Navigational Assistance in Interbody Device Positioning Optimizes Peri- and Post-Operative Outcomes in Minimally-Invasive Spine Surgery

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INTRODUCTION:
Minimally-invasive spine surgery (MISS) and associated robotic or navigational guidance is being increasingly implemented due to its potential to increase surgical accuracy while reducing the risk for complications versus open spine surgery. However, there remains a paucity in literature as to whether or not navigational assistance optimizes interbody device (IBD) placement in MISS. The purpose of this study was to assess if navigationally-assisted MISS technique optimizes interbody device (IBD) placement in ASD patients.
METHODS:
Operative ASD patients undergoing surgery utilizing navigational or robotic guidance (Nav) in IBD placement with pre-(BL) and up to 2-year(2Y) postop radiographic/HRQL data were included. At 1Y or 2Y, a favorable outcome was defined as meeting at least 2 of the following 3 criteria: 1) achieving ideal PT per SRS-Schwab, 2) Achieving ideal PI-LL per SRS-Schwab, 3) No complication requiring reoperation. Means comparison analysis assessed differences in radiographic and patient-reported outcomes at BL and up to 2-years. ANCOVA analysis assessed estimated marginal means while controlling for baseline Charlson Comorbidity Index (CCI).
RESULTS:
299 MIS patients (52.12±11.97 years, 39% female, 31.38±6.64 kg/m^2, mean CCI: 2.23±1.56) were included. At baseline, Nav patients presented with significantly lower CCI compared to Non-Nav patients (1.93 vs 2.41, p=.013). No significant differences in BL deformity assessed by L1-S1 lordosis, S1PI, PI-LL, S1PT, C7-S1 SVA were observed (all p>.05). Likewise, no differences in NRS-Back, Arms, or Leg domains, nor ODI were observed at BL (all p>.05). In terms of surgical differences, Nav patients reported higher rates of TLIF/PLIF (p=.031), higher rates of partial corpectomies (p=.006), yet lower rates of total corpectomies (p=<.001). Likewise, Nav patients were significantly less likely to require a 3-column osteotomy (p=.001) or decompressions (p=.002), more likely to undergo ALIF (.018), and have significantly greater numbers of IBFs in total (p=.048). Furthermore, significantly lower EBL was noted in the Nav cohort (p=.020). All peri-operative differences represented in Table 1. Compared to non-navigated patients, controlled analysis revealed navigated patients were significantly more likely to be considered optimized (36.3% vs. 14.4%, p<.001).
DISCUSSION AND CONCLUSION: Our study revealed improved peri- and post-operative outcomes in robotic or navigation-assisted IBD placement in MISS. Navigated patients demonstrated optimized outcomes by 1Y as measured by reaching radiographic ideal alignment and absence of complications with reoperation, suggesting demonstrable benefit to navigational guidance.

Table 1. Surgical Characteristics

Parameter	Nav?	Mean	Std. Deviation	P-Value
EBL (mL)	No	447.23	667.58	p=.020
	Yes	314.66	282.17	
Number of Interbody Fusions	No	1.18	0.73	p=.048
	Yes	1.36	0.77	
Decompensation	No	0.97	0.17	p=.002
	Yes	0.87	0.34	
ALIF	No	0.14	0.35	p=.018
	Yes	0.01	0.12	
TLIF/PLIF	No	0.79	0.41	p=.031
	Yes	0.88	0.32	
Partial Corpectomy	No	0.29	0.46	p=.006
	Yes	0.72	0.46	
Full Corpectomy	No	0.72	0.45	p<.001
	Yes	0.27	0.45	
3-Column Osteotomy	No	0.17	0.38	p=.001
	Yes	0.05	0.22	