5 scores. Further research is warranted regarding the relationship between fatty infiltration, frailty, and clinical outcomes in elective spinal surgery.

Poster 16

Spinopelvic Fixation Failure in the Adult Spinal Deformity Population: Systematic Review and Meta-Analysis

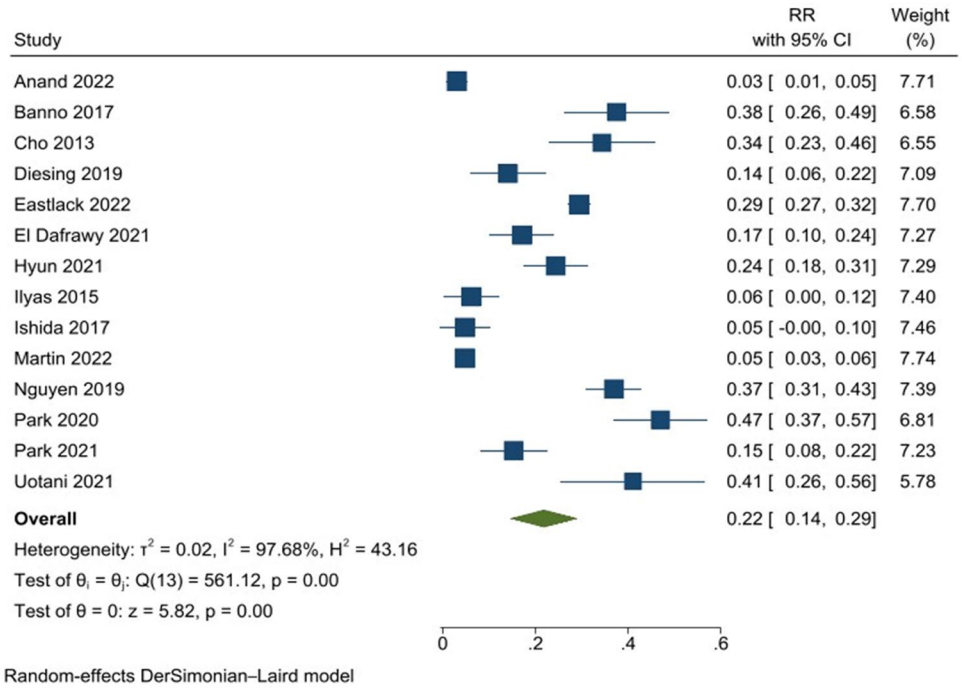
Odland Kari, DAT, ATC, LAT[1], Zuckerman Scott, MD, MPH[2], Polly, Jr. David, MD[3]
[1] University of Minnesota, Department of Orthopedic Surgery, Minneapolis, Minnesota, United States, [2] Department of Neurological Surgery, Vanderbilt University Medical Center, Nashville, Tennessee, United States, [3] University of Minnesota, Department of Orthopaedic Surgery, Minneapolis, Minnesota, United States

Background/Introduction: Despite modern fixation techniques, spinopelvic fixation failure (SPFF) after adult spinal deformity (ASD) surgery ranges from 4.5%-38.0%, with approximately 50% requiring reoperation. Compared to other well-studied complications after ASD surgery, less is known about the incidence and predictors of SPFF. Given the high rates SPFF and reoperation needed to treat it, the purpose of this systematic review and meta-analysis was to report the incidence and failure mechanisms of SPF after ASD surgery.

Materials/Methods: The literature search was executed across four databases: Medline via PubMed and Ovid, SPORTDiscus via EBSCO, Cochrane Library via Wiley, and Scopus. Study inclusion criteria were patients undergoing ASD surgery with spinopelvic instrumentation, report rates of SPFF and type of failure mechanism, patients over 18 years of age, minimum 1-year follow-up, and cohort or case-control studies. From each study, we collected general demographic information (age, gender, body mass index), primary/revision, type of ASD, and mode of failure (screw loosening, rod breakage, pseudarthrosis, screw failure, SI joint pain, screw protrusion, set plug dislodgment, sacral fracture) and recorded the overall rate of SPF as well as failure rate for each type. For the assessment of failure rate, we required a minimum of 12 months follow-up with radiographic assessment.

Results: Of 206 studies queried, 14 met inclusion criteria comprising 3,570 ASD patients who underwent ASD surgery with pelvic instrumentation (mean age 65.5±3.6 years). The mean SPFF rate was 22.1% (range, 3%-41%). Stratification for type of failure resulted in a mean SPFF rate of 23.3% for the pseudarthrosis group; 16.5% for the rod fracture group; 13.5% for the iliac screw loosening group; 7.3% for the SIJ pain group; 6.1% for the iliac screw group; 3.6% for the set plug dislodgement group; 1.1% for the sacral fracture group; and 1% for the iliac screw prominence group.

Discussion/Conclusion: The aggregate rate of SPFF after ASD surgery is 22.1%. The most common mechanisms of failure were pseudarthrosis, rod fracture and iliac screw loosening. Studies of SPFF remain heterogeneous, and a consistent definition of what constitutes SPFF is needed. This study may enable surgeons to provide patient specific constructs with pelvic fixation constructs to minimize this risk of failure.



Random-effects DerSimonian–Laird model

Poster 17

Elective Lumbar Fusion Patients show minimal change in ODI score after 3 months

Makanji Heeren, MD[1], Solomito Matthew, PhD[1], Zeng Francine, MD[2], Antonacci Christopher, MD[2], Esmende Sean, MD[1]
[1] Hartford Healthcare Bone and Joint Institute, Hartford, Connecticut, United States, [2] University of Connecticut Health Center, Farmington, Connecticut, United States

Background/Introduction: Tracking patient reported outcomes measures (PROMs) scores through at least 1 year post surgery is becoming increasingly important for both clinical research and clinical care. Despite the fact that The Oswestry Disability Index (ODI) is a commonly used PROM to assess lower back function, there is a paucity of research assessing longitudinal change in ODI scores over the first post-operative year. Therefore, the purpose of this study was to assess changes in ODI scores for patients undergoing elective lumbar fusion procedures from pre-op through one year postop.

Materials/Methods: Patients were included in this retrospective study if they underwent an elective lumbar fusion between January 2021 and June 2023, and completed their pre-operative and 3, 6, and 12 month post-operative ODI. Descriptive statistics were used to assess trends in ODI scores. Patients were divided into three categories- improved for patients improving by 10 points or more, no change for patients with ODI score changes between -9 and 9 points, and worse for ODI scores that worsened by 10 or more points.

Results: 205 patients (102 females) with an average age of 64.4±12.3 were included in this study. ODI scores remained relatively unchanged after 3 months post-operative (Figure 1). At 3 months, 124 patients improved from pre-op, 66 indicated no change, and 15 indicated they got worse. At 6 months 127 patients improved, 63 indicated no change, and 15 indicated they got worse. By 1 year 131 indicated they improved, 51 indicated no change, and 23 indicate they were worse.

Discussion/Conclusion: Patients who improved by 3 months continued to report improvement at both 6 months and 1 year. Similar patterns were noted for those that indicated that they worsened. The only group that showed any mobility in their scores were those that indicated no change by 3 months. However this mobility was limited to 15 patients (8 worsened and 7 improved by 1 year post-op). These results suggest that elective lumbar patients will typically reach their recovery level by 3 months after surgery based on the ODI. Future studies should determine the utility of 6 month and 12 month PROs.

