

# Correction of degenerative lumbar coronal deformity using asymmetrical interbody cages: Surgical technique and case report

## ABSTRACT

In adult degenerative spondylosis, much emphasis has been placed upon recognizing the sagittal plane deformity and techniques to restore this alignment. However, the coronal plane deformity has not received much attention and, if left uncorrected, may lead to poorer outcomes. Here, we present a case of degenerative lumbar scoliosis with a rigid coronal malalignment secondary to a dysplastic sacrum. We performed staged T11–pelvis lateral and posterior approach to address this deformity. For the first stage, a lateral lumbar interbody fusion was performed at the concavity of the curve from L3 to L5. For the second stage, through posterior approach, a long-segment instrumentation from T11 to pelvis was done along with bilateral asymmetrical posterior lumbar interbody fusion of L5–S1 to level the L5 vertebra at the hemi-curve, thereby leveling the coronal deformity. We propose, for cases with a rigid coronal deformity due to bony dysplasia, correction through the disc space using asymmetrical interbody cages as in this case offers the surgeon an option to achieve a desired correction, without the need for vertebral osteotomy.

**Keywords:** Deformity, lumbar vertebrae, scoliosis, spinal fusion, spondylosis

## INTRODUCTION

While most of the research on degenerative lumbar spondylosis focuses on sagittal malalignment, the coronal plane deformity has not received much attention. Nevertheless, emerging literature highlights the importance of correcting the coronal plane as failing to do so might be associated with high risk of implant failure, decreased health-related quality of life, and further coronal decompensation postcorrection.<sup>[1,2]</sup> The established classification systems of coronal deformity can be found in the original work of Bao *et al.*<sup>[3]</sup> and Obeid *et al.*,<sup>[4]</sup> respectively. Both these works acknowledged the importance of extending the level of instrumentation and correction in the presence of a rigid and degenerated L5–S1 junction as spontaneous correction will not eventuate. While there are many techniques to correct such coronal malalignment, from soft tissue releases to corrective osteotomies, we present a case wherein correction was achieved using bilateral asymmetric interbody cages at L5–S1 in addition to double-level lateral lumbar interbody fusion (LLIF) and multilevel instrumentation.

## CASE PRESENTATION

A 65-year-old male first came to our clinic with low back pain and neurogenic claudication, worsening over 6 months. He had a history of psoriatic arthritis but no other significant medical history. Conservative management with activity modification, physiotherapy, and oral analgesia was

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unsuccessful, and he was unable to perform his regular work. On examination, he had limited range of spinal motion due to stiffness and all classical signs of pain and radiculopathy. There was no sensory deficit; however, power was reduced to Grade 4 in the right L5 myotome.

Standing radiographs showed degenerative lumbar scoliosis with a L4–L5 Grade 1 spondylolisthesis [Figure 1]. Sagittal spinal parameters measured indicated decreased lumbar lordosis ( $16^\circ$ ), sagittal vertical axis (SVA) of 12 cm, a pelvic incidence of  $58^\circ$ , and a pelvic tilt of  $31^\circ$ . Coronal parameters measured indicated a Cobb's angle (L1–L5) of  $16^\circ$ , with a Nanjing Type C and Obeid Type 2A2 coronal curve. The distance between the central sacral vertical line (CSVL)

and the midpoint of the superior endplate of L3 was 3 cm. Computed tomography of the thoracolumbar spine showed obliquity of the sacral endplate with symmetrical disc height, resulting in a tilted L5 vertebra [Figure 2]. Magnetic resonance imaging reported spinal canal stenosis along with foraminal narrowing at L3–4, L4–5, and L5–S1 levels.

A two-stage surgery was planned. First, L3–L5 LLIF was performed. The retroperitoneal space was entered through established lateral approach and oblique corridor was identified.<sup>[5]</sup> Left psoas muscle was retracted, and disc spaces of L3–L4 and L4–L5 were accessed. Following discectomy, wide-bodied polyetheretherketone (PEEK) cages filled with bone morphogenetic proteins (BMPs) and demineralized

