

Vertebral body fracture after TLIF: a new complication

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Abstract

Background The transforaminal posterior approach (TLIF) procedure was first described in 1982. Current literature indicates its equality in outcomes for fusion constructs as other anterior-posterior procedures. As a procedure becomes more popular and is more frequently performed the types and number of complications that occur increase. We report on a two case series that underwent TLIF. Both patients had satisfactory postoperative imaging, but presented later with coronal plane vertebral body fractures in the caudal vertebral body of the TLIF construct. We believe the complication may be related to: (a) unrecognized fracture of the endplate during cage impaction; (b) overloading the endplates by maximizing the lordosis achieved by using the reverse jackknife position on a Jackson table; (c) underlying mineral bone disease in patients. As the TLIF procedure increases in

popularity, caution should be exercised to avoid the same potential complications.

Purpose To describe a potential complication with the TLIF procedure.

Study design Case report.

Patient sample 2.

Outcome measure Revision surgery.

Methods Case series.

Results Caudal vertebral body fracture is a potential complication after TLIF.

Conclusion TLIF procedures can result in an unstable vertebral body fracture potentially necessitating revision decompression & stabilization. We recommend extra caution in patients with mineral bone disease, as technical errors can be magnified.

Keywords Lumbar fusion · TLIF · Vertebral fracture · Revision surgery

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Introduction

Degenerative spondylolisthesis is an acquired type of spinal stenosis caused by relative subluxation of one vertebra on an adjacent vertebra. Non-operative management for this disease processes has consensus amongst spine surgeons involving multi-modal treatment methods: NSAIDs, physical therapy (PT), and epidural steroid injections. Surgical treatment options are varied as different fusion techniques are proven to be successful and advances are being made in minimally invasive approaches.

Harms first described anterior interbody fusion through a transforaminal posterior approach (TLIF) in 1982 [1]. This procedure allows for access to the

Fig. 1 Four views of the lumbar spine **a** AP, **b** lateral, **c** extension, **d** flexion showing L4/L5 spondylolisthesis



intervertebral disc space from a posterior approach. The anterior column is more amenable to fusion because of the compressive forces transmitted across its motion segments. TLIF offers the potential benefit of an anterior and posterior column fusion (360° fusion), without the morbidity of the anterior retroperitoneal approach, and the higher reported complication rate compared to that of direct posterior interbody fusion [2–4]. Current literature indicates that the TLIF procedure not only provides

equivalent restoration of disc height to the 360° fusion, but that it also represents potential cost savings to the hospital with decreased OR time, less blood loss, and shorter hospital stays [5–7].

We report a new complication of coronal plane vertebral body fracture, requiring revision posterior decompression and extension of fusion construct in two patients after a single level TLIF for degenerative spondylolisthesis and spinal stenosis.

Fig. 2 AP (a) and lateral (b) of lumbar spine after TLIF



Case report 1

JO is a 63-year-old male with over 2 years of low back and predominantly right leg pain that had been worsening. Of note the patient has hepatitis C and is currently on the transplant list. His social history is significant for smoking 30 cigarettes per day. Prior to presenting to the office the patient underwent a yearlong trial of non-operative management, and had significant narcotic pain medication requirements. Pain was exacerbated with walking and the patient reported mild weakness with right quadriceps compared to contralateral side. Pre-operative lumbar spine radiographs (Fig. 1) showed degenerative spondylolisthesis at L4/L5. Magnetic resonance imaging (MRI) revealed spinal stenosis with foraminal narrowing on the right at L4/L5. Subsequent TLIF procedure performed without complication (Fig. 2), upright postoperative lumbar spine X-rays were judged to be satisfactory, with good lumbar lordosis and excellent alignment. The patient was discharged from hospital on post-operative day 3. At the 2-week postoperative visit patient returned to office with significant pain in the back, weakness and increasing pain in the right lower extremity. On clinical exam, L4 graded 0/5 for power, L5 1/5, and S1 3/5. Computerized tomography (CT) scan revealed a fractured endplate at L5 (Fig. 3). Given the changing neurologic exam, and the imaging findings, the patient was taken for revision posterior decompression, and spinal fusion with extension of his construct from the pelvis to L1.

