

## Management of traumatic sacral spondyloptosis: illustrative case

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**BACKGROUND** Grade V spondylolisthesis, or spondyloptosis, is a complication of high-energy trauma that is most commonly reported at the lumbosacral junction. Sacral intersegmental spondyloptosis is extremely rare. The authors present a case of spondyloptosis of S1 on S2 with a comminuted fracture of S2 and complex fractures of the L4 and L5 transverse processes, resulting in severe stenosis of the lumbosacral nerve roots.

**OBSERVATIONS** The patient was a 70-year-old woman with a history of a fall 3 weeks prior and progressive L5 and S1 radiculopathy. Instrumentation and fusion were undertaken, extending from L3 to the pelvis because degenerative stenosis at L3–4 and L4–5 was also found. Reduction was achieved, leading to diminished pain and partial resolution of weakness.

**LESSONS** Traumatic sacral spondyloptosis adds a degree of difficulty to reduction, fixation, and fusion. The technique presented herein achieved sagittal realignment via a distraction maneuver of S1–2 in which rods were attached to bilateral dual S2 alar-iliac screws with reduction screws placed at S1, ultimately pulling L5 and S1 up to the rod for fixation.

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**KEYWORDS** spondyloptosis; spondylolisthesis; spine surgery; sacral; spinal fusion

The purpose of this article is to present a rare case of traumatic sacral intersegmental spondyloptosis causing lumbopelvic dissociation and severe lumbosacral stenosis with L5 and S1 radiculopathy.

### Illustrative Case

A 70-year-old woman with a history of type 2 diabetes mellitus and osteoporosis presented to the emergency department with a chief complaint of right lower extremity pain and numbness, which was preceded by a fall from a standing position onto her buttocks 3 weeks prior. Her neurological examination was notable for weakness of right dorsiflexion (3 of 5), weakness of right plantarflexion (1 of 5), weakness on extension of the great toe (1 of 5), and intact rectal tone. The patient did not have bowel or bladder symptoms; however, she did have saddle anesthesia of 3 weeks' duration. Computed tomography and magnetic resonance imaging showed spondyloptosis of S1 on S2, a comminuted fracture of S2, complex fractures of the L4 and L5 transverse processes, and degenerative stenosis at L3–4 and L4–5, leading to severe lumbosacral stenosis (Fig. 1).

Lumbosacral fusion for reduction of the spondyloptosis with pedicle screws from L3 through S1 in addition to dual S2 alar-iliac (S2AI) screw placement bilaterally was performed. After exposure of the bilateral

transverse processes of L3–5 and the sacral ala, pilot holes for pedicle screw placement from L3 through S1 and also for the S2AI screw entry site were marked. Then, with augmented reality guidance, pedicle screw holes from L3 through L5 were cannulated on both sides. Dual screws were placed for S2AI screw fixation bilaterally. Cannulation of the pedicles of S1 was completed, followed by type 1 Smith-Petersen osteotomies with bilateral medial facetectomies at L4–5 and L5–S1 and bilateral hemilaminotomies of L3–4 to decompress the spinal canal at the L3–4 segment, where the patient had stenosis. Pedicle screws were placed from L3 through S2, with fenestrated screws placed at L3 for cement augmentation of the L3 vertebral body. Last, we performed a distraction maneuver of S1–2 in which rods were attached to the S2AI screws with reduction screws placed at S1, ultimately pulling L5 and S1 up to the rod and locking rods on both sides from L3 to S2. Bone morphogenetic protein, demineralized bone matrix, and local autograft from the osteotomies were used for arthrodesis.

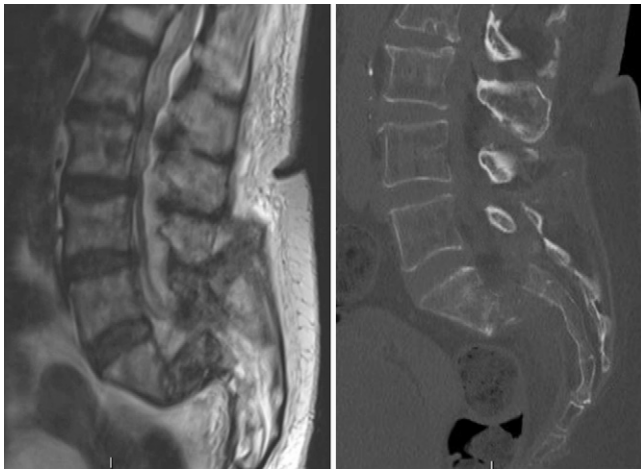
The patient tolerated the procedure well and immediately noted significant pain relief in the right lower extremity as well as improved sensation. Postoperative imaging demonstrated reduction of the spondyloptosis (Fig. 2). Her neurological examination improved to 4/5

**ABBREVIATION** S2AI = S2 alar-iliac.

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**FIG. 1.** Preoperative lumbar sagittal T2-weighted magnetic resonance imaging (left) and computed tomography (right). Spondyloptosis is noted at S1–2 with severe central stenosis.

dorsiflexion but was otherwise stable. She was continent in bowel and bladder function throughout her hospital course. The endocrinology service was consulted and recommended starting anabolic therapy. The patient was discharged to subacute rehabilitation on postoperative day 7. At follow-up 2 weeks after discharge, the patient noted that she was recovering well and could now walk with a walker.