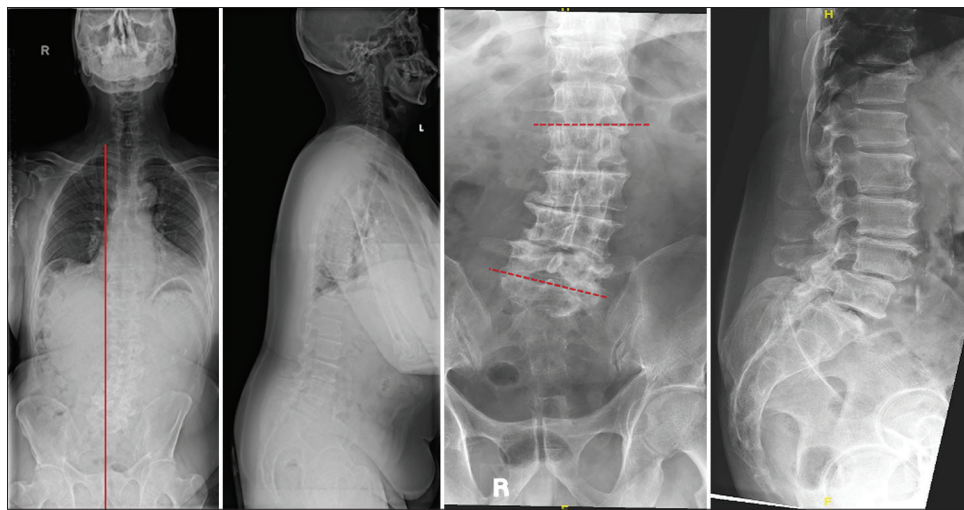


Figure 1: Preoperative standing X-rays showing Grade 1 L4–L5 spondylolisthesis, sagittal vertical axis of 12 cm, pelvic incidence of  $58^\circ$ , pelvic tilt of  $31^\circ$  and lumbar lordosis of  $16^\circ$  (L1–L5). Standing scoliosis X-rays demonstrate Nanjing Type C, Obeid Type 2A2 coronal curve

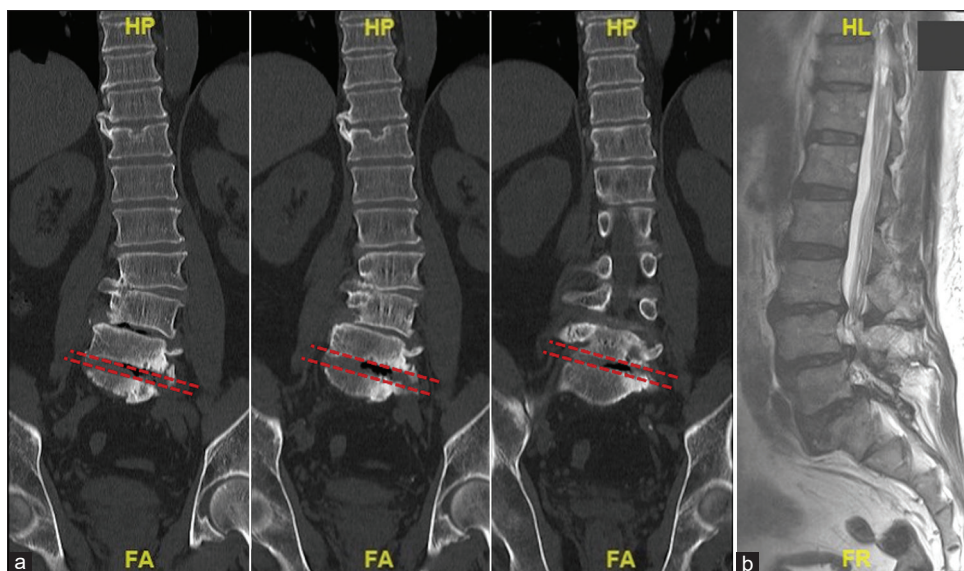


Figure 2: (a) Preoperative computed tomography of lumbar spine demonstrating the oblique sacral tilt with symmetrical L5–S1 disc space, resulting in a tilted L5 vertebral body that was the main driver of his scoliosis. (b) Preoperative magnetic resonance sagittal image of the lumbosacral spine showing multilevel spinal stenosis

bone matrix (DBM) were inserted. Postoperative standing X-rays revealed improvement in the main curve of deformity; however, the overall coronal balance had decompensated further [Figure 3].

Five days later, via posterior approach and navigation guidance, posterior surgery was done wherein screws were inserted from T9 to the pelvis. L3–L4 laminectomies and bilateral facetectomies at L3–L4 and L4–L5 were performed. Bilateral asymmetrical posterior lumbar interbody fusion (PLIF) at L5–S1 was then performed to correct the coronal deformity. The collapsed disc space was distracted (left more than the right to horizontalize the L5

vertebra) using screw-based distractors. Cages measuring 11 mm × 26 mm and 7 mm × 26 mm packed with BMPs and bone graft were implanted on the left and right side, respectively. By placing cages of asymmetric heights, we were able to overcome the sacral obliquity and level the L5 vertebra without the need of an osteotomy [Figure 4a-c]. Contoured rods were inserted, and construct was completed. A combination of interfacetal and posterolateral fusion was performed from T11 to L3.