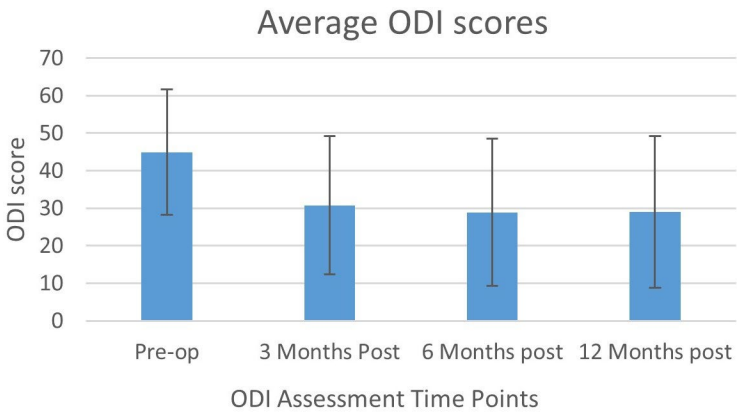


Figure 1: Average ODI scores at each time point along with standard deviation

Poster 18

Osteoporotic Rabbit Vertebroplasty Model Development for Vertebral Compression Fracture Repair Materials Evaluation

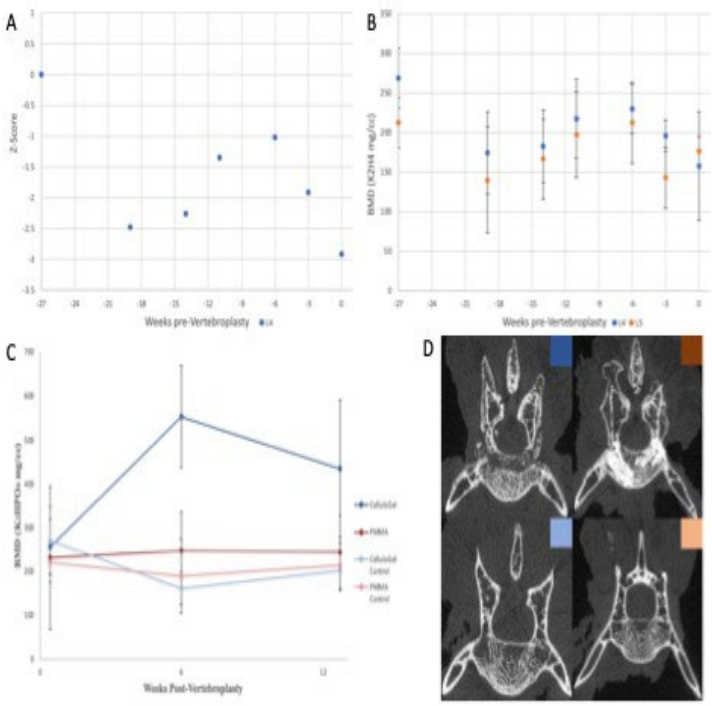
Hemmerla August, BS[1], Grisolano Abigail, [2], Kimes Austin, BS[2], Wray John, BS[2], Lim Ji-Hey, PhD, DVM[1], Ulery Bret, PhD[2], Moore Don, MD, na[1]
[1] University of Missouri - Columbia, Columbia, Missouri, United States, [2] University of Missouri-Columbia, Columbia, Missouri, United States

Background/Introduction: Vertebral compression fractures (VCF) are prevalent in postmenopausal women, often resulting from decreased bone mineral density (BMD) in the vertebral trabeculae due to osteoporosis. The annual incidence of osteoporotic VCFs is estimated to be 550,000-700,000, constituting approximately 27% of all osteoporotic fractures across both genders. Poly(methylmethacrylate) (PMMA) is the only FDA-approved material for vertebroplasty, but it does not address any underlying disorder and can induce stress shielding leading to adjacent vertebral fractures. For these reasons, current biomaterials research in this area focuses on creating alternative bioactive and tissue strength-matched products. Our research aims to develop a standardized osteoporotic rabbit vertebroplasty model for in vivo testing of various biomaterials to treat VCFs.

Materials/Methods: Through ovariectomy and daily dexamethasone injections (0.6mg/kg), an osteoporotic phenotype was accomplished in 24 skeletally mature female New Zealand rabbits. Then a bilateral open vertebroplasty was employed to inject the L4 and L5 with 0.1-0.2 mL PMMA or an osteoinductive hydrogel (CelluloGel) into the trabecular area. BMD was determined during the development of osteoporosis and 90 days after vertebroplasty by quantitative Computed Tomography (qCT). After euthanization, vertebral bodies were harvested and evaluated using micro-CT (μCT), biomechanical testing, and histology.

Results: Development of osteopenia/osteoporosis in the L4 was determined by reaching a Z-score of -2.92 (Figure 1A) and a BMD of 157.5±68.8 (K2PO4 mg/cc) at the surgery date (week 0) when compared to the baseline (week -27) BMD of 268.8±38.2 (Figure 1B). Post-vertebroplasty qCT demonstrated that the hydrogel induced an increased BMD at days 42 and 89, surpassing PMMA and uninjected controls (Figure 1C). μCT revealed improved microarchitecture and denser bone matrix associated with the presence of the hydrogel (Figure 1D). Further biomechanical and histological evaluations are underway and, so far, are consistent with qCT and μCT analysis.

Discussion/Conclusion: This research addresses the common issue of VCFs in postmenopausal women through the development of a standardized osteoporotic rabbit vertebroplasty model for new material testing. Employing an osteoporotic phenotype, we successfully compared an osteoinductive hydrogel (CelluloGel) against gold-standard PMMA. The results demonstrate the hydrogel's ability to increase BMD, enhance microarchitecture, and establish the osteoporotic rabbit vertebroplasty model as a valuable testing platform.


A
Z-Score
Weeks pre-Vertebroplasty
B
BMD (K2HP4 mg/cc)
Weeks pre-Vertebroplasty
C
Weeks Post-Vertebroplasty
Cellulosic
PMMA
Cellulosic Control
PMMA Control
D

Poster 19

Clinical Outcomes of the Prone Transpsoas Lumbar Interbody Fusion Technique: One Year Outcomes

Singh Hardeep, MD[1], Wellington Ian, MD[1], Zeng Francine, MD[1], Antonacci Christopher, MD[1], Mancini Michael, MD[1], Mohamed Mirghani, BS[1], Mallozzi Scott, MD[1], Broska Joellen, MPH[1], Moss Isaac, MD, MS, FRCS(C)[1]
[1] University of Connecticut Health Center, Farmington, Connecticut, United States

Background/Introduction: Lateral lumbar interbody fusion (LLIF) is a common approach utilized to address various lumbar spine pathologies. The prone transpsoas (PTP) is an innovative way of performing a LLIF, providing access to both the anterior and posterior columns of the spine. The aim of this study was to review and investigate the one-year outcomes of LLIF performed via PTP approach with respect to radiographic parameters, patient-reported outcomes measures (PROMs) and complication rates.

Materials/Methods: This was a retrospective review of 97 consecutive patients (161 levels), who underwent a LLIF via PTP approach. Radiographic parameters including lumbar lordosis, segmental lordosis, anterior disc height, and posterior disc height were measured on preoperative, initial postoperative, and 1-year postoperative visits. PROMs including Oswestry Disability Index, visual analog scale (VAS), and pain portions of EQ5D, VAS back, and VAS leg ratings, and postoperative complications were collected.

Results: 97 consecutive patients underwent 161 levels of LLIF. 57% underwent 1 level LLIF, 30% underwent 2 level LLIF, 6% underwent 3 level LLIF, and 7% underwent 4 level LLIF. The most common level of LLIF was L4-5 (35%), followed by L3-4 (33%), L2-3 (21%), and L1-2 (11%). Significant improvements were noted at initial (2deg+/-10deg, $P=0.049$) and 1 year (3deg+/-9deg, $P=0.005$) postoperative periods in lumbar lordosis, segmental lordosis (6deg+/-5deg, $P<0.001$; 5deg+/-5deg, $P<0.001$), anterior disc height (8mm+/-4mm, $P<0.001$; 7mm+/-4mm, $P<0.001$), and posterior disc height (3mm+/-2mm, $P<0.001$; 3mm+/-2mm, $P<0.001$). Significant improvements were seen in ODI at 6 weeks ($P=0.002$), 6 months ($P<0.001$), and 1 year ($P<0.001$) post op; pain EQ5D at 6 weeks ($P<0.001$), 6 months ($P<0.001$), and 1 year ($P<0.001$) post op; leg & back VAS at 2 weeks ($P<0.001$), 6 months ($P<0.001$), and 1 year ($P<0.001$) post op. The average length of stay was 2.5+/-4.5 days, most common complications were ipsilateral hip flexor pain (46%) and weakness (59%), and contralateral hip flexor pain (29%).

Discussion/Conclusion: PTP is a novel way of performing LLIF, allowing simultaneous access to both anterior and posterior columns of the spine. Our one-year data supports that PTP is an effective, safe, and viable approach with similar PROMs and complications profile as LLIF performed in the direct lateral decubitis position.

