



Case report

Accidental anterior longitudinal ligament rupture during lateral lumbar interbody fusion disclosed after posterior corrective fusion surgery resulting in local hyper-lordosis

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Abstract

Objective: To report a case of anterior longitudinal ligament (ALL) injury that was not noticeable during lateral lumbar interbody fusion and was disclosed after posterior corrective fusion surgery.

Case presentation: After performing lateral lumbar interbody fusion followed by posterior corrective fusion surgery, we observed an anterior longitudinal ligament rupture that required additional surgery. Postoperative pain in the left lower limb and muscle weakness due to nerve traction appeared, but this was improved by stabilization between the vertebral bodies.

Conclusion: Unidentified anterior longitudinal ligament rupture can result in unexpected local lordosis during posterior surgery, possibly related to lower extremity palsy. Therefore, checking for possible rupture during and after anterior surgery is important. If the ALL damage is disclosed before posterior surgery, the proper surgical strategy for the posterior surgery must be considered.

Key words: anterior longitudinal ligament, adult spinal deformity, allograft and fibula

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Introduction

Lumbar lordosis (LL) and pelvic incidence (PI) are ideal indications for the treatment of sagittal imbalance caused by adult spinal deformity. PI-LL mismatch is a risk factor of poor clinical outcomes and the occurrence of adjacent segmental diseases¹⁻³⁾ after corrective fusion surgery. Accordingly, the acquisition of LL due to corrective surgery has become a matter of great importance. This condition is often acquired when applying cantilever force. In surgeries addressing spinal deformity, great vessel and nerve injuries,

digestive tract injuries, endplate, and anterior longitudinal ligament (ALL) injury are known complications related to the lateral lumbar interbody fusion (LLIF) procedure⁴⁾; however, these injuries are generally not detected intraoperatively. Tatsuno *et al.* reported that ALL injury occurred in 41.2%⁵⁾ of patients who underwent corrective fusion for adult spinal deformity, making it one of the most frequent complications. Here, we report a case of significant L4/L5 anterior opening due to ALL injury during lateral interbody fusion surgery that required additional surgery.

Case report

History

A 69-year-old woman with a 7-year history of lumbar pain and intermittent limping was diagnosed as having lumbar spinal canal stenosis and underwent observation. One year before, the patient started to experience lumbar pain while walking and noticed that her trunk was dropping forward. She visited our clinic for a checkup because of the inability to maintain a standing posture and walk continuously due to persistent low back pain and pain on the poste-

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rior surface of both lower limbs. With a diagnosis of adult spinal deformity complicated by lumbar spinal canal stenosis, a two-stage anteroposterior spinal fusion was planned.

Physical examination

The patient could walk continuously for 100 m without assistance. The deep tendon reflexes in both the patellar and Achilles tendons diminished, and the muscle strengths in the upper and lower limbs were normal. The patient's sense of touch started to decline from both ankles (left: 5/10, right: 7/10). No bladder or rectal disturbances were observed.

Imaging studies

Anteroposterior radiography revealed a 7-cm shift to the right of the C7-central sacral ventral line. In the lateral view, a 9-cm shift forward of the sagittal vertical axis and a spinal alignment anomaly were observed. The thoracic kyphosis (TK), LL, pelvic tilt (PT), PI, and PI-LL were 15°, 5°, 55°, 59°, and 54°, respectively (Figure 1).

Surgery

At first, LLIF of L2/L3, L3/L4, and L4/L5 was performed using XLIF (NuVasive Inc., San Diego, CA, USA) under neuromuscular monitoring (Figure 2a). One week after the LLIF surgery, posterior thoracolumbar pelvic corrective fusion of the T7-sacral alar-ilium was performed. Intraoperative fluoroscopy revealed that the intervertebral disk space at L4/L5 expanded when the patient was placed in a prone position (Figure 2b). A grade 2 Ponte osteotomy was performed on L2/L3, L3/L4, and L4/L5, and cantilever force was applied for correction using traditional open posterior techniques. When the cantilever force was applied, lordosis suddenly occurred.

Although the intraoperative motor evoked potential monitoring waveforms showed no apparent abnormalities, local lordosis of 52° was observed in L4/L5 postoperatively (Figure 2c). From the second postoperative day, the patient experienced pain in the anterior part of her left lower leg and had difficulty fully extending her hip and knee joints. Additional surgery was performed to facilitate bone healing and achieve stability. An anterior approach was performed to remove the cage and implant a fibular graft to achieve intervertebral stability (Figure 3c).

Postoperative course

Two months after the operation, the patient could move with assistance using a wheelchair and was transferred to a rehabilitation hospital. Six months after operation, the patient could walk with a walker, and the pain in the lower limbs had disappeared without muscle weakness. On the final radiography, the TK, LL, PT, PI, and PI-LL were 25°, 70°, 15°, 59°, and -11°, respectively (Figure 3a, b).

