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Original Article

Unilateral S2 alar-iliac screws for spinopelvic fixation

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Abstract

Background: This study compared the clinical complications, radiographic measurements of deformity, and quality of life outcomes for patients with *de novo* scoliosis undergoing thoracolumbar fusions for spinopelvic fixation (SPF) utilizing unilateral S2 alar-iliac (S2AI) screw or unilateral iliac bolt fixation.

Methods: This retrospective review was performed in 29 patients who underwent SPF at one institution; 10 patients received unilateral S2AI screws, and 19 patients received unilateral iliac bolts. The following variables were studied: reoperation rates, pseudarthrosis, sacral insufficiency fracture, hardware prominence, infection, proximal junctional kyphosis (PJK), deformity correction (radiographs), windshield wipering, hardware fracture, and hardware removal. Outcomes were analyzed utilizing both the visual analog scale (VAS) and Oswestry Disability Index (ODI). The mean follow-up period was 27 months.

Results: The reoperation rate for unilateral S2AI screws was 30% vs. 53% for unilateral iliac bolts (P = 0.43); reoperations were performed with a 1:5 ratio for infection, a 1:4 ratio for pseudarthrosis, and 1:1 a ratio for PJK comparing S2AI screws to iliac bolts, respectively.

Conclusion: There were no significant differences in postoperative complications and reoperation rates between unilateral S2AI screws and unilateral iliac bolts utilized for SPF. For the S2AI screw group, there were no instances of hardware prominence or need for removal. The use of unilateral S2AI screws resulted in adequate fixation and comparably low complication rates.

Key Words: Iliac bolts, reoperation rates, S2 alar-iliac screws, spinopelvic fixation, unilateral fixation

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INTRODUCTION

Some traditional spinopelvic fixation (SPF) techniques have high reported complication rates.[6] Here, we compared the efficacy of unilateral iliac bolts vs. unilateral S2AI screws for performing SPF. Unilateral S2 alar-iliac (S2AI) screws are a newer alternative for SPF stabilization technique vs. the traditional bilateral

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techniques.[2,3] Potential clinical benefits of unilateral S2AI screws include: less hardware prominence, easier placement of screws in line with the other screws without requiring offset connectors, and similar biomechanical stiffness vs. bolts.[1]

MATERIALS AND METHODS

Deformity correction, complication rates, and outcomes were studied in patients undergoing unilateral S2AI screws vs. unilateral iliac bolts for SPF for *de novo* scoliosis or kyphosis. Nineteen patients received unilateral iliac bolts vs. 10 who received unilateral S2AI screws [Table 1]. Patients averaged 67 ± 9 years of age, including 22 females (76%) and 11 smokers (38%). Patients were followed an average of 27 ± 17 months, and underwent assessment of quality of life outcomes (visual analog scale (VAS) and Oswestry Disability Index (ODI)) over a 2-year postoperative period.

Charts were reviewed for reoperation rates, L5-S1 pseudarthrosis, sacral insufficiency fracture, hardware prominence, infection, proximal junctional kyphosis (PJK), windshield wipering, hardware fracture, and hardware removal.

Radiographic and clinical assessment of outcomes

All radiographic measurements utilized the Surgimap Spine 2.2.10 (Nemaris Inc., New York, NY, USA) software and included assessment of lumbar lordosis (LL), pelvic tilt (PT), pelvic incidence (PI), PI-LL mismatch, sagittal vertical axis (SVA), Cobb angle, and trunk shift.

Statistical evaluation

Fisher's exact test or Pearson Chi-square tests determined the statistical significance for reoperation rates. For continuous variables, a two-tailed Student's *t*-test was performed. Statistical significance was set at $P < 0.05$.

RESULTS

Radiographic outcomes

Utilizing postoperative lumbar posterioanterior and lateral films (1.5 and 3 months) and full-length scoliosis standing radiographs (0.5 and 1 year) [Figure 1], the following significant differences were found preoperatively between S2AI screws and iliac bolts, respectively: SVA (95 ± 37 vs. 61 ± 36; $P = 0.02$), LL (27 ± 11 vs. 39 ± 10; $P = 0.01$), PI – LL (34 ± 10 vs. 20 ± 14; $P = 0.02$), and trunk shift (55 ± 33 vs. 31 ± 20; $P = 0.02$). Significant differences were also found in

Table 1: Characteristics of patients undergoing spinopelvic fixation

Baseline demographic data	Unilateral S2AI screw	Unilateral iliac bolt
Total number of patients	10	19
F/U period (months)	20.10	31.16
Mean age in years (range)	69 (48-82)	67 (51-84)
Number of females (%)	7 (70)	15 (79)
Smoking history (%)	4 (40)	7 (37)