Poster 20

A Scoring System to Predict Motor Deficit in Ballistic Lumbosacral Spine Fractures

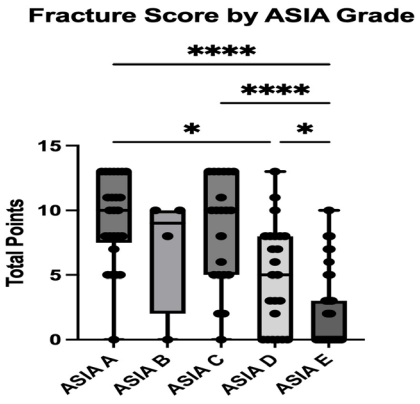
Johnson Christopher, MD, PhD[1], Batbold Anudariya, MD, PhD[2], Lee Michael, MD[1], El DaFrawy Mostafa, MBBCh[1]
[1] University of Chicago, Chicago, Illinois, United States, [2] University of Chicago Medical Center, Chicago, Illinois, United States

Background/Introduction: Civilian gunshot injuries to the lumbosacral spine are an increasingly common problem. These patients often have multiple organ injuries which can limit the initial neurologic evaluation. Our previous work has shown that the presence of a neurological deficit can be predicted based upon the fracture pattern, with an intra-canal trajectory, pedicle fracture, and facet fracture being highly correlated with neurologic deficit (Johnson et al, The Spine Journal, 2023). We extended these findings to develop a scoring system to predict neurologic deficit.

Materials/Methods: IRB approval was obtained to perform retrospective chart review of consecutive patients presenting to a single level 1 trauma center that sustained a ballistic fracture involving the L1-S2 levels from 5/2018 to 11/2022. Cross-sectional imaging was reviewed and fracture morphology was determined. Fracture patterns were then scored using the following points system: intracanal trajectory = 5, pedicle = 3, facet = 3, lamina = 2, isolated spinous process = 0, isolated transverse process = 0. Scores were then assigned and sorted by associated ASIA grade. A Kruskal-Wallis multivariate analysis was performed using Dunn's multiple comparison test.

Results: 148 patients were identified and included in the analysis. Total scores were plotted for each ASIA grade (Figure 1). The average scores (mean+/-SD) were 1.92+/-2.71 for ASIA E, 5.00+/-3.99 for ASIA D, 8.43+/-4.19 for ASIA C, 7.00+/-4.76 for ASIA B, and 9.28+/-3.43 for ASIA A. Multiple comparison testing showed a significant difference between ASIA A and ASIA C injuries compared to ASIA E ($p < 0.0001$), ASIA E vs. ASIA D ($p < 0.05$), and ASIA D vs. ASIA A ($p < 0.05$).

Discussion/Conclusion: This is the first injury scoring system applied to ballistic spine injuries. In general, high scores are associated with a motor deficit (ASIA A-D) and low scores are associated with ASIA E status. The scoring system was able to statistically separate neurological deficit from ASIA E injuries. ASIA B injuries were not adequately powered given there were only 4 in the dataset. This scoring system provides a tool to help identify patients with injuries that have a high probability of being associated with neurologic deficit.


Fracture Score by ASIA Grade
****
****
*
*
Total Points
15
10
5
0
ASIA A
ASIA B
ASIA C
ASIA D
ASIA E

Poster 21

The Impact of Lumbar Bracing on Patient-Reported Outcomes In Short Lumbar Fusion

Opara Olivia, BS[1], Narayanan Rajkishen, MD[2], Kohring Adam, DO[3], Lee Yunsoo, MD[4], Carey Preston, BS[1], Kirkpatrick Quinn, BS[1], Canseco Jose, MD, PhD[1], Hilibrand Alan, MD[1], Vaccaro Alexander, MD, PhD, MBA[1], Kepler Christopher, MD, MBA[1], Schroeder Gregory, MD[1]
[1] Rothman Institute at Thomas Jefferson University, Philadelphia, Pennsylvania, United States, [2] Department of Orthopaedic Surgery, Rothman Institute, Thomas Jefferson University, Philadelphia, Pennsylvania, United States, [3] Thomas Jefferson University, Philadelphia, Pennsylvania, United States, [4] Rothman Institute, Philadelphia, Pennsylvania, United States

Background/Introduction: The use of postoperative bracing after spine fusion surgery is not consistent amongst providers in clinical practice. Among some orthopaedic spine surgeons, the efficacy and indications of these devices after lumbar fusion surgery remains controversial. This study aims to assess the effect of bracing on patient-reported outcome measures (PROMs) on short lumbar fusion surgeries.

Materials/Methods: Retrospective analysis of patients from a single tertiary-referral care center who underwent 1-2 level PLDF/TLIF with or without bracing were identified between 2015 and 2020. Patients were grouped into brace use and no brace. Patient demographics, surgical characteristics, and outcomes were collected from the electronic medical records. Patients with braces were identified from chart review, and the type of lumbar brace administered was an off-the-shelf Lumbar Sacral Orthosis (LSO). Patient-reported outcome measures (PROMs) were collected at baseline, 3, 6, and 12 months postoperatively. PROMs included VAS-back/leg score, Oswestry Disability Index (ODI), Mental health Component Score (MCS-12), and Physical Component Scores (PCS-12). ΔPROMS score was calculated by subtracting preoperative from postoperative values. Bivariate analysis was performed based on groupings, and multivariate linear regression was used to identify factors independently associated with ΔPROMs.

Results: Of the 170 identified, 83 patients were treated with no brace, and 87 were treated with a brace. There was no significant difference in revisions within 60 days and less than 90-day readmissions (P=1.000) among patients in both groups. Compared to the no-bracing group, patients treated with bracing demonstrated a significant increase in the 1-year MCS-12 postoperatively (48.3 vs. 51.8 p=0.032). When accounting for significant predictors in the multi-regression analysis, bracing had no considerable effect on ΔPROMS at three months (ODI, VAS Back, VAS Leg, PCS, and MCS). However, consistent with bivariate analysis, multivariate linear regression of 1-year ΔPROMs identified bracing as an independent predictor of improved MCS-12 scores (β= 5.08, 95% CI: 0.13 to 10.02, P=0.044)

Discussion/Conclusion: Postoperative bracing following 1-2 level PLDF and TLIF surgery did not significantly affect PROMS except for MCS-12 at one year. This may imply that bracing may have a potential psychosomatic benefit for certain patients at one year following surgery.

Poster 22

The Role of L1PA in Patient Reported Outcomes in Patients Undergoing Single Level Lumbar Fusion for Degenerative Spondylolisthesis

Carter Michael, BS[1], Narayanan Rajkishen, MD[1], Toci Gregory, BS[2], Lee Yunsoo, MD[3], McCurdy Michael, MD[4], Dougherty Conor, BS[1], Spracklen Henley, BS[1], Costantino Jake, BS[1], Fras Sebastian, BS[1], Kepler Christopher, MD, MBA[4], Hilibrand Alan, MD[4], Schroeder Gregory, MD[4], Vaccaro Alexander, MD, PhD, MBA[4], Canseco Jose, MD, PhD[4], Lee Joseph, MD[4]
[1] Department of Orthopaedic Surgery, Rothman Institute, Thomas Jefferson University, Philadelphia, Pennsylvania, United States, [2] Rothman Institute, Thomas Jefferson University Hosptial, Philadelphia, Pennsylvania, United States, [3] Rothman Institute, Philadelphia, Pennsylvania, United States, [4] Rothman Institute at Thomas Jefferson University, Philadelphia, Pennsylvania, United States

Background/Introduction: The L1 pelvic angle (L1PA) is an angle drawn from the femoral head that is parallel to the sacral end plate midpoint and a line drawn from the femoral head to L1. L1PA has been shown to be beneficial in the evaluation of pre and postoperative quality of life outcomes in patients with spinal deformities. Prior deformity studies propose an optimal postoperative L1PA as <7.2° and recommend that spine surgeons intraoperatively correct patient spines to this angle to optimize postoperative recovery. There are no prior studies examining the utility of L1PA in the management of patients with degenerative spinal disease.

Materials/Methods: Patients >18 years who underwent either an L4-L5 posterolateral decompression and instrumented fusion or transforaminal lumbar interbody fusion for degenerative lumbar spondylolisthesis were studied. Patients were grouped by preoperative and postoperative L1PA measurements >7.2° and <7.2°. Preoperative, one year postoperative and Δ (postoperative minus preoperative) patient reported outcome measures (PROMs) were collected for each patient including the Oswestry Disability Index (ODI), Physical Component and Mental Component Score of the Short Form-12 Health Survey (PCS-12 and MCS-12, respectively), and Visual analog scale Back (VAS back) and Leg (VAS leg) pain scores. Preoperative, postoperative and Δ radiographic measurements recorded were pelvic incidence (PI), lumbar lordosis (LL), pelvic incidence minus lumbar lordosis (PI-LL), pelvic tilt (PT), and sacral slope (SS).

