# CASE REPORT

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# Ossification of the posterior longitudinal ligament located on the concave side of the apex vertebra in adult spinal deformity

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## ABSTRACT

A 48-year-old female patient presented with discomfort in the front of the chest. Whole spinal X-ray revealed a thoracic curve of 52°, and thoracic computed tomography (CT) myelography and magnetic resonance imaging (MRI) showed that ossification of the posterior longitudinal ligament (OPLL) on the concave side of the apex vertebra (T9) had highly compressed the spinal cord. Cervical MRI also showed that the C4–C5 intervertebral disc herniation mildly compressed the spinal nerve. In concomitant surgery, the patient underwent cervical laminoplasty, in which OPLL was removed by decompressive laminectomy and posterior correction surgery.In patients with adult spinal deformity (ASD), asymmetric mechanical stress at the apex vertebra can cause various abnormal conditions. Long-term local mechanical stress on the concave side of the apex vertebra might have affected OPLL formation in the present case. This is the first report of a surgical case for an ossification located on the concave side of the apex vertebra in a patient with ASD. Mechanical stress at the concave side of the apex vertebra was suspected to be a cause of formation of OPLL.

Keywords: ossification of the posterior longitudinal ligament, adult spinal deformity, concave side, mechanical stress

Abbreviations:
OPLL: ossification of the posterior longitudinal ligament
ASD: adult spinal deformity



## INTRODUCTION

The incidence of adult spinal deformity (ASD) is increasing with aging of the population and surgical treatment is often challenging.[1] Ossification of the posterior longitudinal ligament (OPLL) is relatively rare, but reports of OPLL in North America and Europe have increased and this condition is now recognized to affect people worldwide.[2-4] The pathogenesis of OPLL

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is multifactorial and remains unclear.[5] Here, we report a surgical strategy for ASD in a patient with OPLL located at the concave side of the apex vertebra, and we consider the impact of ASD on formation of OPLL.

## CASE REPORT

A 48-year-old female patient presented with gait disturbance and discomfort in the front of the chest. A neurological examination showed normal findings, whereas whole spinal X-ray revealed a thoracic curve of 52° (Fig. 1a, 1b). Thoracic computed tomography (CT) myelography and magnetic resonance imaging (MRI) showed that an OPLL on the concave side of the apex vertebra (T9) had highly compressed the spinal cord (Fig. 2a–2f). Cervical MRI revealed that a C4–C5 intervertebral disc herniation mildly compressed the spinal nerve. We planned C4–C6 cervical open door laminoplasty, OPLL removal (T8–T9) using "resection at an anterior site of the spinal cord from a posterior approach" (RASPA) procedure,[6,7] and posterior correction surgery (T2–L1).

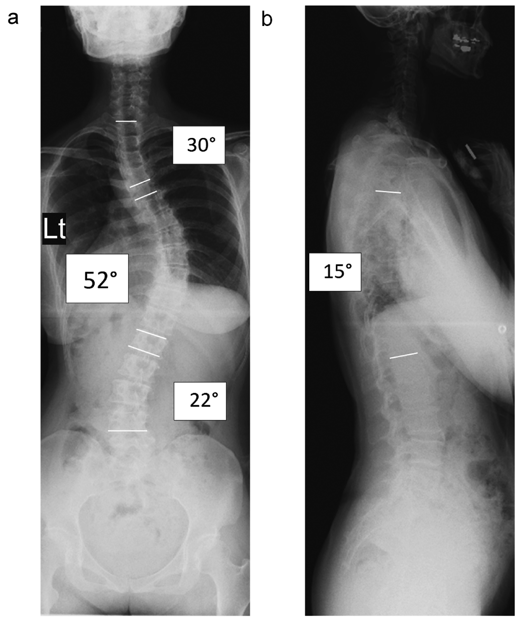


**Fig. 1** Preoperative whole-spine X-ray
**Fig. 1a:** Whole-spine standing X-ray, posterior to anterior view.
**Fig. 1b:** Whole-spine standing X-ray, lateral view.

