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The Spine Journal 11 (2011) 1068–1072

THE SPINE JOURNAL

Case Report

# Vertebral body fractures after transpsoas interbody fusion procedures

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Received 9 February 2011; revised 5 May 2011; accepted 1 July 2011

**Abstract**

**BACKGROUND CONTEXT:** Although the frequency of transpsoas lumbar interbody fusion procedures has increased in recent years, complication reports remain scarce in the literature.

**PURPOSE:** To present four cases of vertebral body fracture after transpsoas interbody fusion procedures in nonosteoporotic patients without significant trauma and discuss relevant biomechanical factors.

**STUDY DESIGN:** Case series and literature review.

**PATIENT SAMPLE:** Patients 1 and 2 were obese men who underwent one- and two-level transpsoas interbody fusion procedures and subsequently experienced coronal plane fracture. Patients 3 and 4 were elderly women who underwent multilevel transpsoas interbody fusion procedures and experienced L5 compression fracture.

**RESULTS:** Patients 2 and 3 were treated nonsurgically after fracture. The fractures healed uneventfully; however, Patient 3 developed a flat back syndrome. Patient 1 underwent posterior instrumented fusion and had solid bridging bone above and below the fracture. Patient 4 was treated with vertebroplasty. Factors potentially contributing to these fractures were discussed.

**CONCLUSIONS:** Fracture can occur after transpsoas lumbar interbody fusion, even in nonosteoporotic patients. Factors, such as intraoperative end-plate breach, subsidence, compression by lateral screws, and cage rolling, could contribute to the development of fractures after transpsoas interbody fusion. 

*Keywords:* Compression fracture; Coronal plane fracture; Lateral interbody fusion; Transpsoas; XLIF

## Introduction

The retroperitoneal transpsoas approach to the lumbar spine has been recently popularized for performing interbody fusions. The direct lateral entryway through the psoas major muscle decreases tissue damage and risk of great vessel injury associated with anterior approaches to the spine [1].

Despite the increasing number of transpsoas interbody fusions being performed, complication reports are still lacking in the literature. To our knowledge, reports of vertebral body fracture after transpsoas interbody fusion remain rare and include cases of nonprogressive end-plate breach [2] and osteoporotic patients without history of significant trauma [3–5]. Here, we report two cases of vertebral body coronal plane fracture after one- and two-level transpsoas interbody fusion procedures and two cases of L5 vertebral body compression fracture after multilevel transpsoas interbody fusion procedures, all of which occurred in nonosteoporotic patients without significant prior trauma.

## Case 1: coronal plane fracture of L4

Patient 1 is a 58-year-old man with a body mass index (BMI) of 32 (height: 6’0’’/183 cm; weight: 240 lbs/109 kg) who did not meet the criteria to get a dual energy

FDA device/drug status: Approved (fusion devices, plates and screws). Investigational (Total Facet Arthroplasty System).

Author disclosures: ***JEBJ:*** Nothing to disclose. ***DKP:*** Nothing to disclose. ***SI:*** Nothing to disclose. ***WKC:*** Research Support (staff and/or materials): Musculoskeletal Transplant Society (B, Paid directly to institution/employer), Stryker (C, Paid directly to institution/employer).

The disclosure key can be found on the Table of Contents and at www.TheSpineJournalOnline.com.

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1529-9430/$ - see front matter 
doi:10.1016/j.spinee.2011.07.020

X-ray absorptiometry scan to assess for osteoporosis. The patient presented with low back pain and bilateral leg pain. Radiographically, the patient had spondylolisthesis and spondylosis at L3–L5 without signs of significant stenosis. This patient was in severe pain and became a candidate for surgery after exhausting conservative treatment.

The patient underwent two-level transpsoas interbody fusion. At L3–L4, a 12×18×55-mm cage was implanted with a lateral two-screw XLP plate (Nuvasive, Inc., San Diego, CA, USA). At the level of L4–L5, an 8×18×55-mm Nuvasive XLF cage/plate construct was placed and supplemented with two lateral screws. Bone morphogenic protein (BMP) was placed in both cages (Fig. 1, Left).

One week after surgery, the patient's pain was significantly intensified without recollection of significant trauma. A computed tomography (CT) scan was ordered that revealed a coronal plane fracture at L4 (Fig. 1, Middle). After exhausting extensive pain management, posterior fusion with pedicle screw instrumentation was performed to stabilize the fracture (Fig. 1, Right). The patient's pain level stabilized and began to improve soon after.