Results: 24 patients were identified with preoperative L1PA<7.2° and 132 with L1PA >7.2°. 18 patients were identified with a postoperative L1PA<7.2° and 138 with L1PA >7.2°. No statistically significant differences existed between either cohorts with respect to preoperative, one year postoperative and ΔPROM measurements. Running L1PA as a continuous variable and comparing it to the PROMS also failed to establish a new threshold for which PROM outcomes were statistically different. Radiographically, L1PA was well correlated with pelvic tilt, pelvic incidence and pelvic incidence minus lumbar lordosis.

Discussion/Conclusion: Pre- and postoperative L1PA does not appear to be predictive of patient reported outcomes in patients with short segment lumbar fusions for degenerative disease. In

contrast to deformity larger spinal deformity, addressing L1 PA in shorter segment degenerative disease may not be as necessary for successful patient outcomes.

Postoperative Patient Reported Outcome Measures (PROMS) for Pre and Postoperative L1PA Cohorts

	Preoperative L1PA			Postoperative L1PA		
	L1PA < 7.2° (N=24)	L1PA > 7.2° (N=132)	P Value	L1PA < 7.2° (N=18)	L1PA > 7.2° (N=138)	P Value
Pre Op ODI	44.5 (17.2)	46.9 (18.1)	0.536	46.0 (17.2)	46.6 (18.1)	0.889
Post Op ODI	18.6 (18.3)	22.9 (20.1)	0.298	23.9 (20.5)	22.0 (19.8)	0.558
Delta ODI	-25.92 (20.3)	-24.09 (20.1)	0.687	-22.11 (20.2)	-24.66 (20.1)	0.619
MCID ODI Present	20 (83.3%)	111 (84.1%)	1.000	14 (77.8%)	117 (84.8%)	0.493
Pre Op PCS	32.1 (8.61)	30.0 (8.23)	0.237	32.1 (7.84)	30.1 (8.36)	0.236
Post Op PCS	43.8 (10.2)	39.6 (11.3)	0.084	40.4 (12.2)	40.2 (11.1)	0.863
Delta PCS	11.6 (10.6)	9.62 (11.0)	0.399	8.28 (10.4)	10.1 (11.0)	0.484
MCID PCS Present	14 (58.3%)	68 (51.5%)	0.694	8 (44.4%)	74 (53.6%)	0.629
Pre Op MCS	47.7 (11.4)	48.0 (10.9)	0.973	45.4 (10.3)	48.3 (11.1)	0.265
Post Op MCS	50.3 (8.58)	52.9 (10.2)	0.091	49.1 (9.49)	53.0 (9.98)	0.059
Delta MCS	2.62 (9.24)	4.93 (11.6)	0.286	3.69 (7.07)	4.69 (11.7)	0.610
MCID MCS Present	5 (20.8%)	44 (33.3%)	0.330	4 (22.2%)	45 (32.6%)	0.533
Pre Op VAS Back	5.71 (2.78)	6.13 (3.03)	0.377	6.30 (2.61)	6.03 (3.04)	0.920
Post Op VAS Back	2.84 (2.59)	3.12 (3.04)	0.996	3.00 (2.74)	3.08 (3.00)	0.757
Delta VAS Back	6.07 (2.99)	-3.02 (3.87)	0.482	-3.31 (3.54)	-2.95 (3.78)	0.980
Pre Op VAS Leg	7.42 (2.46)	6.44 (2.83)	0.097	7.49 (2.23)	6.47 (2.84)	0.143
Post Op VAS Leg	3.09 (3.02)	2.89 (3.08)	0.876	3.02 (3.41)	2.91 (3.02)	0.991
Delta VAS Leg	-4.33 (3.54)	-3.55 (3.92)	0.411	-4.46 (3.31)	-3.57 (3.93)	0.464

Data listed as either: mean (SD) or n (%)

ODI= Oswestry Disability Index

PCS= Physical Component Score (part of Short Form-12 Health Survey)

MCS= Mental Component Score (part of Short Form-12 Health Survey)

VAS= Visual Analogue Scale

MCID= Minimally Clinically Important Difference

Poster 23

ChatGPT in Clinical Diagnosis and Management of Degenerative Lumbar Spondylolisthesis: A Comparison With NASS Guidelines

Tao Xu, BS[1], Garcia-Vargas Julia, MS[1], Karnati Janesh, BA[1], Shankar Sachin, MS[1], Ashraf Ahmed, BA[1], Wu Andrew, BS[1], Agyeman Nana, BS[1], Childress Kelly, BS[1], Garner Rebecca, MD[1], Ranganathan Sruthi, MBBS[2], Van Halm-Lutterodt Nicholas, MD[3], Cheng Joseph, MD[1], Adogwa Owoicho, MD[1]

[1] University of Cincinnati College of Medicine, Cincinnati, Ohio, United States, [2] University of Cambridge School of Clinical Medicine, Cambridge, , United Kingdom, [3] Brown University School of Public Health, Providence, Rhode Island, United States

Background/Introduction: ChatGPT's popularity has been explosive since its release in 2022. It has been successfully used in a variety of settings. Most notably, ChatGPT passed all the USMLE Step Exams, indicating a potential use in undergraduate and graduate medical education. ChatGPT has also demonstrated a 71.7% overall accuracy when its responses were compared to vignettes from the Merck Sharp & Dohme (MSD) Clinical Manual. However, there remains a paucity of research into its viability as a clinical tool.

Materials/Methods: We evaluated ChatGPT's ability to match the 2014 NASS guideline for DLS and the rationale supporting their recommendations. Questions were organized into three separate categories - "Non-Surgical", "Surgical" and "Other" - and individually submitted to ChatGPT (version 3.5). Questions not addressed in the guideline due to the paucity of literature were excluded. Responses were compared to the 2014 NASS guideline and graded by a group of researchers and clinicians as good matches, partially good matches, or poor matches.

Results: For Non-Surgical Treatment Criteria, 100% of ChatGPT's answers were poor matches. For Surgical Treatment Criteria, ChatGPT produced 33.3% good matches, 50% partially good matches, and 16.7% poor matches. For the "Other" Criteria, ChatGPT answer were 33.3% good matches, 33.3% partially good matches, 33.3% poor matches.

Discussion/Conclusion: ChatGPT plays a limited role in the clinical environment, specifically in offering advice in non-surgical management of DLS. It is important to use caution when employing ChatGPT as a medical tool, as it is currently not recommended for standalone use. Additional research is needed to assess the viability and reliability of ChatGPT as a resource before considering widespread adoption in clinical practice.

Poster 24

Comparison of Sarcopenia, Frailty, and Area Deprivation Index for Predicting Mortality and Adverse Events in Thoracolumbar Trauma

Shear Brian, MD[1], Chiu Anthony, BS[1], Stombler Adam, BS[1], Bustos Sabrina, BS[1], Ratanpal Amit, BS[1], Sahlani Mario, MD[1], Lutz Alexandra, MD[1], Ruditsky Alexander, MD[1], Pease Tyler, BS[2], Smith Ryan, BS[2], Karri Jay, MD[1], Bivona Louis, MD[1], Jauregui Julio, MD[2], Cavanaugh Daniel, MD[2], Koh Eugene, MD, PhD[2], Ludwig Steven, MD[2]
[1] University of Maryland Medical Center, Baltimore, Maryland, United States, [2] University of Maryland School of Medicine, University of Maryland Medical Center, Baltimore, Maryland, United States

Background/Introduction: Sarcopenia is a progressive musculoskeletal disorder characterized by the loss of muscle mass and function. Recently, it has gained recognition as an important surgical risk factor. Prior studies have demonstrated its association with adverse outcomes in spine surgery for degenerative, deformity, and neoplastic indications. Currently, there is a dearth of literature investigating the role of sarcopenia in thoracolumbar trauma. The purpose of this study was to compare sarcopenia to two other risk factors of interest in thoracolumbar trauma patients: frailty and socioeconomic deprivation.

Materials/Methods: A retrospective study was conducted at a single urban academic level 1 trauma center. Adult patients who underwent surgical treatment for thoracolumbar trauma were identified from the institutional trauma registry. Sarcopenia was measured using the total psoas area over vertebral body area (TPA/VBA) at the axial midsection of the L3 vertebral body on computed tomography (CT) scan. Area deprivation index (ADI) was determined according to the publicly available Neighborhood Atlas dataset. Frailty was measured using the modified 5-factor frailty index (5-MFI). The primary outcome of interest was postoperative mortality, with secondary outcomes being revision surgery and the occurrence of adverse events. Statistical analysis consisted of univariate and multivariate logistic regression analysis controlling for demographics and polytraumatic injuries.