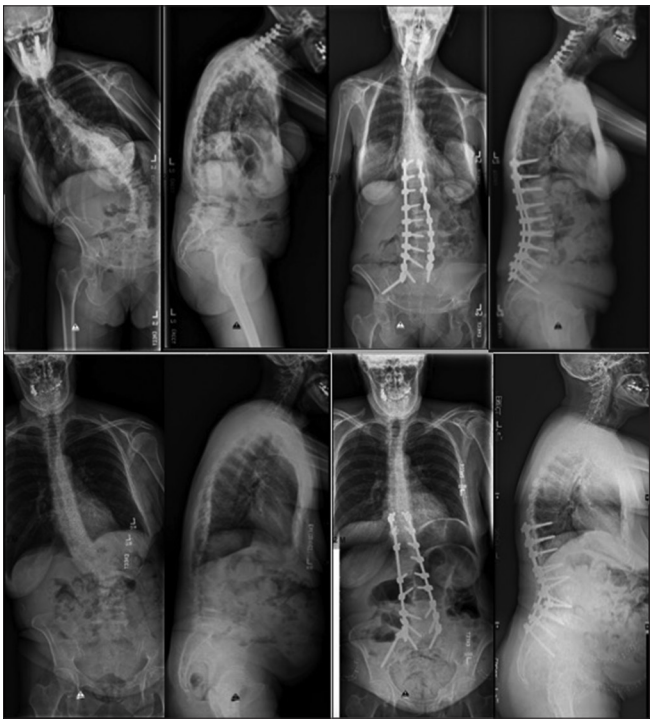

Figure 1: Preoperative and two-year postoperative posteroanterior and lateral radiographs of spinopelvic fixation in (upper row) a patient who underwent direct lateral interbody fusion (DLIF) L2-L5 and SPF with a unilateral S2 sacro-iliac screw and (lower row) a patient who underwent SPF with a unilateral iliac bolt

Table 2: Mean radiographic parameters for unilateral S2AI screw and unilateral iliac bolt groups

Radiographic parameter	Time point	Mean±SD		*P*
		Unilateral S2AI screw	Unilateral iliac bolt	
Cobb angle	Preop	39±16	33±13	0.28
	Postop	13±9	12±9	0.77
SVA	Preop	95±37	61±36	0.02
	Postop	26±30	27±20	0.91
LL	Preop	27±11	39±10	0.01
	Postop	45±9	49±5	0.13
PI	Average	61±5	61±9	1.00
PI-LL	Preop	34±10	20±14	0.01
	Postop	13±7	10±8	0.33
Trunk shift	Preop	55±33	31±20	0.02
	Postop	22±19	26±12	0.49
Change in LL		21±15	9±7	0.01
Change in Cobb angle		28±15	25±15	0.61
Change in SVA		68±43	30±21	0.01

Two-tailed Student's *t*-test was used to calculate *P*

change in LL (21 ± 15 vs. 9 ± 7; $P = 0.01$) and change in SVA (68 ± 43 vs. 30 ± 21; $P = 0.01$) [Figure 2 and Table 2].

The VAS and ODI showed no significant difference between the two groups [Figure 3 and Table 3].

Postoperative complications

The reoperation rate for unilateral S2AI screws was 30% vs. a 53% rate for unilateral iliac bolts; reoperations were for infection (1 vs. 5), pseudarthrosis (1 vs. 4), and PJK (1 vs. 1) [Figure 4 and Table 4]. In both groups deformity correction was maintained, and there were no hardware-related complaints at the lumbosacral junction.

DISCUSSION

The present study provides comparative clinical data of SPF constructs using unilateral S2AI screws vs. unilateral iliac bolts. Here, no significant differences were found between the two groups regarding change in quality of life measures (ODI, VAS for back pain, and VAS for leg pain). Furthermore, both groups achieved significant clinical improvement using accepted values of minimal clinically important difference of 20%.[5] Radiographic measurements showed improvement in Cobb angle, LL, and SVA for both groups. Maintenance of deformity correction was observed throughout the postoperative period except for the cases of PJK. Notably, the unilateral S2AI screw group included patients with a greater preoperative sagittal deformity and decreased preoperative lumbar lordosis which may have contributed to their greater absolute improvement in these radiographic parameters.