### Case 2: coronal plane fracture of L5

Patient 2 is a 54-year-old man with a BMI of 43 (height: 5'8''/173 cm; weight: 285 lbs/129 kg) who did not meet the criteria to get a dual energy X-ray absorptiometry scan to assess for osteoporosis and who presented with back and right leg pain. The patient underwent decompression and total facet replacement for stenosis and Grade 1 spondylolisthesis and experienced postoperative complications of unilateral facet stem lucency and hardware migration (Fig. 2A, B). The patient exhausted extensive pain management and required a fusion for stabilization. The decision to fuse the L4 and L5 vertebral bodies using a lateral transpsoas approach was made in part because the large patient size precluded an anterior approach and cemented instrumentation precluded a posterior approach. A 14×18×50-mm Nuvasive cage with BMP was placed at L4–L5 and supplemented with a Nuvasive XLP plate (Fig. 2C).

Within 2 weeks of surgery, the patient experienced extreme pain in his back, left leg, and thigh when trying to get out of bed. Computed tomography showed a coronal plane fracture of L5 (Fig. 2D). Options were given, and the patient decided to have nonsurgical treatment. The patient's pain significantly improved in a lumbosacral orthosis. The patient's fracture healed, and he returned to work (Fig. 2E).

### Case 3: compression fracture of L5

Patient 3 is a 66-year-old woman with a BMI of 24 (height: 5'4"/163 cm; weight: 140 lbs/64 kg) and a normal femoral neck *T* score of −0.9 who presented with severe back and hip pain radiating down to the left thigh and leg. She was diagnosed with degenerative 65° scoliosis, stenosis, failed back syndrome, and lateral listhesis. This patient became a candidate for spinal surgery after exhausting conservative treatment.

The patient underwent a four-level lateral interbody fusion from L1–L5 (Fig. 3, Left). A 10×18×50-mm Nuvasive cage with BMP was implanted at each level from L1–L4, and a 12×18×55-mm Nuvasive cage with BMP was implanted at level L4–L5. After being reprepped, the patient received a T10–L5 posterolateral revision decompression, fusion, instrumentation, and bone graft. Posterior instrumentation from T10–L5 included 0.25-inch titanium rods and pedicle screws (Medtronic, Inc., Minneapolis, MN, USA).

After 8 weeks, the patient was found to have experienced a compression fracture of L5 resulting in 40% vertebral body height loss and increased L4–L5 anterolisthesis

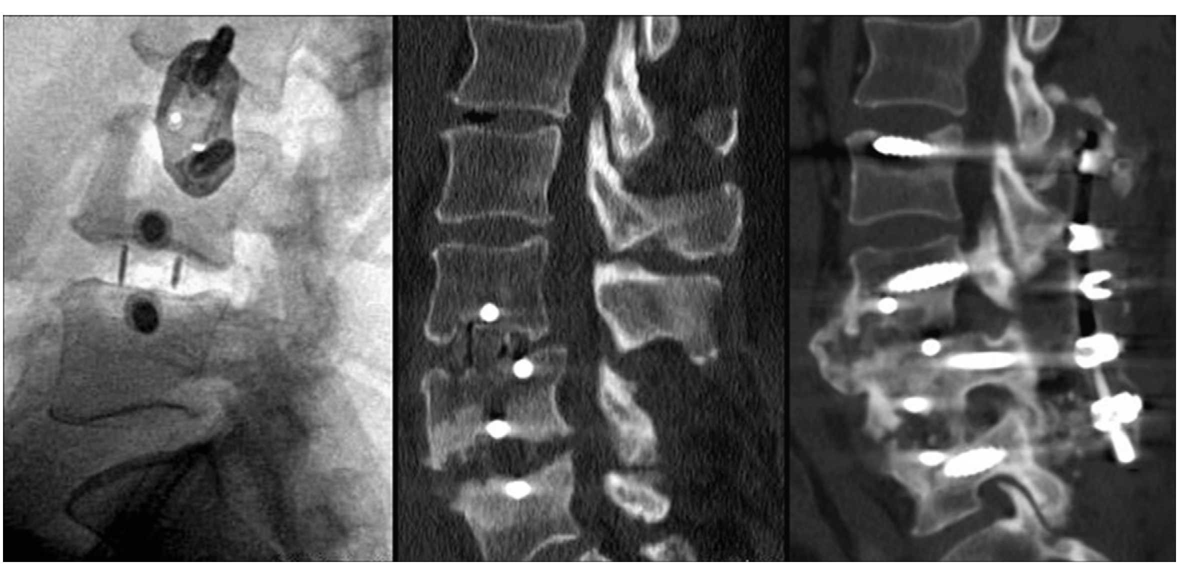

Fig. 1. (Left) Intraoperative lateral radiograph and computed tomography scans showing (Middle) coronal plane fracture initially and (Right) again 4 months later with posterior instrumentation.