Results: A total of 284 patients were included in the analysis. The L3 TPA/VBA ranged from 0.55 to 5.64, with a median of 2.11. Most patients had a 5-MFI of 0 (64.8%), followed by 1 (23.2%), 2 (9.2%), and 3 (2.8%). The ADIs were divided into national quartiles, with 37.0% of patients in the 1st quartile, 38.7% in the 2nd, 16.9% in the 3rd, and 6.3% in the 4th. A total of 22 (7.75%) mortalities occurred, with 18 (6.33%) occurring within 90-days postoperatively. On univariate analysis, only 5-MFI was associated with overall mortality (OR=2.33, P<0.001). On multivariate analysis, none of sarcopenia, ADI, or 5-MFI were significantly associated with mortality, revision, or the occurrence of adverse events.

Discussion/Conclusion: Frailty is a better predictor of mortality in thoracolumbar trauma when compared to sarcopenia and ADI. However, none are strong independent predictors and the reasons for mortality in this population are multifactorial.

Comparison of Sarcopenia, Modified Frailty Index, and Area Deprivation Index Predictors in Thoracolumbar Trauma Patients

Outcome	Odds Ratio	95% CI	P-Value*
L3-TPA/VBA			
Overall Mortality	0.72	[0.48-1.08]	0.117
1-Month Mortality	0.75	[0.44-1.28]	0.296
3-Month Mortality	0.79	[0.51-1.22]	0.28
Any Adverse Event	0.98	[0.79-1.21]	0.828
Revision	1.36	[0.83-2.24]	0.226
5-Factor Modified Frailty Index			
Overall Mortality	**2.33**	[1.49-3.66]	**<0.001**
1-Month Mortality	**2.46**	[1.40-4.35]	**0.002**
3-Month Mortality	**2.66**	[1.63-4.32]	**<0.001**
Any Adverse Event	1.16	[0.85-1.60]	0.347
Revision	1	[0.50-2.00]	1
Area Deprivation Index Quartile			
Overall Mortality	1.57	[0.50-4.96]	0.443
1-Month Mortality	0.95	[0.19-4.83]	0.954
3-Month Mortality	1.15	[0.34-3.90]	0.818
Any Adverse Event	0.85	[0.49-1.48]	0.559
Revision	1.36	[0.42-4.42]	0.61

L3-TPA/VBA = total psoas area over vertebral body area at L3 axial midsection

*Univariate logistic regression

Poster 25

Predictors and Postoperative Complication Risks for Revision Discectomies Following Primary Lumbar Microdiscectomy

Ton Andy, BS[1], Han Jane, BS[1], Mertz Kevin, MD[2], Avetisian Henry, BS[1], Hang Nicole, BS[1], Mills Emily, MD[3], Wang Jeffrey, MD[4], Hah Raymond, MD[4], Alluri Ram, MD[1]
[1] University of Southern California Keck School of Medicine, Los Angeles, California, United States, [2] Harbor-UCLA Medical Center, Torrance, California, United States, [3] Department of Orthopaedic Surgery, Keck School of Medicine, University of Southern California, Los Angeles, California, United States, [4] Keck Medical Center of USC, Los Angeles, California, United States

Background/Introduction: Lumbar microdiscectomies (MD) are among the most common spine procedures in the United States. Patients may, however, develop subsequent reherniations requiring revision discectomy. The objective of this study is twofold: 1) outline demographic and clinical predictors for revision discectomy and 2) compare postoperative complications between primary MD and revision discectomy.

Materials/Methods: Patients who underwent primary lumbar MD from 2010 to 2021 were identified using the PearlDiver National database. Patient diagnoses and procedures were obtained using International Classification of Disease, Ninth, Tenth Revision (ICD-9, ICD-10) and Current Procedural Terminology (CPT) codes. Exclusion criteria were as follows: myelopathy, fusion procedures, simultaneous cervical surgery, trauma, infection, and malignancy. Patients who underwent subsequent revision discectomy were separately identified. Univariate analysis was performed to identify demographic differences, followed by multiple logistic regression to identify independent predictors for revision discectomy. Nearest-neighbor 1:1 propensity-matching was conducted to match primary MD and revision discectomy cohorts by age, sex, Elixhauser comorbidity index (ECI), obesity, smoking, number of levels, and other comorbidities. Postoperative complications were compared using Pearson's chi-squared analysis with odds ratios (ORs).

Results: Overall, 49,681 patients underwent primary lumbar microdiscectomy (52.5% male, 47.5% female) with 3,114 (6.27%) requiring subsequent revision discectomy (53.2% male, 46.8% female). Patients undergoing revision discectomy were slightly younger (49.7+14 vs. 47.9+13 years; $p<0.001$) and were more frequently associated with smoking (21.9% vs. 26.7%; $p<0.001$), obesity class I (13.4% vs. 14.9%; $p=0.019$), excessive alcohol use (6.4% vs. 7.8%; $p=0.002$), coagulopathies (5.6% vs. 6.5%; $p=0.035$), depression (37.4% vs. 44.3%; $p<0.001$), and preoperative opioid use (60.9% vs. 64.4%; $p<0.001$). Male sex (OR:1.08; $p=0.04$), smoking (OR:1.23; $p<0.001$), depression (OR:1.32; $p<0.001$), and persistent postoperative opioid use (OR:1.10; $p=0.034$) as independent predictors for revision discectomy. Revision discectomy was further associated with greater risk of neurological complications (OR:1.43; $p<0.001$), epidural hematoma (OR: 5.356; $p=0.006$), disc reherniation at all timepoints (all $p<0.001$), and need for further decompression at six-, eight- and ten years postoperatively (all $p<0.05$).

Discussion/Conclusion: Predictors for revision discectomy after primary lumbar MD included

male sex, obesity, smoking, and depression. Revision discectomy was associated with significantly greater risk of reherniation and additional need for decompression out to ten years postoperatively.

Complications	Primary Microdiscectomy (n=3,114)	Revision Discectomy (n=3,114)	Odds Ratio (OR)	95% CI	p-value
Infection	14 (0.45%)	19 (0.61%)	1.359	0.68 to 2.72	0.485
AKI	14 (0.45%)	0 (0.00%)	0.570	0.24 to 1.36	0.286
VTE	29 (0.93%)	22 (0.71%)	0.757	0.43 to 1.32	0.399
Dehiscence	14 (0.45%)	16 (0.51%)	1.144	0.56 to 2.35	0.855
Neurological Injury	1,114 (35.77%)	1,239 (39.79%)	1.186	1.07 to 1.31	**p=0.001**
Durotomy	7 (0.23%)	12 (0.39%)	1.717	0.68 to 4.37	0.358
Epidural Hematoma	≤10	16 (0.51%)	5.356	1.56 to 18.4	**0.006**
Novel Postoperative Lumbar Pain	839 (26.94%)	956 (30.70%)	1.201	1.08 to 1.34	**p<0.001**
Postoperative Radiculopathy	982 (31.54%)	1,086 (34.87%)	1.163	1.05 to 1.29	**0.006**
All Short-Term Complications	1,522 (48.88%)	1,689 (54.24%)	1.240	1.12 to 1.37	**p<0.001**
I&D	20 (0.64%)	22 (0.71%)	1.101	0.60 to 2.02	0.877
Opioid Use					
1 Month	1,821 (58.48%)	1,826 (58.64%)	1.007	0.91 to 1.11	0.920
6 Months	367 (11.79%)	409 (13.13%)	1.132	0.97 to 1.31	0.116
12 Months	144 (4.62%)	158 (5.07%)	1.102	0.88 to 1.39	0.443
Disc Reherniation					**all p<0.001**
2 Years	656 (16.1%)	906 (22.2%)	1.537	1.37 to 1.73	
4 Years	122 (3.4%)	228 (6.4%)	1.720	1.54 to 1.92	
6 Years	131 (4.2%)	173 (5.5%)	1.755	1.58 to 1.95	
8 Years	89 (3.8%)	112 (4.8%)	1.775	1.60 to 1.97	
10 Years	36 (2.7%)	55 (4.1%)	1.808	1.63 to 2.00	
Additional Decompression					
2 Years	270 (6.6%)	279 (6.9%)	1.037	0.87 to 1.24	0.721
4 Years	38 (1.1%)	66 (1.9%)	1.135	0.96 to 1.34	0.137
6 Years	**19 (0.6%)**	**35 (1.1%)**	**1.185**	**1.01 to 1.39**	**0.038**
8 Years	**11 (0.5%)**	**25 (1.1%)**	**1.228**	**1.05 to 1.43**	**0.010**
10 Years	**10 (0.7%)**	**4 (0.3%)**	**1.202**	**1.03 to 1.40**	**0.020**

Table 1. Comparison of 30-day postoperative complication rates, opioid use, lumbar disc reherniation, and additional lumbar decompression procedures between propensity-matched primary microdiscectomy and revision discectomy cohorts. *AKI = acute kidney injury, VTE = venous thromboembolism, I&D = incision and drainage.*

* = Percentages are calculated as a proportion of the total number of patients with sufficient follow-up at each corresponding timepoint. All timepoints were assessed independently.

