Stability of L2-S1 Spinal Fusions Utilizing the Minimally Invasive Antepsoas Approach (MIS-ATP) Supplemented by Posterior Percutaneous Fixation (PPF): Is Additional Pelvic Fixation Necessary?

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INTRODUCTION: Long segment instrumented lumbosacral fusions are notorious for implant failure. The use of additional pelvic fixation, although mechanically protective, remains a topic of debate. We sought to determine if instrumented L2-S1 fusions performed via MIS-ATP + PPF confer sufficient mechanical stability obviating the need for pelvic fixation.

METHODS:

A retrospective chart review of 160 patients who received L2-S1 fusions without pelvic fixation, between 2006 and 2024, was conducted to evaluate the incidence of mechanical implant failure. Patients who had at least 1 year follow up were identified (n=79). Implant related adverse events (IRAEs) were defined as either: rod breakage, screw breakage, pseudarthrosis, screw pull out, implant related proximal / distal junctional failure, and the corresponding need for surgical revision. Patient demographics included sex, body mass index, comorbidities (diabetes, osteoporosis), lifestyle factors (smoking, alcohol), past surgical history (previous spine surgery, previous hip surgery, previous abdominal surgery), and diagnoses at initial presentation. Radiographs and electronic charts were reviewed to ascertain the development of IRAEs.

RESULTS:

Overall 79 patients were included that had L2-S1 segments fusions without pelvic fixation with at least a one-year follow up; 58.2 % were female, the average age was 60.1 ± 10.6 years, and the average BMI was 30.3 ± 5.9 kg/m2 (Table 1). Moreover, 30.4 % of patients had diabetes, 20.3 % had osteoporosis, 26.6 % were active smokers, and 15.2 % drank alcohol at the time of their surgery. Furthermore, 27.8 % of the total cohort had a previous spine surgery, 31.6 % had a previous abdominal surgery, and 6.3 % had a previous hip surgery. The largest preoperative indication for surgery was spondylolysthesis (50.5%), followed by stenosis with advanced spondylosis (31.6%), degenerative disc disease (29.1%), degenerative scoliosis (12.7%), post-discectomy syndrome (3.8%), and ASD/PJK (3.8%). Two patients required surgical revision (2.53%) (Table 1).

Of all patients included, 5 (6.33 %) experienced a form of implant related adverse event. These manifested as: implant related proximal junctional failure (PJF) (n=3, 3.80%) and interval radiographic changes to the implants at L5-S1 (n=2, 2.53%). Among the 3 cases of PJF, there was 1 case of L2 screw pullout and 2 cases of proximal junctional kyphosis. Among the 2 cases of radiographic changes at the distal junction, there was 1 S1 screw-rod disconnection and 1 S1 screw breakage. Overall, only 2 patients (2.53%) warranted revision surgeries, notably for the correction of PJFs (Tables 2, 3).

DISCUSSION AND CONCLUSION: Given the high incidence of lumbosacral instrumentation failure in adult spinal deformity following multi-level spinal fusion, optimizing lumbosacral construct biomechanics and fusion biology are paramount. Past literature has argued both for and against the use of pelvic fixation. In our experience, the MIS-ATP technique allows for lumbosacral sagittal alignment restoration, placement of robust interbody support, and high fusion rate in short and long segment lumbosacral fusion constructs. Consequently, the findings of our study suggest that L2-S1 spinal fusion via the MIS-ATP approach can be safely performed without the popular addition of pelvic fixation.

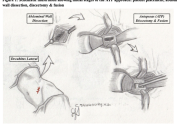

Table 1: Description of L2-S1 Patients Without Pelvic Fixation via the Minimally Invasive Antepsoas Approach with Supplemental Posterior Percutaneous Fixation.

Characteristic	Patients with no implant adverse events (n = 74)	Patients with implant adverse events (n = 5)	Total patients (n=79)
Age	60.1 ± 10.5	57.9 ± 11.4	60.1 ± 10.6
Female sex	43 (58.1%)	3 (3.80%)	46 (58.2%)
BMI (kg/m²)	29.9 ± 5.8	31.3 ± 9.4	30.3 ± 5.9
Comorbidities			
Diabetes	22 (29.7%)	2 (40.0%)	24 (30.4%)
Osteoporosis	15 (20.3%)	1 (20.0%)	16 (20.3%)
Lifestyle factors			
Smoking	19 (25.7%)	2 (40.0%)	21 (26.6%)
Alcohol	11 (14.9%)	1 (20.0%)	12 (15.2%)
Past surgical history			
Previous spine surgery	22 (29.7%)	0 (0.00%)	22 (27.8%)
Previous hip surgery	5 (6.76%)	0 (0.00%)	5 (6.33%)
Previous abdominal surgery	24 (32.4%)	1 (20.0%)	25 (31.6%)
Preoperative diagnosis			
Spond/olisthesis	40 (54.1%)	0 (80.0%)	40 (50.5%)
Stenosis with advanced arthritis	25 (33.8%)	0 (0.00%)	25 (31.6%)
Degenerative disc disease	23 (31.1%)	0 (0.00%)	23 (29.1%)
Degenerative scoliosis	9 (12.2%)	1 (20.0%)	10 (12.7%)
Post discectomy syndrome	3 (4.05%)	0 (0.00%)	3 (3.80%)
ASD/PJK	3 (4.05%)	0 (0.00%)	3 (3.80%)

Table 2: Description of Implant Related Adverse Events

Characteristic	Frequency	Occurrence (%)	Required reoperation
Total	5	6.33%	2
Screw-rod disconnection	1	1.26%	0
Proximal junctional failure (PJF)	3	3.80%	2
Screw breakage	1	1.26%	0

Table 3: Proximal vs Distal Implant Related Adverse Events

Characteristic	Frequency	Occurrence (%)	Required reoperation
Proximal (L1-L2)			
1. PJF	3	3.80%	2
Distal (L3-S1)			
1. Screw-rod disconnection	1	1.26%	0
2. Screw Breakage	1	1.26%	0

a. PJF: Proximal Junctional Failure