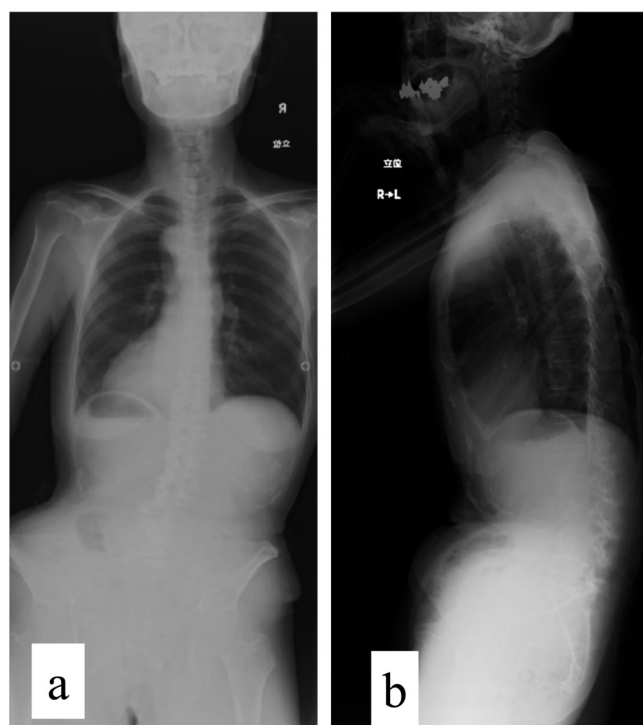


Figure 1 Preoperative whole-spine radiographs in the anteroposterior (a) and lateral views (b).

Ethics statement

In accordance with the Declaration of Helsinki, the authors explained the study to the patient and obtained the patient's consent to participate in the study.

Discussion

In the present case, no ALL injury could be detected during the anterior surgery and L4/L5 significantly expanded owing to the excessive posterior corrective fusion. As a result, additional surgery was required to facilitate bone healing and achieve stability. No ALL injury was detected until the postoperative radiography revealed hyper-lordosis at the L4/L5 level after the posterior corrective fusion. Nakashima reported that accurate intraoperative diagnosis of ALL injury during the LLIF procedure is extremely difficult. According to Tatsuno *et al.*, ALL injury is also extremely difficult to diagnose using post-LLIF radiographic images⁵. Instead, ALL injury can be detected on the basis of larger lordotic angles at the levels with ALL injury than at the levels without ALL injury after corrective fusion surgery for adult spinal deformity⁶. A rupture should be suspected if the interbody tension disappeared during the interbody procedure, including trial insertion in the LLIF surgery. In this case, the cage was anteriorly placed to obtain better correction, and the intervertebral angle increased, which may have caused the ALL injury. Currently,

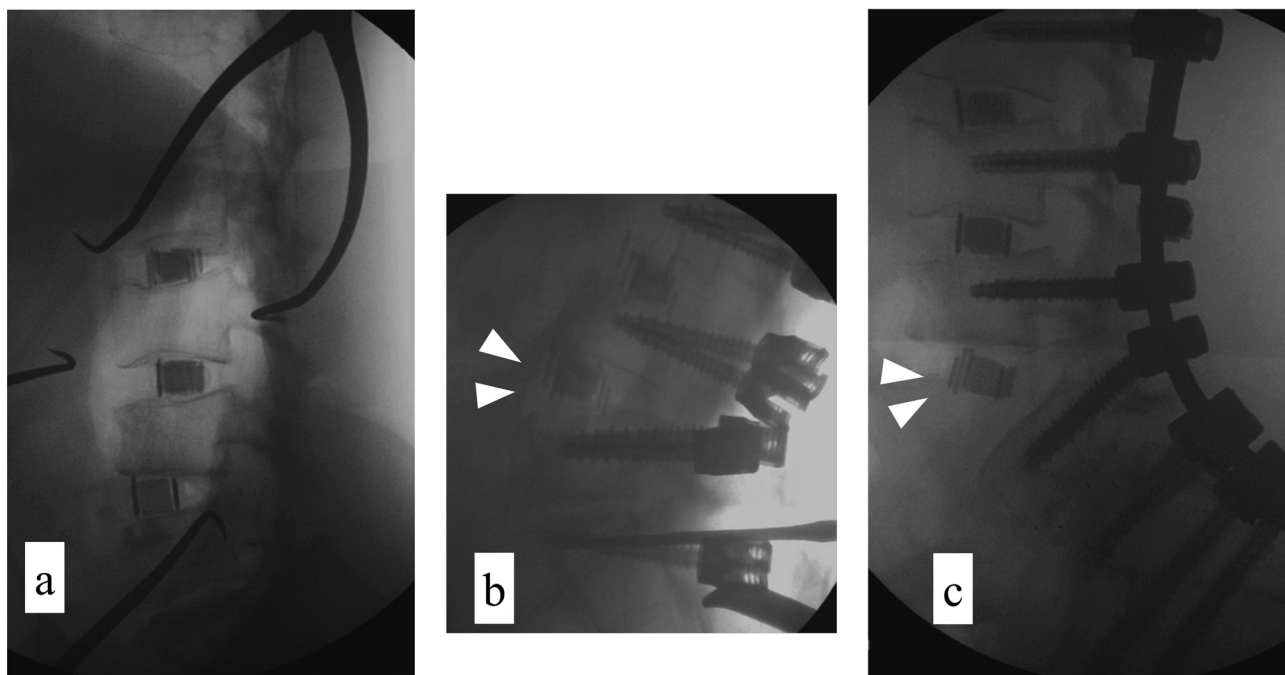


Figure 2 Lateral fluoroscopic images obtained after lumbar interbody fusion (a); in the prone position during surgery (b); and after posterior spinal correction (c).

