An S-2 alar iliac pelvic fixation

Technical note

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Multiple techniques of pelvic fixation exist. Distal fixation to the pelvis is crucial for spinal deformity surgery. Fixation techniques such as transiliac bars, iliac bolts, and iliosacral screws are commonly used, but these techniques may require separate incisions for placement, leading to potential wound complications and increased dissection. Additionally, the use of transverse connector bars is almost always necessary with these techniques, as their placement is not in line with the S-1 pedicle screw and cephalad instrumentation. The S-2 alar iliac pelvic fixation is a newer technique that has been developed to address some of these issues. It is an in-line technique that can be placed during an open procedure or percutaneously. (DOI: 10.3171/2010.1.FOCUS09268)

KEY WORDS • sacropelvic fixation • iliac fixation • percutaneous approach

Distal fixation in thoracolumbar spinal deformity surgery is crucial when arthrodesis to the sacrum is indicated.10 Multiple studies have shown that long instrumentation and fusion to the sacrum without supplemental pelvic fixation predisposes to fixation failure and reoperation.3,4,12 Kim and colleagues6 have shown that the L5–S1 junction is the single level with the highest incidence of pseudarthrosis in adult scoliosis surgery, with a rate of 24%. Pseudarthrosis in adult thoracolumbar spinal deformity surgery is associated with adverse clinical outcomes.2 Multiple techniques exist for spinal fixation distal to S-1 pedicle screws. Techniques for pelvic fixation include transiliac bars, iliac bolts, and iliosacral screws. These techniques frequently require separate incisions for placement or the use of offset connectors, adding to surgical time and morbidity.1,5,7,11 The S2–AI technique is an alternative, low-profile, in-line technique that can provide distal fixation in spinal deformity surgery.

Case Report

We describe the case of a 73-year-old woman who underwent laminectomy 10 years prior to presentation. At presentation she complained of significant low-back pain, which had worsened over the last few years, and, at present time, she had pain at rest as well. Her activity level had declined significantly due to her pain. Nonop-erative management, including 8 epidural injections and 2 courses of physical therapy, had failed to resolve her pain. At the time of presentation, she was taking high-dose oral narcotics on a daily basis without durable pain relief. The patient was neurologically intact with respect to leg sensation and motor function.

Imaging studies showed a postlaminectomy degenerative scoliosis with severe hypertrophy of facet joints. The worst areas were L2–3 and L4–5, with moderate degeneration of L3–4. Radiographs demonstrated a 35° dextroscoliotic degenerative lumbar curve from T-11 to L-5. Lateral listhesis of 5 mm was noted at L3–4. After a discussion of the risks and benefits of surgery, the patient agreed to undergo corrective spinal surgery to address her postlaminectomy spinal deformity.

Operative Technique

The patient underwent a 2-stage posterior–anterior lumbar fusion and stabilization with instrumentation. The first operation was a revision posterior decompression and fusion with instrumentation placed from T-10 to the pelvis, including S2–AI screws.

The patient was given general anesthesia and placed prone on a Jackson frame to enhance lumbar lordosis. Prophylactic antibiotics were administered and the patient’s back was prepared and draped in a sterile fashion. The previous incision was used and extended proximally to the T-9 level. Dissection was carried out through the subcutaneous tissue to the fascial layer. Using a Cobb

Abbreviation used in this paper: S2–AI = S-2 alar iliac.
elevator and electrocautery for dissection, the spinous processes of L-1 and L-2, remnant laminae of L-2, L-3, L-4, L-5, S-1, along with S-2, were exposed. A localizing radiograph was acquired to confirm the levels. Dissection was carried out over the facet joints to the transverse processes. The sacrum was exposed to the level of the S-1 foramen. Next, revision decompression of the neural elements was undertaken from L-1 to S-1 by mobilizing the scar-bone interface and performing complete bilateral facetectomy. Then, pedicle screws were placed using internal and external landmarks from T-10 to S-1, with the exception of the right pedicle of T-12, which was skipped due to medial wall perforation.

Following this step, using fluoroscopic guidance, S2–AI screws were placed bilaterally. The starting point is 1 mm inferior and 1 mm lateral to the S-1 dorsal foramen, which was directly visualized. Angulation was directed toward the greater trochanter and approximately 30° anterior from the floor. A 3.5-mm pelvic drill (extended length) was used to “tap” drill through the sacroiliac articulation. On average, it will be at 35–40 mm before the ilium is reached. The anteroposterior radiograph is used to ensure placement cephalad to the sciatic notch. The pelvic inlet radiograph is then used to ensure extrapelvic placement, as judged by viewing the anterior sacroiliac joint (see Fig. 4). Once the drill was in the ilium, a ball-tipped probe was placed into the ilium and manually advanced through the cancellous bed until a cortex is reached. The length was measured and the tract was then tapped past the sacroiliac articulation. A 7 × 80–mm screw was inserted. Again, radiography was used to evaluate placement.

