

Operative treatment of thoracolumbar fractures in patients with ankylosing spinal disorders: how many levels of fixation are enough?

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INTRODUCTION:

Ankylosing spondylitis (AS) and diffuse idiopathic skeletal hyperostosis (DISH) are the two primary forms of ankylosing spinal disorders (ASD). Although these conditions have distinct pathophysiological origins, both ultimately lead to spinal ankylosis, creating a rigid spine and significantly increasing the risk of unstable spinal fractures. Surgical management of spine fractures in this population carries high risk for perioperative complications and increased short-term mortality. Selecting the optimal length for posterior spinal fixation – specifically, whether to instrument three levels above and below the fracture versus two levels above and below the fracture – remains controversial. This study aimed to compare outcomes associated with different posterior spinal fixation lengths in patients with ASD and traumatic fractures of the thoracic and/or lumbar spine.

METHODS:

We performed a retrospective review of a large, consecutive cohort of adult patients with ASD and traumatic fractures of the thoracic and/or lumbar spine treated operatively with posterior spinal fixation at a single, academic, level 1 trauma center between 2005 to 2020. Patients underwent posterior spinal fixation spanning either two levels above and below the fracture (4 or 5 instrumented levels) or three levels above and below the fracture (6 or 7 instrumented levels). Patient demographics, procedural data, hospital course, and 90-day post-operative data were collected. Statistical analyses were performed using Chi-square and Fishers exact tests for categorical variables and Mann-Whitney U test for continuous variables.

RESULTS:

The study identified 196 cases of ASD (63 with AS, 133 with DISH) with fractures of the thoracic and/or lumbar spine. Of these, 90 patients underwent posterior fixation spanning two levels above and below the injury (2A2B), and 106 patients underwent posterior fixation spanning three levels above and below (3A3B). Mean instrumented levels was 4.61 ± 0.49 for 2A2B and 6.33 ± 0.47 for 3A3B ($p < 0.001$). Baseline demographics, including age, BMI, and percentage of male patients, were comparable between the two groups.

Percutaneous techniques were used in 22 patients in the 2A2B group and in one patient in the 3A3B group ($p < 0.001$). Among open cases, the 3A3B group demonstrated significantly higher surgical invasiveness index scores (12.94 ± 1.81 vs. 9.25 ± 1.50 ; $p < 0.001$), greater blood loss (686.00 ± 567.29 mL vs. 407.21 ± 396.59 mL; $p < 0.001$), and longer operative times ($6:18 \pm 3:50$ vs. $4:29 \pm 1:53$ hours; $p < 0.001$).

The 3A3B group had higher rates of surgical site infection (15.2% vs. 5.9%; $p = 0.087$) and 90-day reoperation (18.1% vs. 7.4%; $p = 0.046$) compared to the 2A2B group. Rate of hardware-related reoperation within 90 days for all cases, including screw revisions and acute rod failure with increased kyphosis, was comparable between groups (2.8% in 3A3B vs. 1.1% in 2A2B; $p = 0.626$).

DISCUSSION AND CONCLUSION:

To the authors' knowledge, this study is the first to compare outcomes in patients with ankylosing spinal disorders and traumatic fractures of the thoracic and/or lumbar spine treated with posterior fixation constructs spanning either two or three levels above and below the injury. The longer posterior fixation construct (three levels above and below) was associated with increased operative time, blood loss, surgical invasiveness index scores, and a higher rate of surgical site infection requiring reoperation within 90 days. Notably, when percutaneous cases were excluded, the difference in surgical site infection rates between groups lost statistical significance, likely due to a reduced sample size, though the trend persisted. No significant difference was observed for hardware-related mechanical failure between the two groups. These results suggest that shorter fixation constructs, two levels above and below the fracture, may offer comparable mechanical stability with lower surgical morbidity, a meaningful consideration in this high-risk patient population.

Table 1: Comparison of Patient Variables

	2A2B	3A3B	p-value
Demographics			
Age (years)	61.0(12.1)	62.0(12.2)	0.405
Sex (M/F)	52 (58.1%) / 36 (41.9%)	56 (52.3%) / 50 (47.7%)	0.410
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BMI	25.0(4.8)	25.0(4.8)	0.987
Operative Time (hr)	4:29(1:53)	6:18(3:50)	<0.001*
Operative Details			
Open Cases	77 (85.6%)	88 (82.1%)	0.141
Percutaneous	13 (14.4%)	18 (16.9%)	0.410
Instrumented Levels	4.61(0.49)	6.33(0.47)	<0.001*
Operative Time (hr)	4:29(1:53)	6:18(3:50)	<0.001*
Blood Loss (mL)	407.21(396.59)	686.00(567.29)	<0.001*
Surgical Invasiveness Index	9.25(1.50)	12.94(1.81)	<0.001*
90-day Reoperation	7.4%	18.1%	0.046*
90-day SSI	5.9%	15.2%	0.087
Hardware-Related Reoperation	1.1%	2.8%	0.626

*Significant difference between groups.

Table 2: Operative Data, All Cases

	2A2B	3A3B	p-value
Operative Details			
Open Cases	77 (85.6%)	88 (82.1%)	0.141
Percutaneous	13 (14.4%)	18 (16.9%)	0.410
Instrumented Levels	4.61(0.49)	6.33(0.47)	<0.001*
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Table 3: Operative Data, Open Cases

	2A2B	3A3B	p-value
Operative Details			
Open Cases	77 (85.6%)	88 (82.1%)	0.141
Percutaneous	13 (14.4%)	18 (16.9%)	0.410
Instrumented Levels	4.61(0.49)	6.33(0.47)	<0.001*
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90-day SSI	5.9%	15.2%	0.087
Hardware-Related Reoperation	1.1%	2.8%	0.626

*Significant difference between groups.

Table 4: Primary Outcomes, All Cases

	2A2B	3A3B	p-value
Primary Outcomes			
Operative Time (hr)	4:29(1:53)	6:18(3:50)	<0.001*
Blood Loss (mL)	407.21(396.59)	686.00(567.29)	<0.001*
Surgical Invasiveness Index	9.25(1.50)	12.94(1.81)	<0.001*
90-day Reoperation	7.4%	18.1%	0.046*
90-day SSI	5.9%	15.2%	0.087
Hardware-Related Reoperation	1.1%	2.8%	0.626

*Significant difference between groups.

Table 5: Primary Outcomes, Open Cases

	2A2B	3A3B	p-value
Primary Outcomes			
Operative Time (hr)	4:29(1:53)	6:18(3:50)	<0.001*
Blood Loss (mL)	407.21(396.59)	686.00(567.29)	<0.001*
Surgical Invasiveness Index	9.25(1.50)	12.94(1.81)	<0.001*
90-day Reoperation	7.4%	18.1%	0.046*
90-day SSI	5.9%	15.2%	0.087
Hardware-Related Reoperation	1.1%	2.8%	0.626

*Significant difference between groups.