The decision to fuse to the pelvis was made due to the extensive decompression conducted due to deteriorating neurological exam, and poor purchase of pedicle screws in L3 and S1, and loosening of screws in L5 following

replacement. In retrospect the authors concede the extent of fusion may have been excessive (Fig. 4c, d).

At 1 month following revision fusion and decompression, the patient's neurological exam had returned to normal.

Case report 2

EA is a 47-year-old female who presented to the office with bilateral leg pain, numbness, and tingling that starts in her low back and travels down both legs to her feet. Clinical exam revealed no neurological deficit, but was significant for a BMI of 38. Pain began 3 years prior to presentation and has slowly worsened to the point of limiting her ability to walk 1 block. It was worse with extension, not alleviated by NSAIDs or PT, and significantly limited her ability to perform activities of daily living. Plain radiographs showed a sacralized L5 vertebral body in the setting of a Grade 1 L3/L4 degenerative spondylolisthesis (Fig. 5). MRI revealed spinal stenosis at the level of the spondylolisthesis. After failing 3 years of non-operative management the patient elected to proceed with surgery. TLIF at L3/4 was performed without issue and the patient was discharged home on post-operative day 3 after a non-complicated hospital course (Fig. 6). Approximately 2 weeks following surgery, after a fall from standing, the patient presented to the emergency room with worsening of her back and leg pain, described by the patient as worse than initial pre-operative pain. XR revealed graft subsidence, loss of lordosis, re-occurrence of the spondylolisthesis, and a fracture through the L4 vertebral body (Fig. 7). Following initial treatment in a clamshell orthotic, CT scan revealed further

Fig. 3 Saggital (a), (c) and coronal (b), (d) CT slices showing L5 superior endplate fracture worsening with time. Images c, d are from a CT 2 weeks after a, b



displacement of the fracture and no signs of union (Fig. 8). Given the imaging pattern and a lack of clinical improvement in the patient the decision was made to return to the operating room for revision posterior spinal fusion (Fig. 9c, d). It was decided to fuse from L1 to the pelvis due to the extent of decompression conducted, and the requirement to fuse two intact vertebral bodies above the fracture.

Discussion

Complications from the TLIF procedure have previously been reported in two groups: major & minor complications [4]. Minor complications include: interbody graft/implant malposition not requiring reoperation, pedicle screw malposition not requiring reoperation, cerebral spinal fluid

Fig. 4 AP (a) and lateral (b) extension to L1 was necessary due to the loose nature of the L5 screws and the weak purchase of the other pedicle screws