Table 3: VAS and ODI changes for the unilateral S2AI screw and unilateral iliac bolt groups

Variable	Mean±SD		*P*
	Unilateral S2AI screw	Unilateral iliac bolt	
ODI (% change)	69±30	36±41	0.20
VAS back pain (cm change)	4.79±2.25	2.44±3.66	0.12
VAS leg pain (cm change)	5.34±3.17	3.17±2.62	0.18

Table 4: Postoperative complications and reoperation rates for the unilateral S2AI screw and unilateral iliac bolt groups

Summary of complications	Number (%)	
	Unilateral S2AI screw	Unilateral iliac bolt
Reoperation	3 (30)	10 (53)
L5-S1 pseudarthrosis	1 (10)	3 (16)
Sacral insufficiency fracture	0 (0)	0 (0)
Hardware prominence	0 (0)	2 (11)
Infection	1 (10)	5 (26)
Windshield wipering	2 (20)	0 (0)
Proximal junctional kyphosis	1 (10)	5 (26)
Hardware fracture	0 (0)	7 (37)
Hardware removal	0 (0)	2 (11)

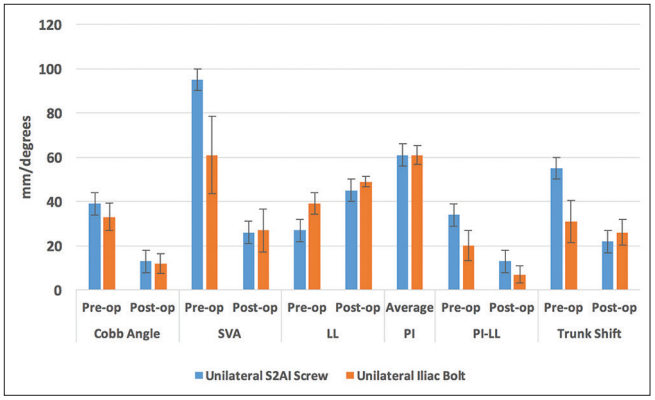

Figure 2: Bar graph of radiographic parameters for unilateral S2AI screw and unilateral iliac bolt groups. Error bars indicate 95% confidence interval

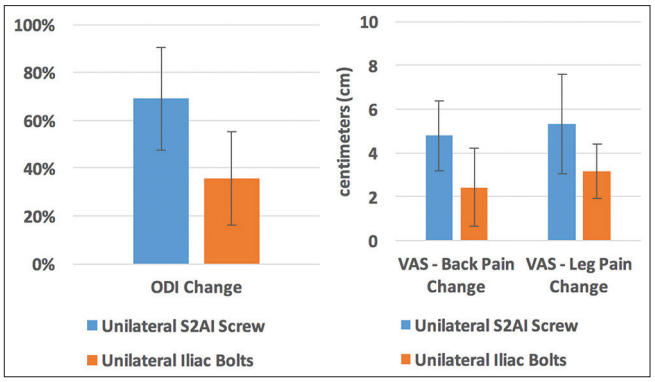

Figure 3: Change in clinical quality of life measures including (left) Oswestry disability index (ODI), (right) visual analog scale (VAS) for back pain and VAS for leg pain. Preoperative and most recent postoperative measurements are used to measure change for both the unilateral S2AI screw and unilateral iliac bolt groups. Error bars indicate 95% confidence interval

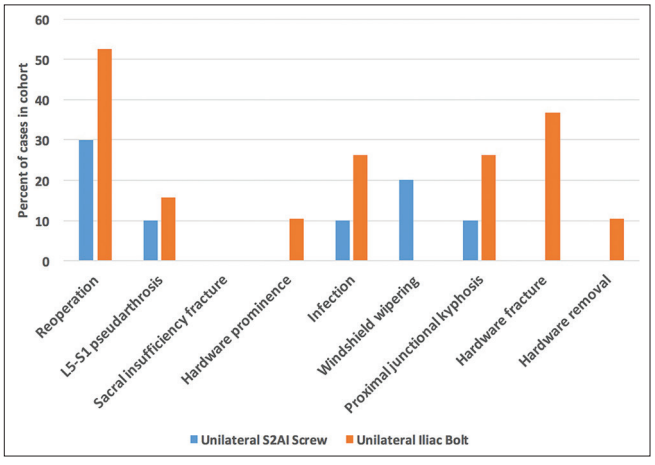

Figure 4: Postoperative complication rates and reoperation rate for the unilateral S2AI group and the unilateral iliac bolt group

The reoperation rate for unilateral S2AI screws was comparable to the unilateral iliac bolts; these data were comparable to those found in two published retrospective series.[3,4] Future double-blind randomized controlled trials would provide more definitive conclusions on the safety and efficacy of unilateral S2AI screws compared to unilateral iliac bolts.

CONCLUSIONS

This study documented no significant differences in postoperative complications for unilateral S2AI screws vs. unilateral iliac bolts for performing SPF.

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Conflicts of interest
There are no conflicts of interest.

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