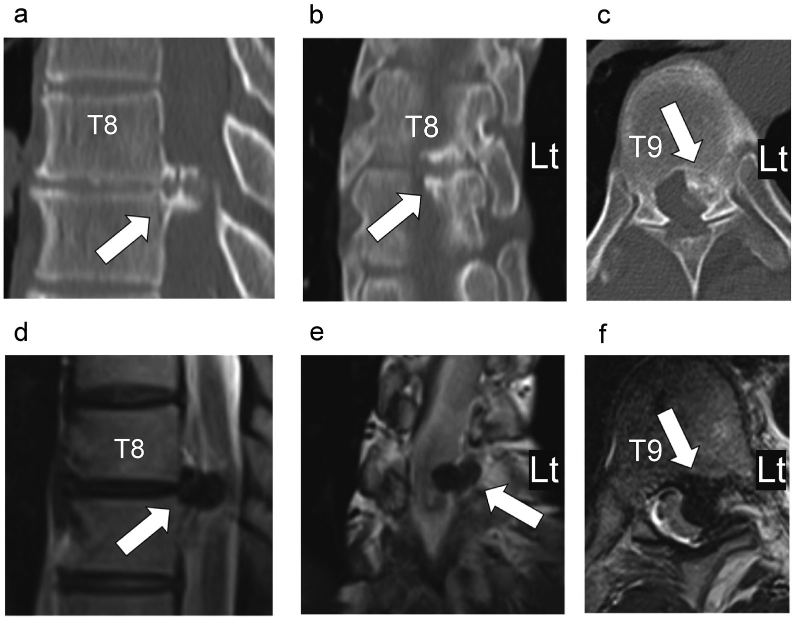


**Fig. 2** Computed tomography (CT) and magnetic resonance imaging (MRI)
**Fig. 2a:** Sagittal view of the CT.
**Fig. 2b:** Coronal view of the CT.
**Fig. 2c:** Axial view of the CT.
**Fig. 2d:** Sagittal view of the T2-weighted MRI.
**Fig. 2e:** Coronal view of the T2-weighted MRI.
**Fig. 2f:** Axial view of the T2-weighted MRI.

First, C4–C6 cervical open door laminoplasty was performed. Pedicle screws were then placed bilaterally at T2, T4, T5, T11, T12, and L1; on the left side at T3 and T6, and on the right side at T7, T8, T9, and T10. A temporary rod was placed on the right side from T7 to 10. T8/9 facetectomy was performed, and the OPLL was found to be partially adhered to the dura mater (Fig. 3a). Intraoperative ultrasound suggested that a mass had highly compressed the spinal cord from the left side (Fig. 3b). This mass was removed and floated using a diamond bar. Ponte osteotomy was performed on the left side of T4–T5 and the right side of T6/7, T7/8, T8/9, and T9/10. After decortication and local bone graft, a 6.0-mm cobalt chromium rod was inserted into the concave side and correction was performed by rod rotation. After rod rotation, compression was applied to the pedicle screw and a 6.0-mm titanium rod was inserted into the convex side. Another 6.0-mm titanium rod was located for prevention of rod breakage. Hematoxylin-eosin staining of the resected specimen revealed normal bone structure, with no indication of malignancy (Fig. 3c). Postoperative X-ray showed that the thoracic curve was 7°, and CT indicated that the ossification had almost been removed (Fig. 4a–c). Gait disturbance was improved, and the patient has been making satisfactory progress.

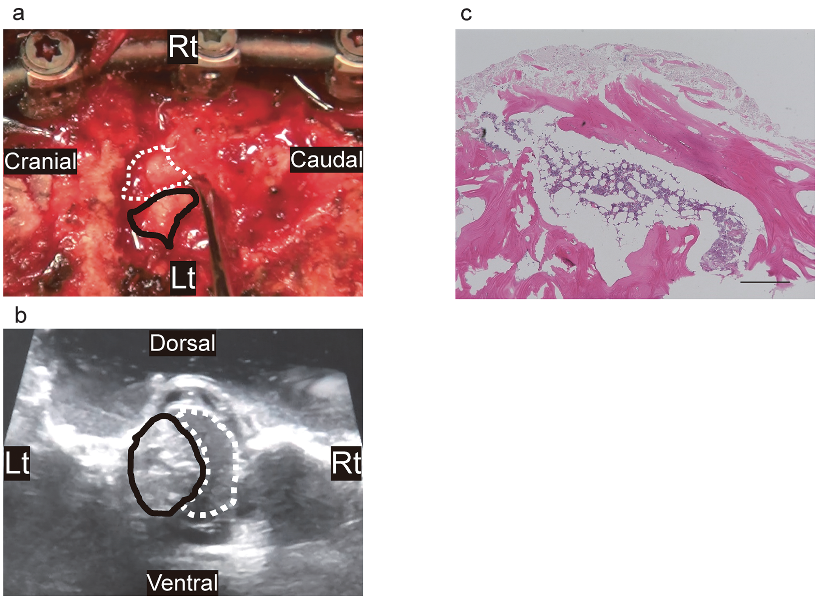


**Fig. 3** Intraoperative ossification of the posterior longitudinal ligament (OPLL) image and postoperative histopathological examination

**Fig. 3a:** The OPLL (black solid line) was rigidly attached to the dura mater (white dotted line).

**Fig. 3b:** Intraoperative ultrasound sonography showed the OPLL (black solid line) extended into the dura mater (white dotted line).