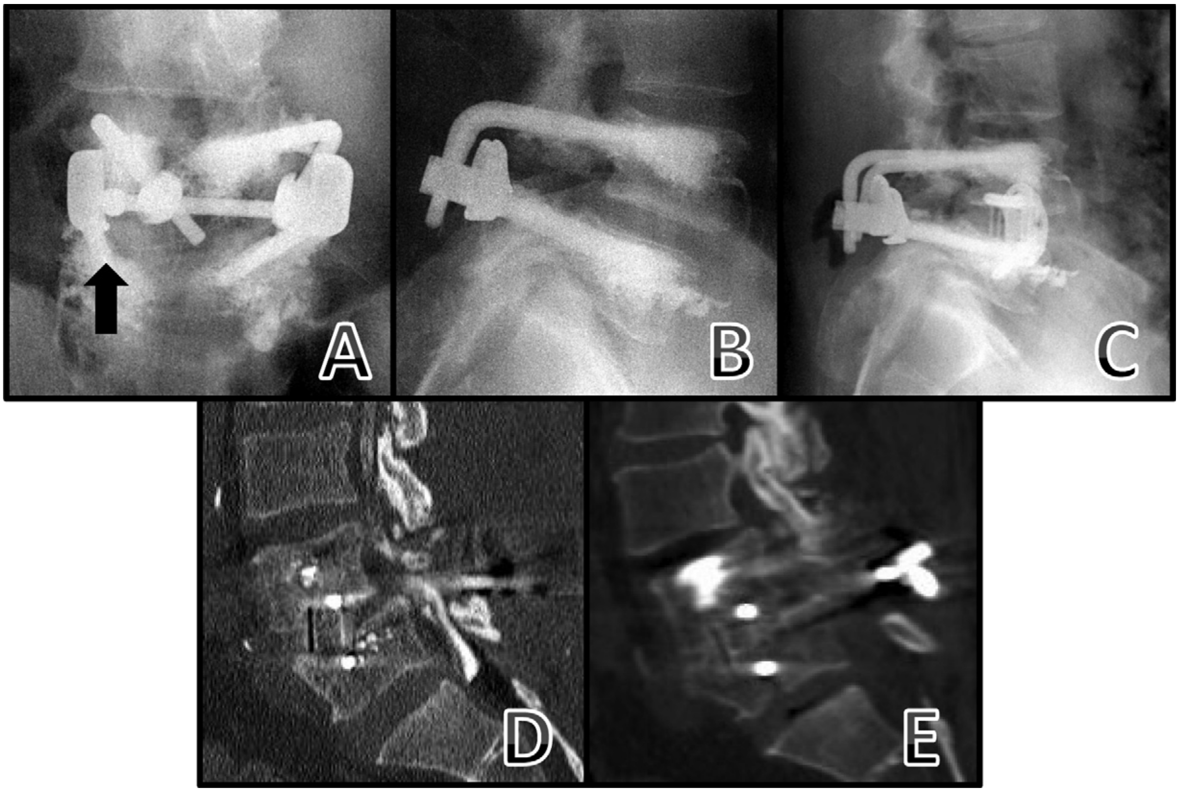


Fig. 2. (A) Anteroposterior and (B) lateral radiographs showing failed total facet arthroplasty system (TFAS; Archus Orthopedics, Redmond, WA, USA) (hardware migration is indicated by arrow), (C) immediate postoperative lateral radiograph, and (D) computed tomography scans showing the L5 coronal plane fracture initially and (E) 15 months postoperatively.

with no history of significant trauma (Fig. 3, Middle). She was subsequently assessed and diagnosed with flat back syndrome from local kyphosis at L5. This was explained, and a surgical option was suggested; however, surgery was never performed. After 14 months, L4–L5 fusion was observed on CT (Fig. 3, Right). The patient had persistent back pain and leg pain at her 2-year follow up.

