Impact of Ankylosing Spondylitis and Diffuse Idiopathic Skeletal Hyperostosis on Spinal Trauma Outcomes

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INTRODUCTION: Thoracolumbar spine trauma in patients with pre-existing conditions like ankylosing spondylitis (AS) and diffuse idiopathic skeletal hyperostosis (DISH) presents a unique set of challenges due to the rigidity and altered biomechanics of their spines. This study aimed to compare the demographic characteristics, surgical interventions, and clinical outcomes of surgically treated thoracolumbar trauma patients with AS, DISH, and a control group without these conditions. The hypothesis was that patients with AS and DISH would exhibit distinct injury patterns, require different surgical approaches, and experience varied clinical outcomes compared to the control group.

METHODS:

This retrospective cohort study analyzed medical records from 189 patients who underwent surgical intervention for thoracolumbar trauma at a level 1 trauma center between 2015 and 2024. Patients were categorized into three groups: AS (n=20), DISH (n=32), and a control group (n=137). Demographic data included age, sex, BMI, comorbidities (diabetes, bone density disorders), smoking status, and ASA scores. Clinical data comprised the mechanism of injury, neurological status (ASIA scale), and Injury Severity Scores (ISS). Surgical variables documented included surgery type, spinal region, and number of fused levels, time to surgery, duration of surgery, surgical approach, and intraoperative complications. Primary outcomes assessed were neurological changes, average levels fused, trauma fusion level, postoperative complications, hospital stay, ICU admission, in-hospital mortality, and readmission rates. Descriptive statistics summarized baseline characteristics. Ordinary Least Squares (OLS) regression models were used for continuous outcomes, while multinomial logistic regression analyzed categorical outcomes, calculating Odds Ratios (ORs) and 95% Confidence Intervals (CIs). Statistical significance was set at $p<0.05$.

RESULTS:

Significant demographic differences were observed. **AS (71.95±13.59 years) and DISH (73.53±11.45 years) patients were significantly older than controls (45.18±22.30 years) (p<0.0001)**. Males were more prevalent in AS (90.00%) and DISH (75.00%) groups compared to controls (63.50%). **Type 2 Diabetes was significantly more common in AS (45.00%, OR 9.40, 95% CI [2.11–41.93], p=0.003) and DISH (40.63%, OR 8.04, 95% CI [2.31–27.97], p=0.002) groups versus controls (10.22%).** Osteoporosis was markedly higher in the DISH group (34.37%) compared to AS (15.00%) and controls (5.84%), with DISH patients being 22.43 times more likely to have osteoporosis (p<0.001).

Regarding trauma and outcomes, the **average number of fused levels was significantly higher in AS (5.80±1.64) and DISH (5.09±2.19) groups than in controls (3.82±2.33) (p<0.0002)**. Low-energy falls (from standing or height) were more prevalent injury mechanisms in AS (35.00% and 20.00% respectively) and DISH (46.88% and 9.37% respectively) patients compared to controls (16.06% and 8.76% respectively) (p=0.0014). **AS patients were significantly more likely to undergo open surgery (OR 8.09, 95% CI [1.29–50.86], p=0.026)**. Trauma fusion levels also differed significantly (p=0.0002), with thoracic spine fusions more common in AS (50.00%) and DISH (65.63%) groups. **In-hospital mortality was significantly higher in the AS group (15.00%)** compared to DISH (6.25%) and controls (2.92%) (p=0.037), with AS patients 793.38 times more likely to experience mortality (p=0.044). A greater proportion of AS (50.00%) and DISH (46.87%) patients required skilled nursing or specialized care post-discharge compared to controls (45.25%) (p=0.004).

DISCUSSION AND CONCLUSION:

This retrospective cohort study highlights important insights into the demographic characteristics, surgical interventions, and clinical outcomes of surgically managed thoracolumbar trauma in patients with AS and DISH, compared to a control group. The findings demonstrate that individuals with AS and DISH are typically older and carry a higher burden of comorbidities, particularly Type 2 Diabetes, and in the case of DISH, a significant co-occurrence of osteoporosis. This inherent fragility renders them susceptible to unstable thoracolumbar fractures from low-energy mechanisms, such as falls, in contrast to the higher-energy trauma seen in the general population. Surgically, their rigid spines necessitate more extensive fusion constructs, with AS patients often requiring open approaches due to fracture complexity. More importantly, the significantly elevated in-hospital mortality rate in the AS group underscores their extreme vulnerability and poorer prognosis. Furthermore, a greater proportion of both AS and DISH patients require intensive post-acute rehabilitation, reflecting increased functional impairment. These distinctions underscore the need for heightened clinical suspicion, specialized pre-operative risk stratification, tailored surgical planning, and robust post-operative care pathways to optimize outcomes for this unique and high-risk patient population.