## Discussion

### Observations

Spondyloptosis is a complication of high-energy trauma that typically occurs at the lumbosacral junction following a fall from a height or a road traffic accident.<sup>1,2</sup> Sagittal plane spondyloptosis is

more common than coronal plane spondyloptosis.<sup>1</sup> Sacral intersegmental spondyloptosis in adults is extremely rare because fusion of the five sacral segments should be complete before the third decade of life.<sup>3</sup> Three other cases of an adult with sacral spondyloptosis have been reported in the literature, only one of which was treated surgically.<sup>2,4,5</sup>

Management of spondyloptosis is dependent on (1) the duration of time that has passed following traumatic injury and (2) the extent of the neurological deficit. A report of sacral spondyloptosis in a 27-year-old female athlete revealed complete fusion of the posterior aspect of S2 with the anterior aspect of S3 within 5 years following trauma without surgical intervention, as the injury went unnoticed with no neurological deficits and minimal pain was experienced by the patient.<sup>4</sup> However, spondyloptosis with neural sparing is extremely rare, and realignment may or may not lead to partial recovery of function.<sup>1,6</sup> Mishra et al.<sup>2</sup> reported a case of spondyloptosis of S1 over S2 with a concomitant burst fracture at L2 in a 27-year-old female following a car accident, resulting in complete paraplegia. The patient did not wish to undergo surgery for spondyloptosis and was operated on only for an associated L2 burst fracture, and no neurological function was recovered prior to hospital discharge or during the follow-up period.<sup>2</sup>

The single reported case of sacral spondyloptosis treated surgically was published in 1993, prior to the availability of technology such as S2AI screws, which authors note would have likely reduced the bulkiness of and complications associated with instrumentation used in repair.<sup>5</sup> A 21-year-old female had fallen 30 feet and landed on her feet, resulting in spondyloptosis of S1 over S2, which was reduced using large forceps and fixed using a double-cobra plate secured with screws to the ilia, a reconstruction plate used for parallel fixation, pedicle screws in L3 and L4, and rods secured to the pelvic plates with laminar hooks to create a two-point fixation base for distraction.<sup>5</sup> Although the patient's postoperative course was



**FIG. 2.** Preoperative (A) versus postoperative (B) sagittal computed tomography shows reduction of sacral spondyloptosis. Postoperative lateral (C) and anteroposterior (D) radiographs show hardware between L3 and S2.

complicated by both a persistent cerebrospinal fluid leak necessitating fat and fascia lata grafts and infection requiring debridement and a free latissimus dorsi flap, the patient was free of pain and able to walk almost normally 3 years later.<sup>5</sup>

Early intervention and complete realignment should be prioritized to prevent the progression of compressive nerve damage and limit residual listhesis, because duration of injury is associated with postoperative residual listhesis, and residual listhesis is associated with postoperative nociceptive and neuropathic pain.<sup>1</sup>

## Lessons

In summary, this is a rare case of sacral spondyloptosis in the setting of osteoporosis that was corrected using a reduction screw at S1 in addition to dual bilateral S2Al screws. There are limitations, given that this is a single case and one of few sacral spondyloptosis cases to be reported in the literature. However, it is important to note that in such cases, both early intervention and complete realignment should be prioritized. Finally, the reduction method described herein is an effective treatment for sacral spondyloptosis, resulting in both decreased pain and neurological improvement.

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## Disclosures

Dr. Bydon reported serving as a consultant for Nuvasive spine. Dr. Witham reported being an Advisory Board Member (unpaid) and stockholder from Augmedics and receiving grants from Gordon and Marilyn Macklin Foundation outside the submitted work. No other disclosures were reported.

## Author Contributions

Conception and design: Witham, Tracz, Judy, Sacino. Acquisition of data: Witham, Judy, Sacino. Analysis and interpretation of data: Witham, Judy, Sacino. Drafting the article: Tracz, Judy. Critically revising the article: Witham, Tracz, Judy, Bydon. Reviewed submitted version of manuscript: Witham, Tracz, Judy, Sacino. Approved the final version of the manuscript on behalf of all authors: Witham. Study supervision: Witham.

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