Poster 26

Evaluation of Perioperative Care and Drivers of Cost in Geriatric Thoraco-Lumbar Fractures

Tarawneh Omar, MS[1], Narayanan Rajkishen, MD[1], McCurdy Michael, MD[2], Issa Tariq, BS[1], Lee Yunsoo, MD[3], Opara Olivia, BS[2], Pohl Nicholas, MS[1], Tomlak Alexa, BS[1], Sherman Matthew, BS[1], Canseco Jose, MD, PhD[2], Hilibrand Alan, MD[2], Vaccaro Alexander, MD, PhD, MBA[2], Schroeder Gregory, MD[2], Kepler Christopher, MD, MBA[2]
[1] Department of Orthopaedic Surgery, Rothman Institute, Thomas Jefferson University, Philadelphia, Pennsylvania, United States, [2] Rothman Institute at Thomas Jefferson University, Philadelphia, Pennsylvania, United States, [3] Rothman Institute, Philadelphia, Pennsylvania, United States

Background/Introduction: As the population of elderly patients continues to rise, the number of these individuals presenting with thoracolumbar fractures is expected to increase. The purpose of this study was therefore to examine the patient profile of elderly patients presenting with a thoracolumbar fracture requiring surgery. Specifically, we sought to examine the role that decade of life may play among patients aged 60-69 (sexagenarian), 70-79 (septuagenarian), and 80-89 (octogenarian) on thoracolumbar fusion perioperative outcomes. Secondarily, we aimed to characterize the variability of cost associated with thoracolumbar fractures while identifying drivers of cost of care in the geriatric population. This work will provide valuable information as the number of elderly patients presenting with lumbar fractures continues to rise.

Materials/Methods: We queried the United States Nationwide Inpatient Sample(NIS) for adult patients undergoing spinal fusion for thoracolumbar fractures between 2012-2017. Patients were stratified by decade 60-69(sexagenarians), 70-79(septuagenarians) and 80-89(octogenarians).Bivariable analysis followed by multivariable regression was performed to assess independent predictors of length of stay(LOS), cost, and discharge disposition.

Results: A total of 2,767 patients were included, of which 46%(N=1,268) were sexagenarians, 36% septuagenarians and 18%(N=502) octogenarians. Septuagenarians and octogenarians had shorter LOS compared to sexagenarians(ß = -0.88 days; p=0.012) and(ß =-1.78; p < 0.001), respectively. LOS was reduced with posterior approach(-2.46 days[95% CI:-3.73–1.19]; p<0.001), while Hispanic patients had longer LOS(+1.97 [95% CI: 0.81–3.13]; p<0.001). Septuagenarians had lower total charges $12,185.70(p=0.040), while the decrease in charges in octogenarians was more significant, with a decrease of $26,016.30(p<0.001) as compared to sexagenarians. Posterior approach was associated with a decrease of $24,337.90 in total charges(p=0.026). Septuagenarians and octogenarians had 1.72 higher odds(p<0.001) and 4.16 higher odds(p<0.001), respectively, of discharge to a skilled nursing facility.

Discussion/Conclusion: Older patients undergoing fusion for thoracolumbar fractures had shorter LOS and reduced hospital cost. However, these patients had a higher likelihood of discharge to SNFs and acute inpatient rehabilitation. Additionally, our findings highlight a healthcare disparity in thoracolumbar fracture, as Hispanic patients experienced dramatically

longer LOS and associated costs. The observations highlight the need for increased research to further understand drivers of cost associated with current perioperative care strategies and policy considerations among this vulnerable population.

Poster 27

Applying GPT-4 to Automate Patient-Facing Communication of Spine Imaging Reports: A Pilot Study

Khazanchi Rushmin, BA[1], Chen Austin, BS[2], Follett Matthew, MD[1], Staub Jacob, BS[1], Balu Abhinav, BS[2], Hsu Wellington, MD[1], Patel Alpesh, MD, MBA[1], Divi Srikanth, MD[1]
[1] Northwestern University Department of Orthopaedic Surgery, Chicago, IL, , United States, [2] Northwestern University Feinberg School of Medicine, Northwestern, Chicago, Illinois, United States

Background/Introduction: As patients gain increased access to their healthcare data, attention must be drawn toward comprehension. For example, radiologist interpretations of spine imaging studies are written for medical professionals, but an operative candidate's understanding of this information is crucial to the shared decision-making process. Individual report summarization by a surgeon is a time-intensive task; therefore, we assessed the ability of a large-language model (LLM), GPT-4, to automate the simplification of preoperative spine MRIs.

Materials/Methods: Preoperative spine MRIs from patients that underwent lumbar fusion and/or decompression for degenerative spondylolisthesis in 2022 were retrospectively queried at a tertiary, academic medical center. Reports were deidentified and input into the GPT-4 API with the prompt: "Please translate a radiology report into plain language that is easy to understand". Default settings were used apart from setting temperature to 0 to maximize reproducibility. Output word counts and Flesch-Kincaid reading levels were compared to original reports with paired t-tests and Chi-square tests, respectively. A trained orthopaedic spine surgeon reviewed all translated radiographic reports for inaccuracies and omissions from the original reports. These a priori grading criteria were focused on information a spine surgeon would want their patient to understand, including the following minor criteria (presence of mild/moderate degenerative changes and mild/moderate canal narrowing) and major criteria (nerve compression, signs of instability, failure to describe stenosis severity, and failure to describe the location of stenosis).

Results: Of 40 included reports, the average word count was 374 ± 116 with a mode reading level of 12th grade (33%). The GPT translations had a similar word count (406 ± 79, $p = 0.1383$) with a lower reading level distribution (mode: 9th grade [35%], $p = 0.0017$) (Table 1). Five (13%) of translations were indicated to have a major inaccuracy while 23 (58%) had a major omission.

Discussion/Conclusion: In our pilot cohort, GPT-4 significantly improved the readability of preoperative spine MRI radiology reports. While summarizations rarely included inaccuracies, omissions were more common. This highlights GPTs lack of domain-specific information, likely secondary to the lack of healthcare data in its development. More focused training data is required before LLMs can competently augment this spine surgeon's task.

Table 1. *Original radiology reports versus GPT summarizations, n = 40*

	Original	GPT	p-value
Word Count (Mean [SD])	374 (117)	406 (79)	0.1383
FK Grade Level (%)			0.0017
6th	0%	10%	
7th	3%	15%	
8th	0%	20%	
9th	8%	35%	
10th	13%	15%	
11th	25%	0%	
12th	33%	5%	
13th	8%	0%	
14th	13%	0%	
Accuracy (n [%])			
Major inaccuracies (> 0)	-	5 (13%)	
Minor inaccuracies (> 0)	-	1 (3%)	
Major omissions (> 0)	-	23 (58%)	
Minor omissions (> 0)	-	0 (0%)	

Poster 28

Is Transforaminal Lumbar Interbody Fusion or Posterior Lumbar Decompression and Fusion Superior for Different Grades of Degenerative Spondylolisthesis? An Analysis of 1-Year Clinical Outcomes

Ezeonu Teeto, BS[1], Giakas Alec, MD[2], Narayanan Rajkishen, MD[2], Lee Yunsoo, MD[3], Carter Michael, BS[2], Alvaro Catherine, BS[1], Christianson Alexander, BS[4], Pena Jose, BS[1], Thomas Nathan, BS[5], Canseco Jose, MD, PhD[6], Hilibrand Alan, MD[6], Vaccaro Alexander, MD, PhD, MBA[6], Schroeder Gregory, MD[6], Kepler Christopher, MD, MBA[6]

[1] Sidney Kimmel Medical College at Thomas Jefferson Iniversity, Philadelphia, Pennsylvania, United States, [2] Department of Orthopaedic Surgery, Rothman Institute, Thomas Jefferson University, Philadelphia, Pennsylvania, United States, [3] Rothman Institute, Philadelphia, Pennsylvania, United States, [4] Philadelphia College of Osteopathic Medicine, Philadelphia, Pennsylvania, United States, [5] Drexel University College of Medicine, Philadelphia, Pennsylvania, United States, [6] Rothman Institute at Thomas Jefferson University, Philadelphia, Pennsylvania, United States

Background/Introduction: Despite the significant prevalence and high disease burden of degenerative spondylolisthesis (DS), consensus regarding surgical management is still lacking. Therefore, the primary objective of this study will be to identify which lumbar fusion surgical approach optimizes patient-reported outcome measures (PROMs) for varying severity levels of spondylolisthesis.