Final steps during this operation included the placement of posterior interbody cages at L2–3 and L3–4, as well as prophylactic vertebroplasty at T-9 to prevent proximal junctional kyphosis due to fracture. Appropriate-length rods were contoured and the spine was reduced to the coronally straight rods. Segmental compression was applied to the construct and the end caps were torqued down. Copious irrigation of the wound and arthrodesis followed. Local bone, cancellous chips, demineralized bone matrix, and iliac crest were placed onto the decor- ticated surfaces. The wound was closed in layers. The patient tolerated this procedure well and recovered in the hospital until transfer to a rehabilitation center on postoperative Day 10.

The second-stage anterior discectomy and fusion of L5–S1 was performed 1 month after the first operation. A right retroperitoneal exposure was done by a fellowship-trained vascular surgeon. The L5–S1 disc space was exposed and the great vessels protected. A discectomy was performed, the endplates prepared, and a femoral ring allograft filled with demineralized bone matrix was placed at L5–S1. An anterior plate was used with 2 locking screws in both L-5 and S-1. The surgical wound was irrigated and closed by the approach surgeon without complication. The patient again recovered in the hospital and was discharged to home on postoperative Day 3. Standing radiographs showed adequate alignment and hardware placement at 1 year postoperatively (Fig. 1).

At 1-year follow-up, the patient was off all narcotic medications and had returned to independent activities. Her Oswestry Disability Index score improved from 50 preoperatively to 20 at 1 year postoperatively.

Fig. 1. Standing 3-ft radiographs of S2–AI pelvic fixation in a patient treated for thoracolumbar spinal deformity.

Fig. 2. Percutaneous placement in a cadaveric specimen: the screws have been placed in full on the left side and the rod advanced. This image illustrates the S2–AI screw in line with the cephalad instrumentation.
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Discussion

An S2–AI sacropelvic fixation is a new technique described contemporaneously by Dr. Sponseller and Dr. Kebaish for use in the pediatric and adult population, respectively. O'Brien et al. adapted it for use in minimally invasive applications (Fig. 2). The S2–AI technique for pelvic fixation is a modification of an S-2 alar screw driven through the sacroiliac articulation into the iliac wing. This technique is preferable because the screws have a lower profile and are in line with cephalad instrumentation. On average, the S2–AI screw was 2 cm deeper than the starting point for a traditional iliac screw. The relatively deeper location and smaller dissection to place the S2–AI screw is crucial in cases where wound breakdown can be an issue—such as in neuromuscular scoliosis. Furthermore, with 4 years of clinical experience, the authors have found no need for the use of offset connectors to link long constructs to the S2–AI screws, even with the presence of dual-bilateral S2–AI screw placement.

Concerns have been raised regarding the penetration of the sacroiliac articulation by the S2–AI screw. It is important to review the sacroiliac joint articulation to address these concerns. Anatomical studies have demonstrated that the projection of the lateral sacral mass on the ilium is larger than the projection of the sacroiliac articular cartilage. The posterior aspect of the sacroiliac joint corresponds to a nonarticular area. In a cadaveric study, O’Brian et al. found that approximately 60% of S2–AI screws did violate the articular cartilage of the sacroiliac joint (Fig. 3). Though a concern, the clinical significance of this penetration is unknown. It is important to note that traditional iliac screws do bridge the sacroiliac joint with fixation on either side of it. At 5–10 years postoperatively, Tsuchiya et al. found no increase in sacroiliac degeneration with traditional iliac fixation. Two-year prospective clinical data have been presented on the S2–AI technique at the 2009 Annual Meetings of the Scoliosis Research Society and North American Spine Society (Sponseller PD et al., presented at the Scoliosis Research Society Annual Meeting, 2009; and Kebaish K et al., presented at the North American Spine Society Annual Meeting, 2009). The authors have found no increase in sacroiliac degeneration or pain at 2-year follow-up in either adult or pediatric populations. More long-term data are needed, but the S2–AI technique exhibits promise as a good alternative to iliac fixation at this time.

The S2–AI screw can be placed by either open or percutaneous approaches, a detail that currently limits the application of traditional iliac fixation. Wang et al. used minimally invasive technique to place iliac screws; however, these constructs did not include S1 pedicle screws. No reports currently exist that have placed minimally invasive iliac screws with S1 pedicle screws. Recently, O’Brien and colleagues found that percutaneous S2–AI placement was feasible, reproducible, and safe in a cadaveric feasibility study. As centers move toward expanding the application of minimally invasive spine surgery, it is crucial to have a minimally invasive spine fixation option.
Conclusions

The S2–AI fixation is a potential option in open and minimally invasive spinal surgery. The screws are in-line with cephalad instrumentation, are approximately 2 cm deeper compared with iliac screws, cross-connectors are not needed, and lengths of 80–100 mm are attainable. Limitations of the technique include direct penetration of the sacroiliac joint, and pending biomechanical evaluation.

Disclosure

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

References


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