**Fig. 3c:** Hematoxylin-eosin staining. Bar = 500μm.

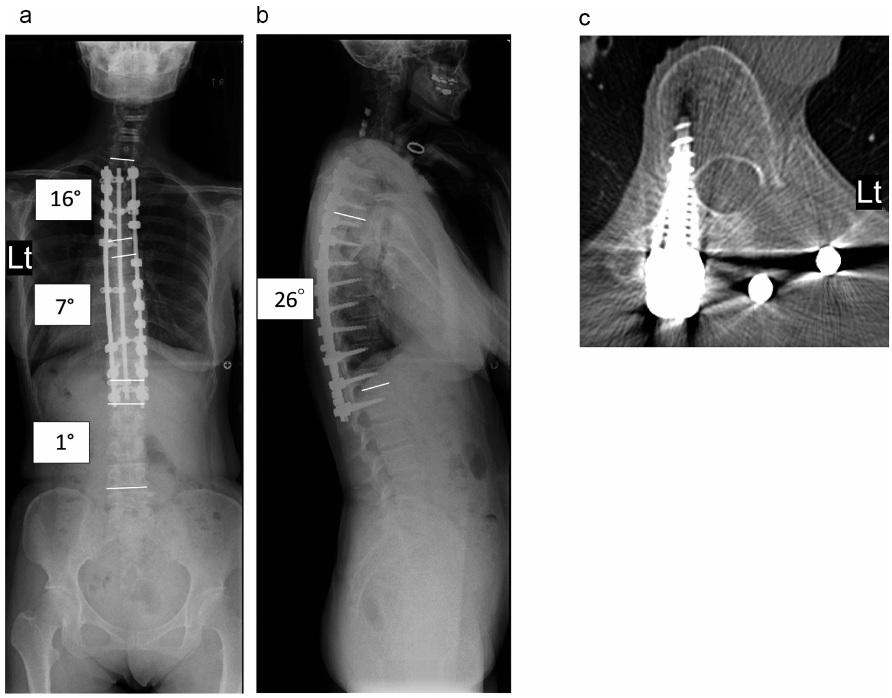


**Fig. 4** Postoperative whole-spine X-ray and computed tomography (CT) images

**Fig. 4a:** Whole-spine standing X-ray, posterior to anterior view.

**Fig. 4b:** Whole-spine standing X-ray, lateral view.

**Fig. 4c:** Axial view in CT showing the ossification of the posterior longitudinal ligament region at T9 after the operation.

## DISCUSSION

In this case, we temporarily performed cervical laminoplasty, in which we removed the OPLL by decompressive laminectomy and posterior correction surgery for ASD due to the risk of curve progression, since the thoracic curve was 52°.[8] If only the OPLL had been removed and scoliosis had progressed, a second corrective surgery would have been extremely difficult in this case. The patient was informed about the procedure, after which she agreed to undergo the concomitant surgery.

Asymmetric mechanical stress is believed to be associated with various abnormal conditions in scoliosis.[9,10] We speculate that OPLL formation depends on mechanical stress on the concave side of the apex vertebra. There are reports on the association between progression of ossification of the ligament and mechanical stress. For instance, Takatsu et al showed that progression of cervical OPLL after laminectomy occurred more rapidly due to mechanical stress.[11] Similarly, Ando et al found that growth of thoracic OPLL depends on the tensile mechanical stress at kyphotic segments and that micromotion might induce vulnerable spinal cord deterioration.[12] In addition, Kanno et al found that concentration of mechanical stress on a decompressed thoracolumbar junction due to fusion of adjacent levels and a larger intervertebral range of motion may cause re-extension of ossification of the ligamentum flavum.[13] In our case, long-term mechanical stress might have affected OPLL formation.

As far as we are aware, there has been no report on ASD in a patient with OPLL located at the concave side of the apex vertebra. OPLL is a multifactorial disease resulting from genetic and environmental factors. In this case, mechanical stress may have been one factor in OPLL formation.

## CONCLUSION

This is the first report of OPLL on the concave side of the apex vertebra in a patient with ASD. Mechanical stress on the concave side of the apex vertebra was suspected to be a cause of OPLL formation.

## CONFLICTS OF INTEREST AND SOURCE OF FUNDING

No funds were received in support of this work. No benefits in any form have been or will be received from a commercial party related directly or indirectly to the subject of this manuscript. The authors declare no conflict of interest.

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