Materials/Methods: Upon obtaining IRB approval, adult patients (> 18 years old) who underwent primary single-level lumbar fusion for degenerative spondylolisthesis were retrospectively identified. Preoperative flexion-and-extension lateral radiographs were reviewed to assess severity of spondylolisthesis. DS was classified using the Meyerding grading system, as well as the validated Clinical and Radiographic Degenerative Spondylolisthesis (CARDS) classification system. PROM scores were collected preoperatively and 1-year postoperatively and included the Oswestry Disability Index (ODI), Visual Analog Scale Back and Leg (VAS Back and VAS Leg, respectively), and the mental and physical component of the short-form 12 survey (MCS and PCS).

Results: A total of 594 patients were identified. There were 260 patients (55.4% female) who underwent posterior lumbar decompression and fusion (PLDF) and 334 patients (54.5% female) who underwent transforaminal lumbar interbody fusion (TLIF). Patients in the PLDF group were older (65.9 vs. 61.5, $p<0.001$), had higher Charlson comorbidity indices (2.79 vs. 2.15, $p=0.001$), and were more likely to have a Meyerding grade of 1 (90.8% vs. 81.4%, $p=0.002$). Patients with CARDS class A spondylolisthesis experienced greater improvement in ODI (-11.02 vs. -3.06, $p=0.005$) when they underwent TLIF; however, patients with CARDS class B experienced greater ODI improvement after a PLDF (-14.33 vs. -5.45, $p<0.001$). Patients with Meyerding grade 1 spondylolisthesis experienced greater improvement in ODI (-10.15 vs. -6.27, $p=0.006$) and MCS (5.68 vs. 2.87, $p=0.011$) when they underwent PLDF compared to TLIF. There were no other differences in PROM improvement between approaches for other grades and classes.

After controlling for patient characteristics, these differences persisted on linear regression analysis.

Discussion/Conclusion: While there are several factors to consider, these results show that PLDF may be the optimal approach for degenerative spondylolisthesis patients with milder degrees of disc slippage. In patients with more severe spondylolisthesis +/- kyphosis, we observed no difference in clinical outcomes 1 year after surgery.

1 Year Delta PROMs by Degenerative Spondylolisthesis Severity

	PLDF	TLIF	p-value
CARDS Class A			
Delta ODI	-3.06 (8.08)	-11.02 (16.5)	**0.005***
Delta MCS	6.12 (11.4)	6.45 (14.7)	0.908
Delta PCS	1.85 (4.93)	2.76 (6.28)	0.476
Delta VAS Back	-2.74 (3.29)	-3.28 (3.45)	0.479
Delta VAS Leg	-3.24 (3.76)	-3.55 (4.03)	0.729
CARDS Class B			
Delta ODI	-14.33 (18.7)	-5.45 (12.6)	**<0.001***
Delta MCS	6.13 (12.6)	2.76 (12.3)	0.056
Delta PCS	4.80 (9.87)	3.04 (7.34)	0.154
Delta VAS Back	-2.87 (3.18)	-2.75 (3.14)	0.777
Delta VAS Leg	-4.26 (3.35)	-3.90 (3.36)	0.448
CARDS Class C			
Delta ODI	-7.52 (16.0)	-8.00 (15.6)	0.812
Delta MCS	4.89 (13.2)	2.48 (11.2)	0.128
Delta PCS	3.95 (9.23)	3.29 (8.67)	0.563)
Delta VAS Back	-3.51 (3.02)	-3.16 (3.12)	0.363
Delta VAS Leg	-3.99 (3.74)	-3.71 (3.66)	0.558
CARDS Class D			
Delta ODI	-10.04 (16.2)	-6.36 (15.1)	0.399
Delta MCS	4.94 (16.2)	4.78 (10.8)	0.966
Delta PCS	7.46 (12.5)	4.49 (10.7)	0.361
Delta VAS Back	-2.13 (2.89)	-3.96 (3.63)	**0.046**
Delta VAS Leg	-3.66 (3.76)	-3.93 (3.33)	0.787
Meyerding Grade 1			
Delta ODI	-10.15 (17.2)	-6.27 (14.0)	**0.006***
Delta MCS	5.68 (12.8)	2.87 (11.8)	**0.011***
Delta PCS	4.34 (9.57)	2.85 (7.73)	0.056
Delta VAS Back	-3.00 (3.11)	-3.01 (3.20)	0.970
Delta VAS Leg	-4.05 (3.56)	-3.71 (3.60)	0.278
Meyerding Grade 2			
Delta ODI	-7.20 (12.8)	-13.18 (17.6)	0.088
Delta MCS	3.96 (15.4)	5.37 (13.2)	0.694
Delta PCS	4.63 (9.07)	4.95 (9.66)	0.887
Delta VAS Back	-3.42 (3.24)	-3.61 (3.32)	0.806
Delta VAS Leg	-3.21 (3.91)	-4.01 (3.59)	0.389

Abbreviations: PLDF = Posterior Lumbar Decompression and Fusion. TLIF = Transforaminal Lumbar Interbody Fusion. ODI = Oswestry Disability Index. MCS = Mental Component Score. PCS = Physical Component Score. VAS = Visual Analogue Score

*Bold values indicate statistical significance (p<0.05)

Poster 29

Risk Factors for Prolonged Opioid Use in Opioid-Naïve Patients Following Lumbar Spine Surgery: A MSSIC study

Chaker Anisse, MD[1], Kagithala Dheeraj, BS[1], Telemi Edvin, MD[1], Rademacher Anneliese, BS[1], Schultz Lonni, PhD[1], Hu Jianhui, PhD[2], Schwalb Jason, MD[2], Abdulhak Muwaffak, MD[2], Chang Victor, MD[1]
[1] Henry Ford Hospital, Detroit, Michigan, United States, [2] Henry Ford Health System, Detroit, Michigan, United States

Background/Introduction: Long term opioid prescriptions following surgical procedures can place patients at increased risk for opioid dependence. Given the ongoing opioid epidemic, pinpointing factors that contribute to extended opioid use among opioid-naïve patients is imperative to address. In this study, we identified risk factors associated with prolonged opioid usage in opioid-naïve patients undergoing lumbar spine surgery at 1-year, and 2-years post-operatively.

Materials/Methods: A Michigan Spine Surgery Improvement Collaborative (MSSIC) database search was performed for opioid-naive patients undergoing lumbar surgeries between March 2018 to September 2021. Multivariate analysis was conducted to identify which variables were associated with long-term opioid use.

Results: 6.8% and 6.3% of opioid-naïve patients were continuing to use opioids 1- and 2-years after initial surgery, respectively. Continued opioid use at 90-days was associated with an elevated risk of continued opioid use at 1-year (5.37[3.38-8.53], $p<0.001$). Patients with failure to achieve minimal clinically important differences (MCID) on Patient-Reported Outcomes Measurement Information System (PROMIS) scores at one or two years post-operatively were at an increased risk for prolonged opioid use (2.45[1.78-3.37], $p<0.001$; 3.10[2.11-4.56], $p<0.001$, respectively). Previous spine surgery was associated with increased opioid use at 2-years (1.44[1.08-1.93], $p=0.013$), while a history of depression and symptoms duration greater than 12 months were associated with continued use at 1-year (1.30[1.01-1.68], $p=0.042$, 2.13[1.04-4.36], $p=0.039$, respectively).

Discussion/Conclusion: Continued opioid use at 90-days was amongst the strongest predictor of long-term opioid use after elective lumbar spine surgery in opioid-naïve patients. Identifying and addressing risk factors that may contribute to chronic opioid use will aid surgeons in implementing targeted interventions to minimize opioid dependence postoperatively.