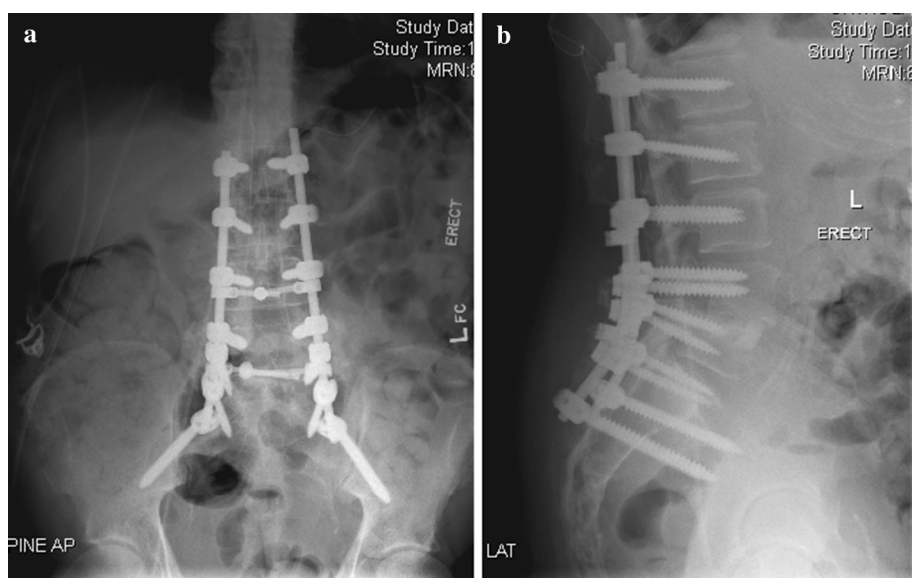
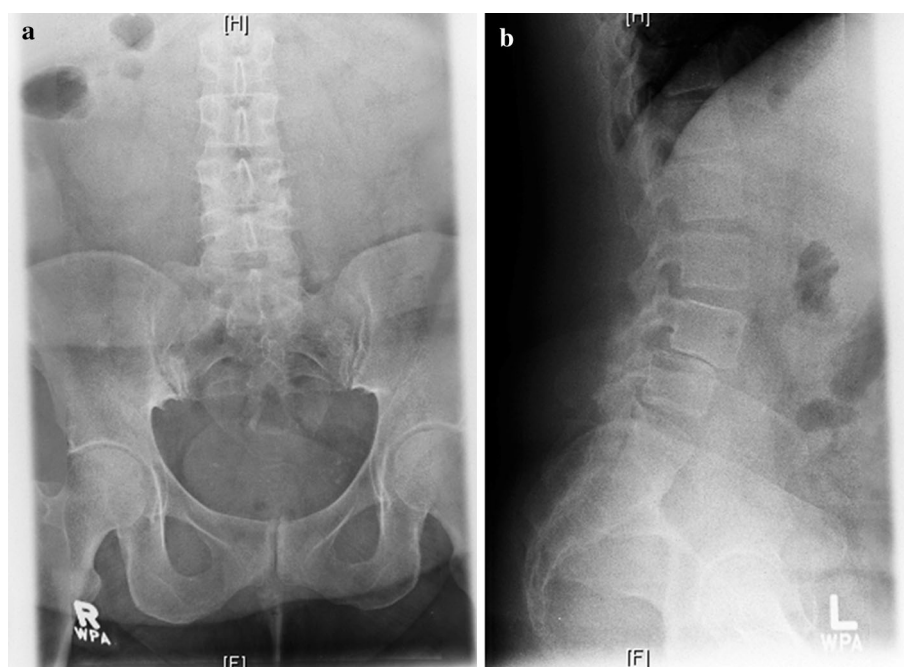


Fig. 5 AP (a) and lateral (b) of patient with L3/L4 degenerative spondylolisthesis



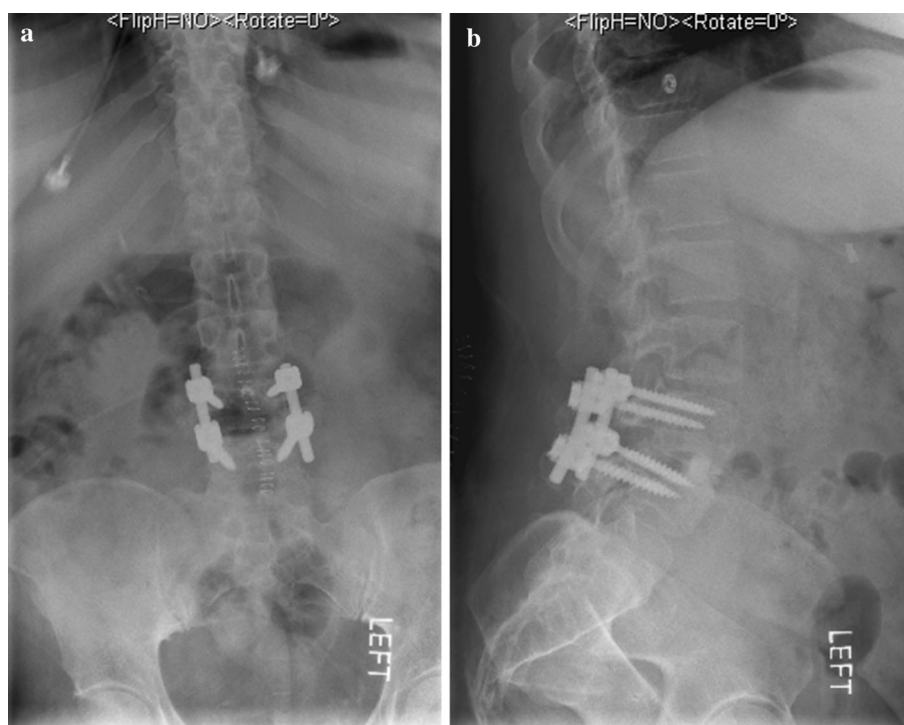
(CSF) leak, transient neurologic deficit, contralateral radiculopathy, hematoma, and anemia [4, 8].