## Case 4: compression fracture of L5

Patient 4 is a 76-year-old woman with a BMI of 25 (height: 5'3"/155 cm; weight: 144 lbs/65 kg). The patient had a normal femoral neck *T* score of −0.4 and a history of L5–S1 fusion, three-level low-grade spondylolisthesis and recent L1–L4 revision decompression and posterolateral fusion

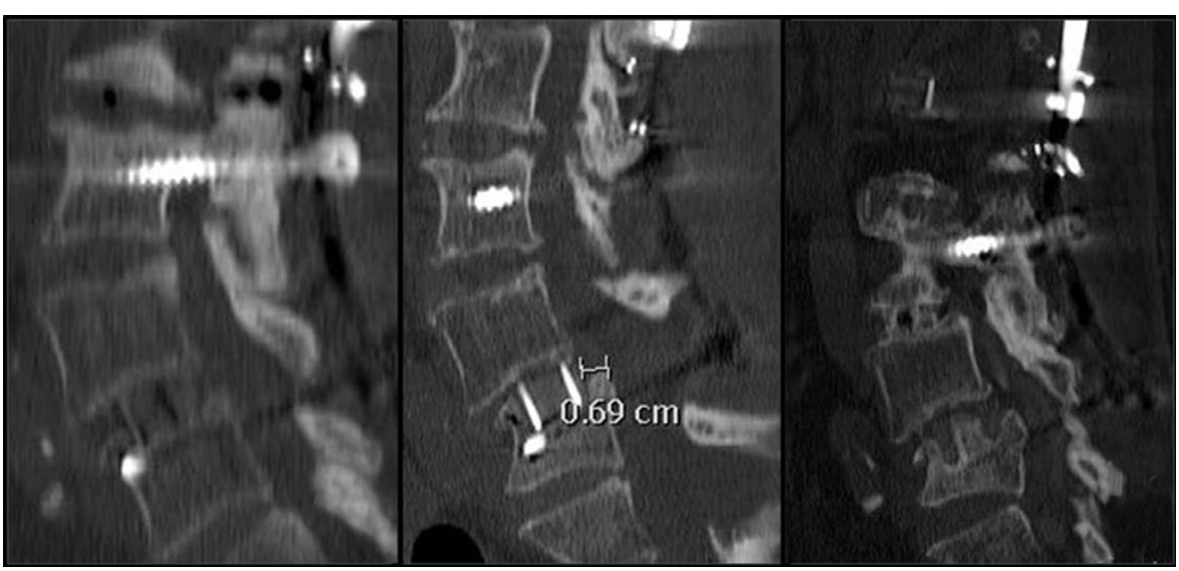


Fig. 3. (Left) Computed tomography scans of patient postoperatively, prefracture; (Middle) postfracture, 2 months postoperatively; and (Right) 14 months postoperatively.

(Fig. 4A). Pseudarthrosis, as evidenced by posterior hardware lucency, and gross movement developed after the surgery. It was determined that an L2–L5 transpsoas interbody fusion procedure was required to augment her posterolateral fusion to stabilize her spine.

An 18×8×50-mm polyether-ether-ketone Cougar cage (Depuy, Inc., Warsaw, IN, USA) was installed in the L2–L3 intervertebral space with an Aegis plate. An 18×12×50-mm polyether-ether-ketone Cougar cage was implanted at L4–L5 (Fig. 4B). Computed tomography images taken within days after the surgery revealed a wedge fracture of the superior aspect of L5 (Fig. 4C). Because of severe pain, the patient underwent vertebroplasty with polymethylmethacrylate cement and revision of posterior instrumentation. At 1-year follow up, CT images showed successful fusion with clinical improvement (Fig. 4D).

## Discussion

This report describes four cases of vertebral body fracture after transpsoas lumbar interbody fusion procedures. Two obese male patients underwent one- and two-level transpsoas interbody fusion procedures, respectively, and subsequently experienced coronal plane fracture. Two elderly female patients underwent multilevel transpsoas interbody fusion procedures and subsequently experienced compression fracture at L5.

The biomechanical performance and failure characteristics of lateral interbody constructs are scarce [3,5] in the literature. In a recent biomechanical evaluation, Cappuccino et al. [6] have shown that the lateral approach technique remarkably reduced segmental motion when supported with posterior fixation. However, they did not present any data or explain any potential failure mechanisms of lateral interbody fusion constructs.

