

Comparative Analysis of S2 Alar-Iliac Fixation Alone Versus Dual Fixation with Triangular Titanium Implants: Increased Risks Without Clear Benefit

Sophia Soehnen, Sydney Chratian, Nazihah S Bhatti, Mustaqueem Pallumeera, Varun Kumar Singh

INTRODUCTION:

Triangular titanium implants (TTI) have recently been adopted to supplement S2 alar-iliac (S2AI) screws in an effort to reduce micromotion, enhance pelvic fixation stability, and minimize postoperative sacroiliac joint pain. While prior biomechanical studies suggest benefits, limited clinical data are available. This study compares the operative outcomes of patients undergoing sacropelvic fixation with S2AI screws alone versus S2AI screws combined with TTI.

METHODS:

This retrospective review yielded 135 patients who underwent sacropelvic fixation with a minimum of one year of follow-up at a single institution. The cohort included patients who underwent isolated pelvic fusion as well as those with long spinal constructs. Patients were categorized based on pelvic fixation type: those who received S2AI screws alone (S2AI group) and those who received dual pelvic instrumentation with both S2AI screws and triangular titanium implants (TTI + S2AI group). Demographic data, intraoperative characteristics, and postoperative outcomes were collected. Categorical variables were analyzed using Pearson's chi-square test, and continuous variables were assessed using Wilcoxon rank-sum tests.

RESULTS:

Patient demographics and the number of fusion levels showed no statistically significant differences between groups. Operative times were significantly longer in the TTI + S2AI group compared to the S2AI-only group ($p < 0.0001$). Postoperative complications were more frequent in the TTI + S2AI group (42%) compared to the S2AI-only group (7%; $p < 0.0001$). Reoperation rates were also higher in the TTI + S2AI group (36% vs. 17%; $p = 0.0139$), most commonly involving hardware revision and extension. A greater proportion of reoperations involved the thoracolumbar-to-pelvis instrumentation region in the TTI + S2AI group (13% vs. 2%; $p < 0.01$), while no significant difference was observed in reoperations involving the pelvic fixation alone.

DISCUSSION AND CONCLUSION: The addition of TTI to S2AI fixation was associated with significantly higher reoperation rates, including early S2AI screw failures within the first year, compared to standard S2AI fixation. These findings contrast with prior biomechanical and clinical reports, which have suggested that additional sacroiliac joint fixation may reduce rod strain and protect against hardware failure at the S2AI level. Hardware revision or extension was the most common indication for reoperation in the TTI + S2AI cohort. It is possible that the increased rigidity from TTI implants alters stress distribution across the construct, contributing to proximal junctional failures at the thoracic and lumbar levels, an effect well documented in the setting of long-segment fusions. While the reoperation rate in the S2AI-only group was slightly higher than that reported in prior studies, this may reflect a higher case complexity or variability in postoperative management. In contrast, previously reported revision rates for isolated TTI constructs in SI joint fusion are substantially lower than observed in this dual-implant cohort. These findings challenge the presumed protective biomechanical role of TTI supplementation and raise concerns about its use in complex constructs without clearly defined indications. Further studies are warranted to evaluate the long-term benefits and risks of dual pelvic fixations.

Table 1. Patient Demographics

	S2AI	TTI & S2AI	P-Value
BMI (kg/m)	32.1 ± 6.3	30.81 ± 5.6	0.2646
Age (yr)	61.2 ± 12.4	62.35 ± 9.4	0.8605
Female (%)	71.1	64.4	0.4303

Table 2. Operative Details

	S2AI	TTI & S2AI	P-Value
Spinal Levels Fused	9.1 ± 4.2	9.04 ± 3.66	0.9007
Intraoperative Complication (%)	4.44	6.67	0.5830
Length of Surgery (hours)	7.3 ± 2.2	5.3 ± 1.5	< 0.0001**

**Significant Difference

Table 3. Postoperative Details

	S2AI	TTI & S2AI	P-Value
Length of Hospital Stay (days)	5.3 ± 6.4	6.7 ± 3.4	0.0383**
Postoperative Complication (%)	6.67	42.2	< 0.0001**
Reoperation (%)	16.7	35.6%	0.0139**

**Significant Difference

Table 4. Indications for Reoperation

	S2AI	TTI & S2AI	P-Value
Hardware Revision and Extension	7.76%	17.76%	0.0814*
Infection and Debridement	3.33%	2.22%	0.7187
Hardware revision	3.33%	11.11%	0.0712*
Rod Failure	1.11%	0%	0.4779
S2AI Failure	1.11%	4.4%	0.2155

*Moderate Difference

Table 5. Reoperation by Instrumented Region for each Implant Group

	S2AI	TTI & S2AI	P-Value
Pelvic Screw	1.11%	4.4%	0.2676
Thoracic/Lumbar	13.33%	10.00%	0.5712
Thoracic/Lumbar-Pelvic	2.22%	13%	0.0162**

**Significant Difference