Risk Factors for Continued Use of Opioids at 1- and 2-Years

	Lumbar - Opioid Naïve Patients							
	Opioid Use at 1-Year (N=3,469)				Opioid Use at 2-Year (N=2,484)			
Patient Characteristics	IRR	95% CI		p-value	IRR	95% CI		*p-value*
Baseline PROMIS functional score	**0.83**	**0.72**	**0.97**	***<.05***	**0.76**	**0.65**	**0.88**	***<.001***
Baseline EQ-5D score	0.94	0.86	1.03	*0.189*	0.94	0.83	1.06	*0.291*
Baseline pain score	1.02	0.96	1.10	*0.508*	1.06	0.97	1.16	*0.194*
PHQ2 depression baseline	1.13	0.88	1.46	*0.340*	1.07	0.64	1.81	*0.788*
Private insurance	0.95	0.68	1.33	*0.749*	1.05	0.68	1.63	*0.825*
Current smoker	1.31	0.92	1.87	*0.131*	0.90	0.55	1.48	*0.691*
Age (ref: 18-64)								
65-69	0.84	0.54	1.31	*0.437*	1.59	0.99	2.54	*<.1*
70-74	0.87	0.50	1.53	*0.639*	1.04	0.60	1.81	*0.895*
75-79	1.09	0.64	1.86	*0.745*	1.05	0.56	1.96	*0.882*
80+	1.18	0.63	2.22	*0.599*	0.93	0.47	1.86	*0.845*
Female	0.98	0.73	1.32	*0.902*	1.17	0.77	1.79	*0.464*
BMI (ref: underweight or normal)								
overweight	0.92	0.60	1.41	*0.698*	1.50	0.90	2.49	*0.121*
class I obesity	1.09	0.76	1.57	*0.644*	1.57	0.93	2.66	*<.1*
class II obesity	1.09	0.74	1.63	*0.659*	1.11	0.57	2.14	*0.758*
class III obesity	0.99	0.52	1.87	*0.970*	0.85	0.45	1.58	*0.602*
Race (ref: White)								
Black	1.28	0.85	1.93	*0.236*	1.19	0.64	2.21	*0.573*
other	1.34	0.71	2.53	*0.365*	1.09	0.54	2.19	*0.804*
Education (ref: HS)								
less than HS	0.89	0.56	1.42	*0.636*	1.42	0.72	2.79	*0.311*
2-year college	0.91	0.69	1.20	*0.520*	0.96	0.64	1.45	*0.858*
4-year college +	**0.66**	**0.50**	**0.87**	***<.01***	0.95	0.67	1.36	*0.789*
Symptom duration (ref: < 3 months)								
3-12 months	1.57	0.73	3.34	*0.247*	0.76	0.47	1.23	*0.263*
>= 12 months	**2.13**	**1.04**	**4.36**	***<.05***	0.73	0.45	1.20	*0.219*
Pre-op opioid use								
ASA >2	1.07	0.81	1.41	*0.635*	0.96	0.66	1.38	*0.812*
Previous spine surgery	1.17	0.90	1.53	*0.248*	**1.44**	**1.08**	**1.93**	***<.05***
Levels: 3+	1.20	0.89	1.63	*0.238*	0.97	0.57	1.65	*0.905*
Fusion	1.16	0.93	1.44	*0.196*	1.33	0.94	1.90	*0.112*
Unemployed at baseline	0.89	0.69	1.14	*0.357*	1.14	0.73	1.76	*0.569*
History of depression	**1.30**	**1.01**	**1.68**	***<.05***	0.93	0.59	1.44	*0.732*
History of anxiety	1.02	0.74	1.42	*0.885*	**1.54**	**1.04**	**2.26**	***<.05***
Not achieve MCID: PROMIS at 1- or 2-year	**2.45**	**1.78**	**3.37**	***<.001***	**3.10**	**2.11**	**4.56**	***<.001***
Opioid use at 90 days	**5.37**	**3.38**	**8.53**	***<.001***	1.38	0.49	3.90	*0.538*

Poster 30

Combined ACR with Smith-Peterson Osteotomy for Larger Correction of Sagittal Malalignment.

McDermott Michael, DO[1], Garett Jonathon, BS[1], Barner Kyle, DO[2], Parmar Ronak, BS[1], Patel Ashish, MD[1]
[1] Duly Health and Care, Naperville, Illinois, United States, [2] Research Hospital, Kansas City, Missouri, United States

Background/Introduction: Restoration of sagittal alignment is understood to be a primary objective when performing lumbar fusion surgery. Lordotic cages and posterior osteotomies may be applied in various ways to achieve lordosis. Anterior Column Reconstruction (ACR) via release of the anterior longitudinal ligament (ALL) has been reported to obtain up to 30° of lordosis correction at a single intervertebral level. ACR can be combined with a Smith-Peterson osteotomy (SPO), which may cause a large sagittal correction. The primary purpose of this study is to evaluate the change in lumbar alignment after ACR with and without an SPO.

Materials/Methods: This is a retrospective review of a single center's ACR cases from 2015-2023. All patients who had undergone a transpsoas ALL release and placement of a hyperlordotic cage were included in this study. Preoperative, immediate postoperative AP and lateral radiographs were collected and analyzed for sagittal alignment parameters and ACR segmental angle change.

Results: 27 patients with a mean age of 68.2 ± 8.7 years were enrolled in the study. Nineteen of the patients underwent ACR alone, and eight patients underwent ACR with an SPO. The average lumbar lordosis (LL) was 30.5 ± 18.1° and the mean preoperative PI-LL mismatch was 27.2 ± 9.9°. Patients who underwent a combined ACR with SPO had an average postoperative LL of 51.8 ± 12.9°, which was significantly higher than the ACR group (36.1 ± 14.6°, $p = 0.02$). The average postoperative PI-LL mismatch for the ACR + SPO group was 10.6 ± 7.7 compared to 20.9 ± 14.6 for the ACR group ($p = 0.07$). The ACR + SPO group demonstrated a postoperative segmental angle change of 14.5 ± 5.0° at the ACR level, which was significantly higher than the ACR group (7.6 ± 6.3, $p = 0.03$)

Discussion/Conclusion: ACR with SPO is a powerful tool for the restoration of sagittal alignment; as it has improved lumbar lordosis, PI-LL mismatch, and segmental level correction more than ACR alone.

Poster 31

Diabetes Increases Risk of Lumbar Spinal Fusion Complications; Association with Altered Structure of Newly Formed Bone at the Fusion Site

Elgafy Hossein, MD, FRCS(C)[1], *Lecka-Czernik Beata, PhD*[2]
[1] *University of Toledo Medical Center, Toledo, Ohio, United States,* [2] *University of Toledo, Toledo, Ohio, United States*

Background/Introduction: Diabetes predisposes to spine degenerative diseases often requiring surgical intervention. However, the statistics on the prevalence of spinal fusion success and clinical indications leading to the revision surgery in diabetes are conflicting. The purpose of presented analysis was to determine the link between diabetes and lumbar spinal fusion complications using a database of patients residing in the same community and receiving care at the same medical facility.

Materials/Methods: Retrospective observational study of patients (n = 552, 45% male, 54 ± 13.7 years old) undergoing lumbar spinal fusion. Outcome measures included clinical indications, excluding infections, and relative risk (RR) for revision surgery in diabetes. A paravertebral tissue recovered from non-union site of diabetic and non-diabetic patients was analyzed for microstructure of newly formed bone.

Results: Diabetes increased relative risk for revision surgery due to non-union complications (2.80, 95% CI [1.12, 7.02]) and degenerative processes in adjacent spine segments (2.26, 95% CI [1.45, 3.53]). In diabetes, a risk for revision surgery exceeded the relative risk for primary spinal fusion surgery by 44% (2.36, 95% CI [1.58, 3.52] vs 1.64, 95% CI [1.16, 2.31]), which was already 2-fold higher than diabetes prevalence in the studied community. Micro computed tomography of bony fragments found in the paravertebral tissue harvested during revision surgery revealed structural differences suggesting that newly formed bone in diabetic patients may be of compromised quality, as compared to non-diabetic patients.

Discussion/Conclusion: Diabetes significantly increases risk for unsuccessful lumbar spine fusion outcome requiring revision surgery. Diabetes predisposes to the degeneration of adjacent spine segments and pseudoarthrosis at the fusion sites and affects structure of newly formed bone needed to stabilize fusion.