As seen in the current cases, a major mode of failure for the lateral interbody construct is coronal fracture in the vertebral body and end plate. We think that the failure of the construct was initiated at the end plate around the screws. Placement of screws close to the end plate can destruct subchondral trabecular support and alter the motion of the end-plate under loading and thus the stress distribution over the end plate. We speculate that this alteration in the stresses on the end plate caused the fracture and cage subsidence. The violation of end plates during overzealous preparation for grafting or implant placement might have also contributed to the end-plate fracture. Load transfer through the fused segment occurred via the screw-plate system after the cage subsided. When an adjacent level also had a lateral plate construct, two screws within the same vertebra formed a plane where trabecular strength was weakened the most. Further loading of the multiple levels eventually resulted in a coronal fracture of the vertebra. Similar mechanisms have also been proposed in reports of fracture in osteoporotic patients and in cadaveric studies [3,5,7,8].

As shown in the biomechanical analysis performed by Cappuccino et al. [6], the lateral plate and cage construct showed significant motion in the sagittal plane when compared with lateral interbody fusion with posterior fixation. It should be noted that their results are from the L3–L4 level, which is naturally more stable in the sagittal plane compared with lower lumbar levels. Also, considering that the patients in our cases were lacking in anteroposterior stability to some degree because of spondylolisthesis and so on, the stability provided by the lateral plate and cage construct might have been further reduced compared with the stability of the nondiseased lumbar segments analyzed by Cappuccino et al. Therefore, it is possible that the lateral plate and cage construct may be vulnerable to sagittal motion and anteroposterior translation, which may lead to subsequent cage rolling or migration during flexion and extension of the spine. Because the interbody cage design was not wide enough in this plane as seen in the CT images, it may not have provided the necessary biomechanical stability to restrict anteroposterior movement. In this case,

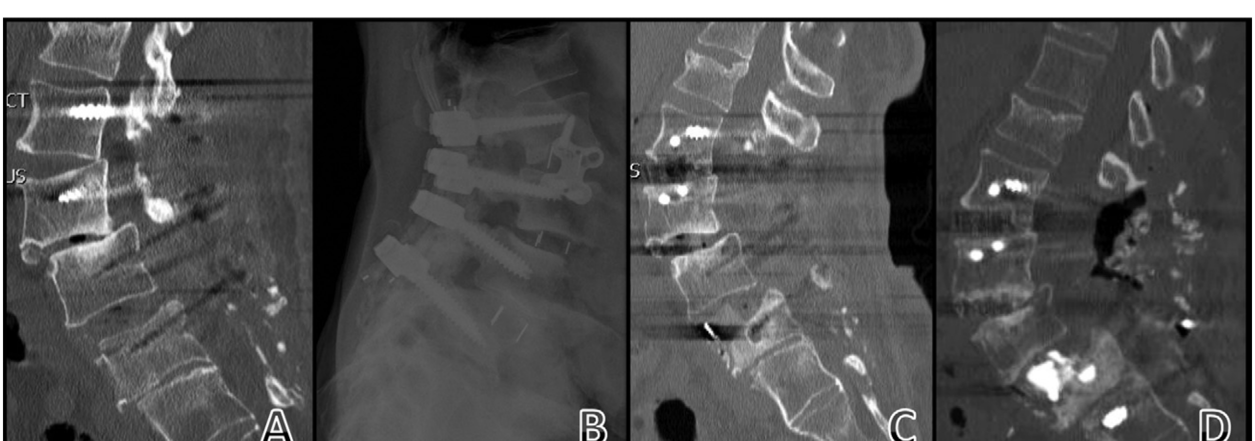


Fig. 4. Computed tomography (CT) scans showing (A) previous posterior instrumentation, (B) immediate postoperative lateral radiograph, (C) L5 wedge fracture, and (D) the fracture site 1 year postoperatively.

the edges of the interbody implant would constitute stress risers on the end plates and would contribute to end-plate fracture. It should be noted that this might be a reason why the cages are in line with the coronal vertebral body fractures seen in Cases 1 and 2 radiographs.

The cases presented in this report show fractures soon after or during transpsoas interbody fusion procedures in four nonosteoporotic patients. Various factors might have contributed to these fractures, including intraoperative end-plate breach, subsidence, compression by lateral screws, cage rolling because of cage aspect ratio, and inadequate construct stability in the sagittal plane. Further investigation and biomechanical data are required to determine the etiologies of these fractures. Based on these fracture reports, we caution surgeons that transpsoas interbody fusion is not without risk of postoperative clinical complications, even in nonosteoporotic patients.

## Acknowledgments

The authors thank Elisabeth Clarke, Kathleen Elias, and Mary Kolb for all of their administrative help.

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