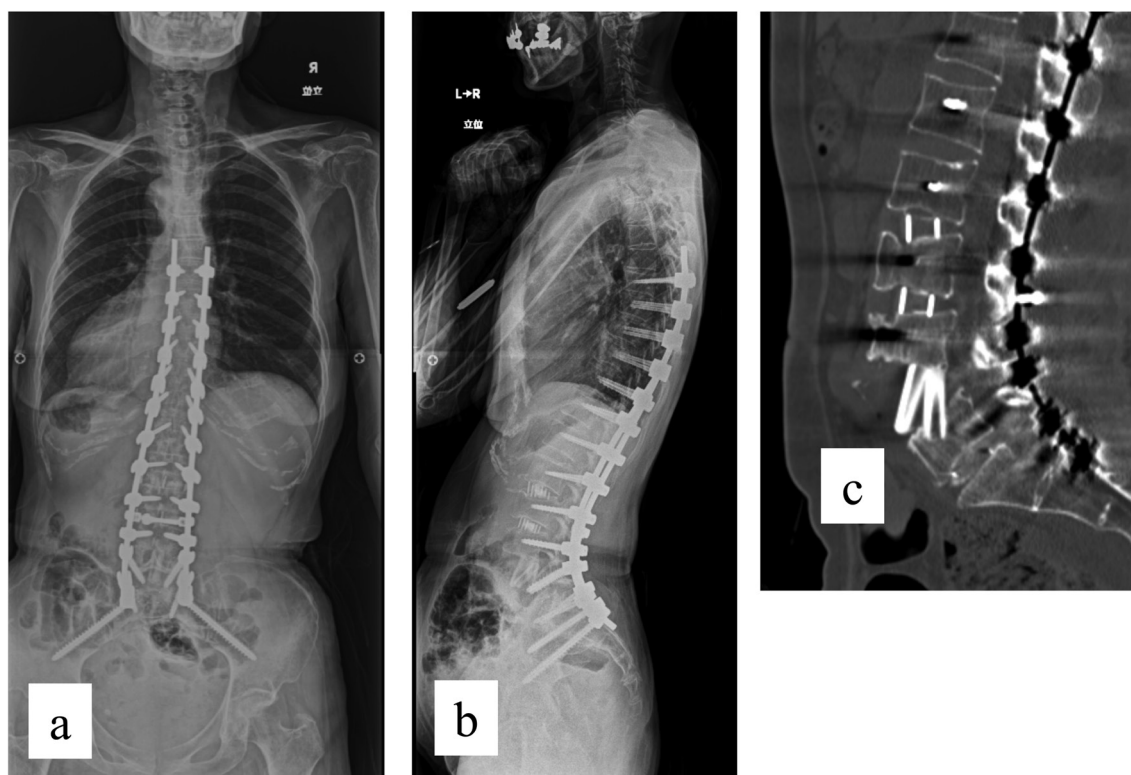


Figure 3 Postoperative whole-spine radiographs in the anteroposterior (a) and lateral views (b) views. (c) Postoperative sagittal CT images of the fibular graft implanted in L4/L5.

no consensus has been reached on local lordosis obtained by grade 2 osteotomy in patients with ALL rupture and/or intraoperative endplate injury⁷⁾. As hyper-lordosis poses a negative impact on bone healing and possible risk of greater vessel injury⁸⁾, we believe that the rod curve must be adjusted to prevent excessive curvature at the level with ALL rupture or using dual rods can reduce the risk of implant failure. If ALL injury is found before the posterior surgery, using a Bendini spinal rod bending system (NuVasive Inc., San Diego, CA, USA) might help prevent excessive local lordosis. Yamamura reported that anterior columnar reconstruction using a mesh cage was effective for ALL rupture accompanied by a large anterior expansion⁹⁾. Similar to this case, if the intervertebral space is opened excessively, one of the possible salvage methods is fibular grafting. Despite the formation of local accidental lordosis, the patient's activities of daily living fortunately improved as compared with her

preoperative condition, without going through a tragic turning point in the form of vascular injury.

Conclusion

Undetected ALL injury may be present during LLIF; therefore, it should be carefully considered during anterior surgery. The alignment from the time of posture change during posterior corrective fusion surgery should also be examined, as unexpected local lordosis may develop.

Author contributions: Yosuke Shibao wrote the manuscript, and all authors participated in the study. All authors have read and approved the final manuscript.

Conflicts of interest: The authors have no potential conflicts of interest related to the present manuscript.

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