Assessment of Modern Iatrogenic Flatback Syndrome: Nearly 70% of Short Lumbar Fusions had Undercorrection of L4-S1 Lordosis

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INTRODUCTION: Revision spinal procedures in deformity patients are costly and invasive. However, the prevalence, modes of failure, and extent of deformity of iatrogenic ASD is unknown.

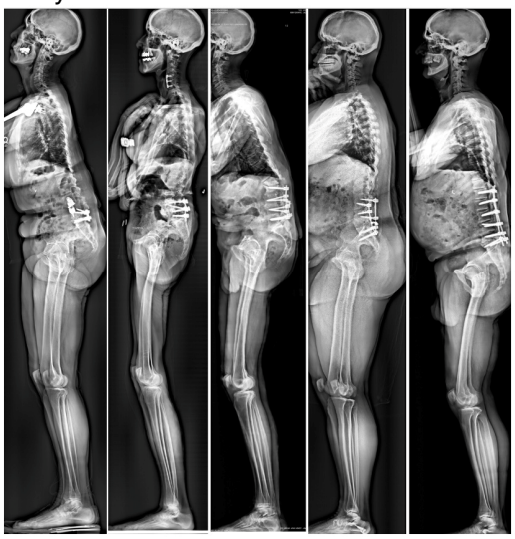
METHODS:

ASD patients with (IATROGENIC) and without (PRIMARY) prior spine surgery were included. IATROGENIC patients were prior short (L1-iliium) (IATROGENIC DEGEN) and long fusion (IATROGENIC DEFORMITY) constructs. DEGEN patients were further stratified into common modes of failure: implant, junctional, malalignment, and neurologic. Comparative analyses were performed on baseline demographics, spinopelvic alignment, offset from published segmental lordosis goals, patient-reported outcome measures (PROMs), and surgical procedures.

RESULTS: Among 785 patients, 430 (55%) were PRIMARY, 181 (23%) were IATROGENIC DEFORMITY, and 174 (22%) were IATROGENIC DEGEN. DEGEN modes of failure included 27% implant, 40% junctional, 73% malalignment, and 28% neurologic. DEGEN patients were older (PRIMARY=60.6 vs DEGEN=66.3 years) and frailer (2.8 vs 4.4), and had worse baseline deformity (PT, PI-LL, SVA, L4-S1) and PROMs (NRS Back Pain, ODI, SRS-12 Total) compared to primary patients (all $p<0.001$). Segmental lordosis analysis revealed that 98/131 (75%) of SRS-Schwab type N patients were undercorrected, and only 12% were matched to L4-S1 goal (35-40 degrees). Likewise, 67/93 (72%) patients with L4-S1 spanning constructs, 19/21 (91%) patients with L1-L4 spanning constructs, and 10/11 (91%) patients with L1-S1/ilium spanning construct were undercorrected (**Figure**). DEGEN patients more often underwent 3-column osteotomies (12% vs 30%, $p<0.001$) and decompression (50% vs 62%, $p=0.021$), and had a higher Surgical Invasiveness Score (78.3 vs 87.8, $p=0.006$).

DISCUSSION AND CONCLUSION:

Nearly half of ASD surgeries were revision spinal fusions. Revisions were predominantly associated with sagittal malalignment with 72-91% being undercorrected to segmental lordosis goals, often at L4-S1. Revision patients underwent more invasive procedures, such as 3-column osteotomy. Further initiatives to optimize alignment are needed to avoid costly and invasive deformity corrections.



	PRIMARY (N=430)	REVISED (N=174)	P value
Spinopelvic Parameters			
PT (°)	23.0 (10.8)	28.0 (9.1)	**<0.001**
PI (°)	52.9 (12.6)	57.9 (13.9)	**<0.001**
TK (°)	-35.5 (21.3)	-30.1 (17.6)	**0.003**
LL (°)	39.4 (24.0)	28.3 (21.1)	**<0.001**
L1-L4 (°)	3.2 (20.1)	1.6 (18.7)	0.556
L4-S1 (°)	36.2 (15.2)	26.7 (13.0)	**<0.001**
PI-LL (°)	13.5 (22.0)	29.6 (18.5)	**<0.001**
SVA (mm)	50.8 (61.5)	106.3 (66.8)	**<0.001**
T1SPi (°)	-1.9 (5.9)	3.3 (6.7)	**<0.001**
Patient-Reported Outcome Measures			
NRS Back Pain	6.9 (2.4)	7.6 (2.0)	**<0.001**
ODI	41.0 (18.1)	50.5 (15.0)	**<0.001**
SRS-22 Total	2.9 (0.6)	2.7 (0.5)	**<0.001**

Figure 1. Preoperative imaging (left) and outcomes (right) for patients undergoing fusion with and without previous lumbosacral fusion.
Abbreviations: PT = Pelvic Tilt, PI = Pelvic Incidence, TK = Thoracic Kyphosis, LL = Lumbar Lordosis, L1-L4 = L1-L4 Lordosis, L4-S1 = L4-S1 Lordosis, PI-LL = Pelvic Incidence minus Lumbar Lordosis, SVA = Sagittal Vertical Axis, T1SPi = T1 SpinoPelvic Inclination, NRS = Numerical Rating Scale, ODI = Oswestry Disability Index, SRS-22 Total = Scoliosis Research Society 22-Item Total.