Postoperatively, he was fitted with a thoracolumbosacral orthosis, mobilized, and discharged on day 9. Two months later, standing radiographs were taken [Figure 5]. The sagittal

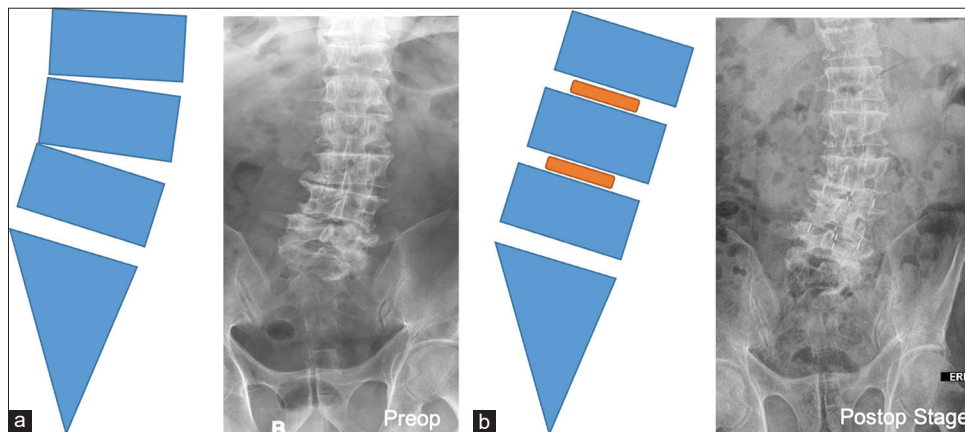


Figure 3: (a) Asymmetrical L3–L4 and L4–L5 disc spaces contributing to coronal deformity, (b) after stage 1 (lateral lumbar interbody fusion), coronal imbalance progressed due to the existing sacral tilt

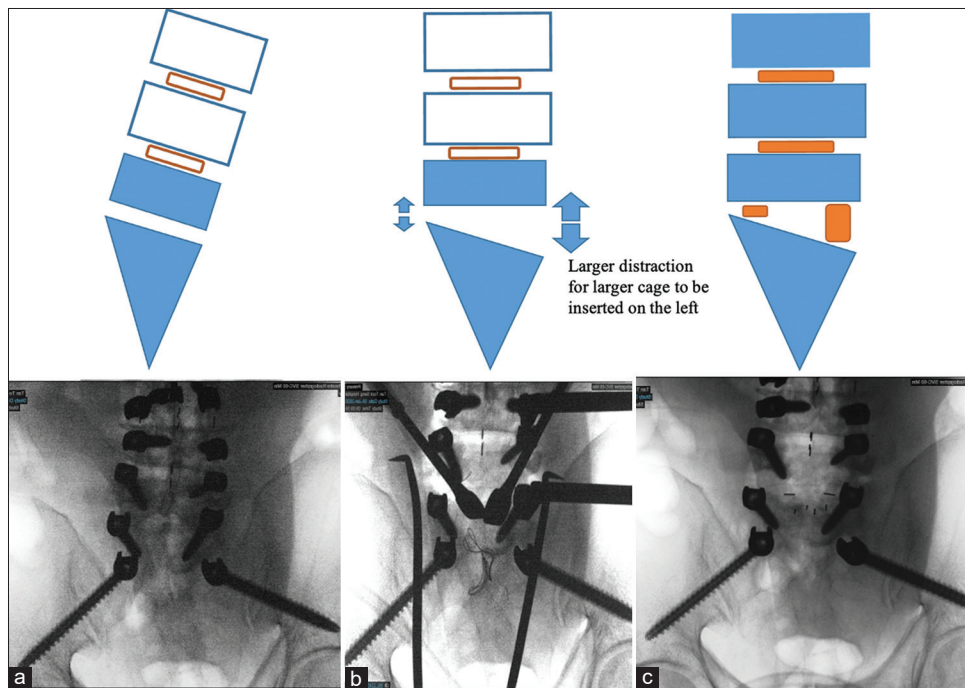
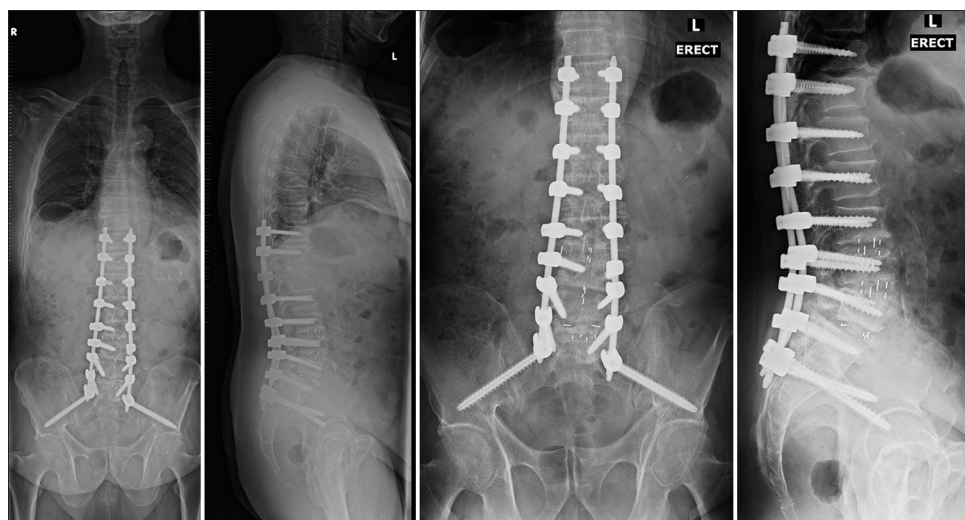