Table 1a: Quantitative Demographic Characteristics in Surgically Treated Thoracolumbar Fracture Patients

Demographic Information	AS (n=20)	DISH (n=32)	Neither DISH/AS (n=137)	p-value	AS OLS Coefficient (vs. other predictors),	DISH OLS Coefficient (vs. other predictors),
Age (mean ± std)	71.95 ± 13.59	73.53 ± 11.45	45.18 ± 22.30	**<0.0001**	5.54 (p=0.206)	**12.08 (p=0.001)**
ASA (mean ± std)	3.3 ± 0.57	3.34 ± 0.55	3.11 ± 0.80	0.198	-0.01 (p=0.941)	0.06 (p=0.727)
BMI (mean ± std)	32.05 ± 7.94	30.72 ± 4.79	28.01 ± 7.18	**0.0148**	2.48 (p=0.182)	0.95 (p=0.586)

Table 1b: Categorical Demographic Characteristics in Surgically Treated Thoracolumbar Fracture Patients

Demographic Information	AS (n=20)	DISH (n=32)	Neither DISH/AS (n=137)	p-value	AS vs. Neither (OR, 95% CI)	p-value (AS vs. Neither)	DISH vs. Neither (OR, 95% CI)	p-value (DISH vs. Neither)
Gender, n (%)				**0.0395**				
Male	18 (90.00)	24 (75.00)	87 (63.50)		Reference (1.00)	N/A	Reference (1.00)	N/A
Female	2 (10.00)	8 (25.00)	50 (36.50)		0.17 [0.03-0.96]	**0.044**	0.54 [0.18-1.62]	0.102
Race, n (%)				0.1588				
White	16 (80.00)	21 (65.62)	80 (58.39)		Reference (1.00)	N/A	Reference (1.00)	N/A
Black/Asian/Other	4 (20.00)	11 (34.38)	57 (41.61)		1.03 [0.32-6.12]	0.971	2.12 [0.78-7.50]	0.178
Diabetes, n (%)				**<0.0001**				
None	11 (55.00)	19 (59.38)	119 (86.86)		Reference (1.00)	N/A	Reference (1.00)	N/A
Type 1	0 (0.00)	0 (0.00)	4 (2.92)		NC	1.000	NC	1.000
Type 2	9 (45.00)	13 (40.63)	14 (10.22)		9.40 [2.11-41.93]	**0.003**	8.04 [2.31-27.97]	**0.002**
Bone Density Disorders, n (%)				**<0.0001**				
None	6 (20.00)	14 (43.75)	106 (77.37)		Reference (1.00)	N/A	Reference (1.00)	N/A
Osteopenia	11 (55.00)	7 (21.88)	23 (16.79)		2.97 [0.74-13.82]	0.114	0.95 [0.30-5.24]	0.934
Osteoporosis	3 (15.00)	11 (34.37)	8 (5.84)		8.04 [4.32-314.15]	0.063	22.43 [1.89-315.09]	**<0.001**
Smoking Status, n (%)				0.0857				
Never	11 (55.00)	18 (56.25)	87 (63.50)		Reference (1.00)	N/A	Reference (1.00)	N/A
Current	2 (10.00)	3 (9.37)	27 (19.71)		0.24 [0.67-2.91]	0.396	0.34 [0.11-2.78]	0.476
Former	7 (35.00)	11 (34.38)	23 (16.79)		1.21 [0.55-9.14]	0.259	1.36 [0.78-7.81]	0.130

*NC: Not applicable/not calculable due to zero observations for the 'AS' or 'DISH' group, resulting in perfect separation.

Table 2: Categorical Trauma and Acute Outcomes in Surgically Treated Thoracolumbar Fracture Patients

