

## **Development of a Modified Surgical Invasiveness Index for Minimally-Invasive Adult Spinal Deformity Surgery**

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### **INTRODUCTION:**

Minimally Invasive Spine Surgery (MISS) techniques in adult spinal deformity (ASD) surgery provides greater incrementally benefit to patients with increasing frailty states, though associated risks have not been established. The purpose of the present study is to create a modified Surgical Invasiveness index and score for MIS patients undergoing ASD surgery.

### **METHODS:**

Surgical ASD patients  $\geq 18$  yrs operated on using MISS technique with complete pre-(BL) and minimum two-year (2Y) data were included. A novel Minimally-Invasive Spine Surgery Invasiveness Score (MISSIS) was developed against length of stay (LOS) and operative time (op time) using multivariable linear regression models. Beta-Sullivan method established point values for each variable used using standardized beta coefficients obtained from MVA analysis to create a point-based scoring system normalized to 100 points. Cohort MISSIS scores were calculated for all patients, ranked into tertiles (Low, Moderate, High), and compared via ANOVA analysis against BL, perioperative, and 2Y outcomes.

### **RESULTS:**

A total of 111 MIS (69.31 $\pm$ 10.59 years, 55% female, 28.52 $\pm$ 6.04 kg/m<sup>2</sup>, CCI: 2.13 $\pm$ 1.57) patients were included. Point distributions were as follows: Staged procedure (+23), tubular decompression (+3), Percutaneous instrumentation (+10), facet osteotomy per level (+3), three-column osteotomy per level (+3), Smith-Peterson osteotomy per level (+3), ALIF (+13), TLIF (+5), LLIF/XLIF (+8), iliac fixation (+5), revision surgery/history of spine surgery (+3), per 10° change in PI-LL (+5), per 2° change in PT (+3), per 1 cm change in C7-S1 SVA (+3), per 1° change in thoracic kyphosis (+13). Mean cohort MISSIS: 258.56 $\pm$ 152.22. At baseline, when comparing ranked MISSIS scores, patients did not differ significantly in age, gender, BMI, or CCI (all  $p > .05$ ). However, significant differences were observed with increasing invasiveness associated with increased BL global malalignment by PI-LL ( $p = .001$ ) and GAP score ( $p = .002$ ). Perioperatively, increasing MISSIS was associated with increased risk of SICU admission ( $p = .007$ ) and intraoperative complications ( $p = .008$ ). However, increased invasiveness was also associated with significantly increased likelihood of improving in GAP score by 1Y in all groups ( $p = .026$ ). In terms of postoperative complications, increasing MISSIS was associated with significantly increased number of complications overall ( $p = .002$ ), and complications requiring reoperation ( $p = .020$ ) such as implant failure/malposition or neurological complication (both  $p < .046$ ).

### **DISCUSSION AND CONCLUSION:**

As minimally-invasive deformity surgery continues to grow in popularity across the globe, the need for more granular invasiveness criteria emerges. This study presents a novel Minimally-Invasive Spine Surgery Invasiveness Score (MISSIS) system allowing for greater predictive potential of operative time, length of stay, and postoperative complications associated with increasing complexity and invasiveness in MIS surgery.

Fig. 1. Points associated with increasing LOS and OpTime.

Surgical variables	Points
Staged	10
Same-Day Flipped (vs Prone Lateral)	13
Tubular decompression	3
Percutaneous instrumentation	10
<b>Osteotomies</b>	
Facet osteotomy (per level)	3
Three-column (per level)	3
Smith-Petersen (per level)	3
<b>Interbody fusion</b>	
ALIF	13
TLIF	5
LLIF/XLIF	8
Iliac Fixation	5
Revision Surgery (or pmh of spine sx)	3
<b>Radiographic Variables</b>	
PI-LI (per 10 deg change)	5
Pelvic tilt (per 2 deg change)	3
SVA (per 1 cm change)	3
Thoracic kyphosis (per 1 deg change)	13
<b>TOTAL</b>	<b>100</b>