Figure 4: (a) Coronal imbalance secondary to oblique sacrum take off, resulting in tilted L5 vertebral body. (b) Bilateral wide decompression and asymmetric distraction using a screw-based distractor, to horizontalize L5 superior endplate. (c) Bilateral PLIF cages used to maintain correction and prevent point loading, with T11–pelvis instrumentation



**Figure 5: Sixth-month postoperative X-rays – Scoliosis long films and thoracolumbar anteroposterior and lateral views**

parameters showed an improved lumbar lordosis of  $38^\circ$  and improved SVA (6.5 cm anterior to the superioposterior endplate of S1). Pelvic incidence remained unchanged and pelvic tilt was  $28^\circ$ . The Cobb's angle (L1–L5) improved to  $5^\circ$ , and CSVL was central. He was able to ambulate independently, and symptoms of low back pain and lower limb claudication resolved completely. Further follow-up was uneventful.

## DISCUSSION

Correction of the lumbosacral junction poses a greater challenge than the midlumbar region. This area is typically recessed between the two iliac wings and may already have some form of partial fusion (sacralization). In our patient, there was a Type C coronal imbalance and a rigid lumbosacral junction with a sacral obliquity. This was the main driver of his truncal shift. The disc space was however symmetrical, and therefore, if usual interbody fusion was done, this alone would not address his problem.

Hence, in the first stage of surgery, L3–L5 LLIF was performed via the oblique (anterior to psoas) approach placing the cages as anteriorly as possible to achieve lordosis.<sup>[6]</sup> This improved the sagittal balance. However, the major curve was accentuated due to the existing oblique take off at the sacrum, with symmetrical disc space at L5–S1. To address this, we chose to use asymmetrical PLIF cages for L5–S1. Subsequently, a T11–pelvis long-segment posterior instrumentation with iliac extension was done to maintain the correction with a solid lever arm on the sacropelvic foundation.<sup>[3]</sup> Here, the keys to complete correction were the (1) posterior wide release, (2) bilateral screw-based distraction, (3) leveling of the L5 endplates, (4) insertion of asymmetric cages to level the oblique sacrum, and

(5) final compression and distraction to fine tune the desired correction.

A similar concept of asymmetrical interbody fusion with the use of unilateral interbody cage placement on the concave side has been demonstrated in four cases by Heary and Karimi, wherein a mean  $17.9^\circ$  of coronal plane deformity correction was achieved.<sup>[7]</sup> In our case, the use of two cages maximized the total surface area between cage and endplate interface, and this reduces the risk of subsidence as load to failure increases.<sup>[8,9]</sup> In addition, the correction through disc spaces allows us to avoid performing vertebral osteotomies, which have traditionally been indicated in severe and rigid spinal deformity.<sup>[10]</sup>

## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the journal. The patient understands that his name and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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