Major complications include: interbody graft/implant malposition requiring reoperation, pedicle screw malposition requiring reoperation, neurologic deficit lasting greater than 3 months, infection, ileus more than 3 days, blood vessel damage, deep vein thrombosis, and pulmonary embolus [4].

Complication rates following TLIF are low, and similar to that of the anterior posterior lumbar interbody fusion counterparts [4]. Rates of misplaced pedicle screws during

a TLIF procedure are at 5 %, which is similar to any other procedure requiring pedicle screw placement [3]. Post-operative patients with transient neurologic deficits are documented at 2–7 % and one study looking at minimally invasive TLIF recorded a 4 % rate of neurologic deficits lasting greater than 3 months [4]. Incidental durotomy is recognized as a 4 % risk, however a series of 100 patients from 2005 reported approximately a 20 % risk of CSF leak during TLIF [5]. Incidence of infection post operatively is 5 % [5]. Manifestations of complications via gastrointestinal issues have been reported after TLIF and they

Fig. 6 AP (a) and lateral (b) of lumbar spine after TLIF



include mostly ileus as well one case of pseudomembranous colitis [5].

Potter reports over 80 % of his patients have greater than 50 % reduction in pre-operative pain, supporting the theories that TLIF works for patient with spondylolisthesis, degenerative scoliosis, and degenerative disc disease [5]. Limitations include the success of the procedure in patients with rigid coronal plane & kyphotic deformities.

We are not aware in the literature of fractures of the vertebral body after a TLIF procedure; the two cases described involve first a wedge compression fracture through the inferior endplate of L5 that led to spinal instability and recurrence of the listhesis and foraminal compression. The second case involves a coronal plane fracture of the inferior instrumented vertebra.

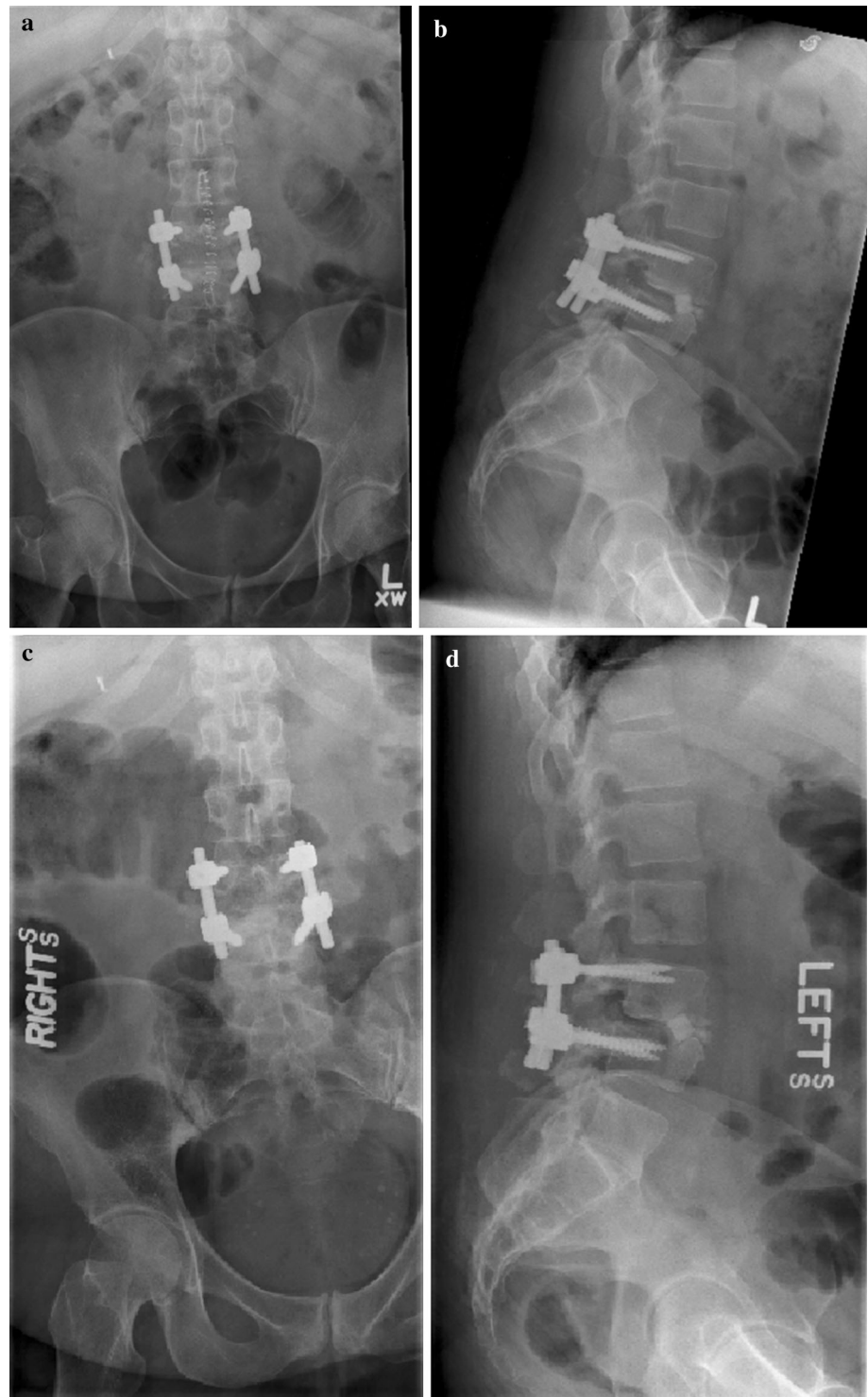
Several potential mechanisms could explain such complications:

- Pedicle screw misplacement, which means more stress has to go through the TLIF spacers.
- Occult fracture at the time of the TLIF insertion that was not recognized. It is possible that during impaction of the TLIF, the hammering of the spacer to its final position created a fragility of the endplate that leads ultimately to a fracture. The irregular surface of the spacer may impact the endplate and create a microfracture.

- Likewise during the TLIF preparation of the disc it is possible to damage the bony endplates and get into the weaker subchondral bone that will eventually collapse further under axial loading.
- Authors own technique: It has been the senior authors practice to jackknife the break of the Jackson table after the TLIF insertion in order to recreate as much lordosis as possible. As the author became more comfortable with this technique to create lordosis, the reverse break in the table had been increased up to 20°. This may have been responsible for a Nutcracker effect on the TLIF spacers and the adjacent endplate at the time of this maneuver. The weakened subchondral bone may have failed before the TLIF spacer could. Tensioning the intact ALL as we create lordosis may also accentuate this effect.
- A patient reported fall may have precipitated the fracture pattern seen in case 2.
- Patient condition: in both cases the patient was either significantly overweight or was diagnosed with metabolic bone disease. Our pre operative assessment omitted formal bone density testing, and results may have altered instrumentation strategies.

It is of note, that the senior author had performed over 200 TLIF's preceding these cases without observing this complication. The senior surgeon had recently modified his TLIF technique to include breaking the Jackson table to 20°

Fig. 7 AP (a), (c) and lateral (b), (d) XR at 2 weeks apart with fracture now evident at superior endplate of fusion construct & graft subsidence



jackknife to maximize segmental lordosis, and these two complications occurred within 2 months.

Following the observation of these complications, the senior author has modified his technique to only jackknife to 10°. This is to avoid overloading the endplates, and prevent a nutcracker effect from an intact anterior longitudinal ligament.

Lessons learned:

All the lessons are geared towards avoiding the mechanisms above.

- Careful removal of the vertebral disc material, to avoid inadvertent damage to the endplates. Thus preserving as much structural integrity as possible.

Fig. 8 Saggital (a) and axial (b) illustrating coronal plane fracture morphology of L4 vertebral body

