Intraoperative 3D Navigation and Post-Operative Infection in Thoracolumbar Fusion

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INTRODUCTION: Pedicle screw fixation is a technique used to provide rigid fixation in thoracolumbar spine surgery. Safe intraosseous placement of pedicle screws is necessary to provide optimal fixation as well as to avoid damage to adjacent anatomic structures. A variety of techniques have been described to allow for safe placement of pedicle screws, including the use of anatomic landmarks, fluoroscopy, ultrasound, and 3D printed models. Despite the wide variety of techniques available, none thus far has been able to fully eliminate the risk of malpositioned screws. Intraoperative 3-dimensional navigation (I3DN) was developed to improve accuracy in the placement of pedicle screws. Multiple prior studies have shown improved accuracy with navigated screw placement relative to freehand or fluoroscopy-assisted insertion. I3DN requires the use of intraoperative image acquisition in which the 3D fluoroscopy unit is placed circumferentially around the sterile field. This creates a theoretical risk of wound contamination. To our knowledge no previous studies have investigated whether infection rates are higher with I3DN.

METHODS: From 2016 to 2020, a single-institution, retrospective study was undertaken by two reviewers using the “Epic” electronic medical record system. Patients were identified using CPT codes utilized for thoracolumbar fusion and instrumentation. Inclusion criteria included patients over the age of 18 undergoing thoracolumbar posterior instrumented fusion. Exclusion criteria included any fusion crossing the cervicothoracic junction, prior spine infection, and incomplete medical records. A number of patient co-morbidities, demographic, and operative data were collected. The primary outcome measure was return to the operating room for culture positive incision and drainage. Data was assessed using student t-test, chi-squared and fisher exact test, and a univariate and multivariate regression analysis was subsequently done to further elucidate independent risk factors.

RESULTS:

There was 1246 patients identified after CPT code search, of which 589 patients remained after exclusion criteria. Of these remaining patients, 417 patients were instrumented using I3DN and 172 patients did not use I3DN. There were no significant differences in baseline demographic data. The I3DN group has significantly greater return to the operating room for culture positive incision and drainage (17 (4.1%) vs 1 (0.6%), p=.025). On univariate analysis, revision status, operative time, and number of levels fused were associated with the primary outcome measure. On multivariate analysis, revision status and number of levels fused remained significantly associated with return to the operating room for incision and drainage, while the use of I3DM trended towards significance with an OR of 6.49 (0.84 – 50.02, p=.073).

DISCUSSION AND CONCLUSION:

In this study, we demonstrated a statistically significant increase in return to the operating room for culture positive incision and drainage with the use of I3DN on univariate analysis and a trend towards significance on multivariate analysis. Post-operative infections are multifactorial and infection risks associated with I3DN need to be weighed against safety benefits of improved accuracy of pedicle screw positioning, especially in cases with complex anatomy such as revisions and deformity patients.

Table 2. Specific microorganisms identified based on intra-operative culture.

O-Arm Use	Microorganism
Yes	Klebsiella pneumoniae, finegoldia magna
Yes	MRSA
Yes	Proteus Mirabilis, Prevotella Bivia
No	Proteus Mirabilis
Yes	MSSA, Corynebacterium striatum
Yes	MRSA
Yes	Enterococcus Faecalis, Streptococcus Mitis, Prevotella Bivia
Yes	Enterobacter Cloacae
Yes	MSSA, Proteus Mirabilis
Yes	VRE (Vanco resistant enterococcus)
Yes	E Faecalis, E Coli
Yes	Pseudomonas
Yes	Staph Lugdenesis, Proteus Penneri, Enterococcus
Yes	Klebsiella Pneumoniae
Yes	Enterobacter Cloacae
Yes	MSSA
Yes	MSSA
Yes	Klebsiella Pneumoniae, Proteus Mirabalis

Table 4. Factors associated with return to OR for I&D on multivariable logistic regression.

Characteristic		Adjusted Odds Ratio (95% CI)	*p* Value
I3DN use	Yes	6.49 (0.84–50.02)	0.073
	No (reference)	1	
Revision status	Yes	2.94 (1.10–7.83)	0.031
	No (reference)	1	
Levels fused	–	1.13 (1.02–1.27)	0.026