Trauma/Outcome Variables	AS (n=20)	DISH (n=32)	Neither DISH/AS (n=137)	p-value	AS vs. Neither (OR, 95% CI)	p-value (AS vs. Neither)	DISH vs. Neither (OR, 95% CI)	p-value (DISH vs. Neither)
Mechanism of Injury, n (%)				**0.0014**				
MVC	7 (35.00)	14 (43.75)	93 (67.88)		Reference (1.00)	N/A	Reference (1.00)	N/A
Fall From Standing	7 (35.00)	15 (46.88)	22 (16.06)		1.37 [0.14-4.14]	0.757	1.45 [0.37-5.65]	0.595
Fall From Height	4 (20.00)	3 (9.37)	12 (8.76)		2.97 [0.39-22.86]	0.295	1.47 [0.24-8.81]	0.675
Other	2 (10.00)	0 (0.00)	10 (7.30)		7.40 [0.44-124.93]	0.165	NC	1.000
Neurological Status at Admission (ASIA score), n (%)				0.1912				
A	1 (5.00)	1 (3.13)	22 (16.06)		0.04 [<0.01-54.71]	0.823	0.05 [<0.01-1.66]	0.093
B	0 (0.00)	3 (9.37)	6 (4.38)		NC	0.997	6.39 [0.26-148.58]	0.259
C	0 (0.00)	3 (9.37)	5 (3.65)		NC	1.000	3.19 [0.38-2648.24]	0.125
D	5 (25.00)	6 (18.75)	32 (23.36)		0.41 [0.08-1.93]	0.258	0.34 [0.13-2.05]	0.356
E	14 (70.00)	19 (59.38)	72 (52.55)		Reference (1.00)	N/A	Reference (1.00)	N/A
Neurological Outcomes, n (%)				0.6669				
No Change	17 (85.00)	28 (87.50)	107 (78.10)		Reference (1.00)	N/A	Reference (1.00)	N/A
Improvement	3 (15.00)	3 (9.37)	24 (17.52)		5.09 [0.31-83.13]	0.253	1.85 [0.27-12.58]	0.530
Worsening	0 (0.00)	1 (3.13)	6 (4.38)		NC	1.000	0.01 [<0.01-2.36]	0.102
Open Surgery, n (%)	13 (65.00)	22 (68.75)	110 (80.29)	**0.0008**	8.09 [1.29-50.86]	**0.026**	1.89 [0.38-9.41]	0.436
Surgical Decompression, n (%)	6 (30.00)	14 (43.75)	66 (48.18)	**0.0394**	0.344 [0.07-1.56]	0.178	1.37 [0.42-4.52]	0.603
Trauma Fusion Level, n (%)				**0.0002**				
Cervicothoracic Junction (C7-T2)	6 (30.00)	6 (18.75)	36 (26.28)		0.39 [0.64-2.43]	0.315	0.07 [0.01-0.41]	**0.003**
Lumbar Spine (L1-L5)	0 (0.00)	0 (0.00)	19 (13.87)		NC	1.000	NC	1.000
No Fusion	0 (0.00)	0 (0.00)	8 (5.83)		NC	1.000	NC	1.000
Thoracic Spine (T1-T12)	10 (50.00)	21 (65.63)	31 (22.63)		Reference (1.00)	N/A	Reference (1.00)	N/A
Thoracolumbar Junction (T11-L2)	4 (20.00)	5 (15.62)	43 (31.39)		0.37 [0.07-2.01]	0.257	.17 [0.04-0.71]	**0.015**
Postoperative Complications, n (%)	2 (10.00)	5 (15.62)	22 (16.06)	0.647	0.98 [0.084-11.27]	0.984	1.98 [0.33-11.74]	0.452
Cases Requiring Reoperation, n (%)	2 (10.00)	0 (0.00)	9 (6.57)	0.2613	327.97 [0.39-277977.81]	0.115	NC	1.000
Disposition, n (%)				**0.004**				
Home-Based Care	7 (35.00)	11 (34.37)	62 (45.25)		Reference (1.00)	N/A	Reference (1.00)	N/A
Deceased	2 (10.00)	2 (6.25)	4 (2.92)		15.59 [0.09-2562.44]	0.291	1.51 [0.01-323.92]	0.816
Rehabilitation & Acute Care (short-term)	1 (5.00)	4 (12.51)	41 (29.93)		0.27 [0.02-3.11]	0.269	0.56 [0.12-2.58]	0.458
Skilled Nursing and Specialized Care	10 (50.00)	15 (46.87)	30 (21.90)		2.08 [0.47-9.17]	0.097	1.70 [0.46-6.35]	0.111
Readmission Rate, n (%)	4 (20.00)	3 (9.38)	17 (12.41)	0.4592	5.59 [0.88-36.83]	0.071	1.48 [0.28-7.66]	0.643
In-Hospital Mortality, n (%)	3 (15.00)	2 (6.25)	4 (2.92)	**0.0372**	793.38 [1.21-521022.70]	**0.044**	4.95 [0.09-263.17]	0.430
Lost to Follow-Up, n (%)	7 (35.00)	10 (31.25)	24 (17.52)	0.0948	2.37 [0.45-12.38]	0.297	2.73 [0.72-10.28]	0.138

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