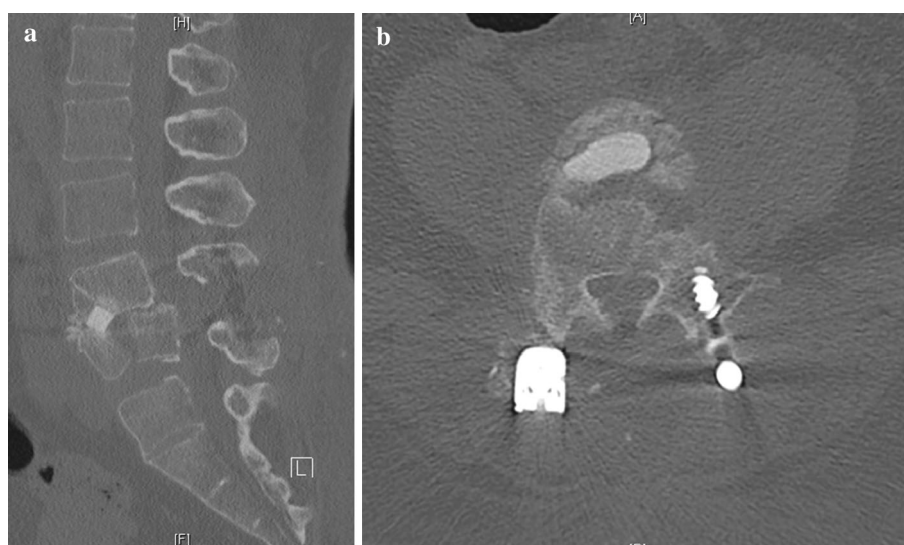
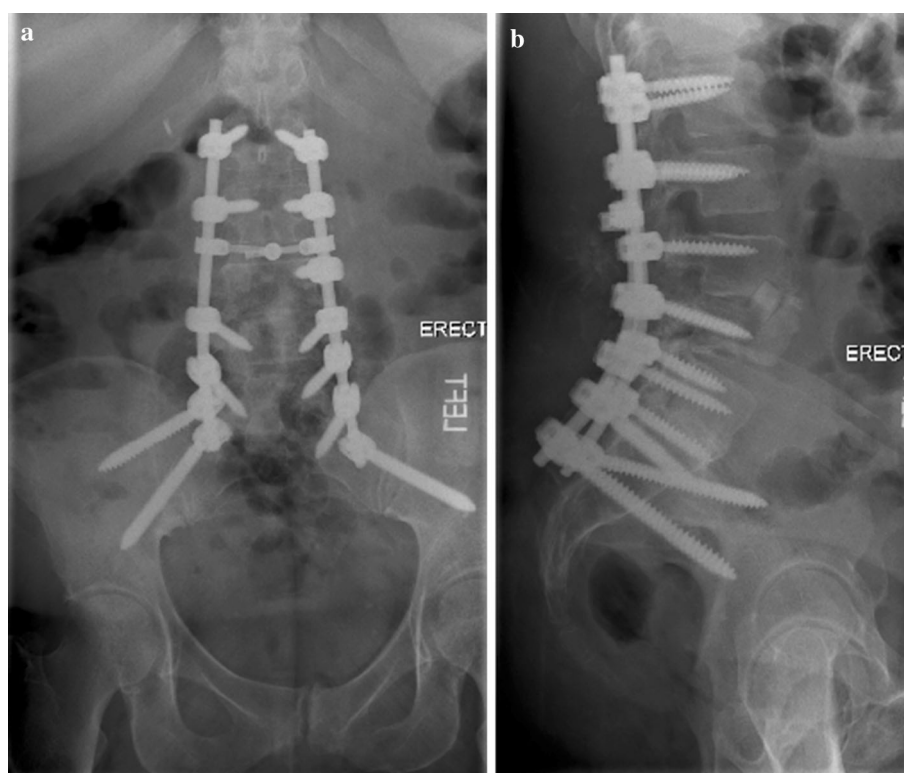


Fig. 9 AP (a) and lateral (b) after revision for fracture



- If using the reverse break on a Jackson table to re-create lordosis, care must be taken not to overload the endplates. We recommend using a maximum of 10° jackknife for the reasons above.
- Extra caution must be exercised when performing TLIF surgery in patients with metabolic bone disease, as any technical errors may be magnified by the already diminished structural strength of vertebral bodies.
- Preoperative bone testing in all patients at risk of osteoporosis.

Conclusion

Indirect reduction of the foramina and the spinal canal by achieving excessive lordosis when performing a TLIF can result in vertebral body fracture at the inferior vertebral body requiring revision and fusion construct extension. The authors recommend proceeding with caution when performing TLIF in patients with osteopenia, osteoporosis, or any other metabolic derangement that may alter bone quality as this may increase the likelihood of fracturing the

endplate and predispose the patient to needing additional more complex surgery.

Compliance with ethical standards

Conflict of interest None of the authors has any potential conflict of interest

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