

Buckling of the Ligament Flavum: A Cause of Spinal Cord Compression After Two-Level Anterior Cervical Discectomy and Fusion

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Abstract

The authors present a rare case of neurological deterioration after an anterior cervical discectomy and fusion due to ligament flavum buckling into the spinal canal. A 59-year-old man with cervical kyphosis underwent anterior cervical discectomy and fusion at the C4-5-6 level. Five days after surgery, the patient suddenly developed motor weakness in both the shoulder and triceps. Urgent cervical spine MRI revealed posterior spinal cord compression due to buckling of the ligament flavum into the spinal canal at the C4/5 level. The patient underwent emergency decompressive C3 to C5 laminectomies with posterior lateral mass screw fixation. Six months after surgery and following rehabilitation, the patient's upper extremity muscle strength was fully recovered.

Keywords: *Anterior Cervical Discectomy and Fusion; Intervertebral Disc; Cervical Kyphosis; Ligament Flavum; Spinal Stenosis*

Abbreviations

ACDF: Anterior Cervical Discectomy and Fusion; MRI: Magnetic Resonance Imaging

Introduction

Anterior cervical discectomy and fusion (ACDF) is one of the most commonly performed cervical spine surgeries. Many studies have shown that the clinical outcome of ACDF is good or excellent for most patients. However, there are still cases with only fair or even poor outcomes [1]. Related complications such as postoperative hematoma, spinal cord injury, nerve root injury, recurrent laryngeal nerve palsy, dysphagia, dural tearing, esophageal perforation, and vertebral artery injury can be troublesome or life-threatening. In this case report, we describe a rare case of a patient with cervical disc herniation who developed post-reduction neurological deterioration after only a two-level ACDF due to buckling of the ligament flavum and spinal cord compression.

Case Presentation

A 59-year-old man presenting with a 1-year history of tingling in both hands and progressive difficulty in walking was referred to our neurosurgery department. The preoperative neurological examination revealed para-paresis (leg motor grade: 4/5).

The initial cervical X-ray revealed cervical kyphotic deformity. Cervical magnetic resonance imaging (MRI) revealed a C4/5 disc extrusion with significant central canal stenosis, and a high signal change in T2-weighted images of the spinal cord. In addition, moderate to severe bilateral neural foraminal stenosis was observed at the C5/6 level (Figure 1).

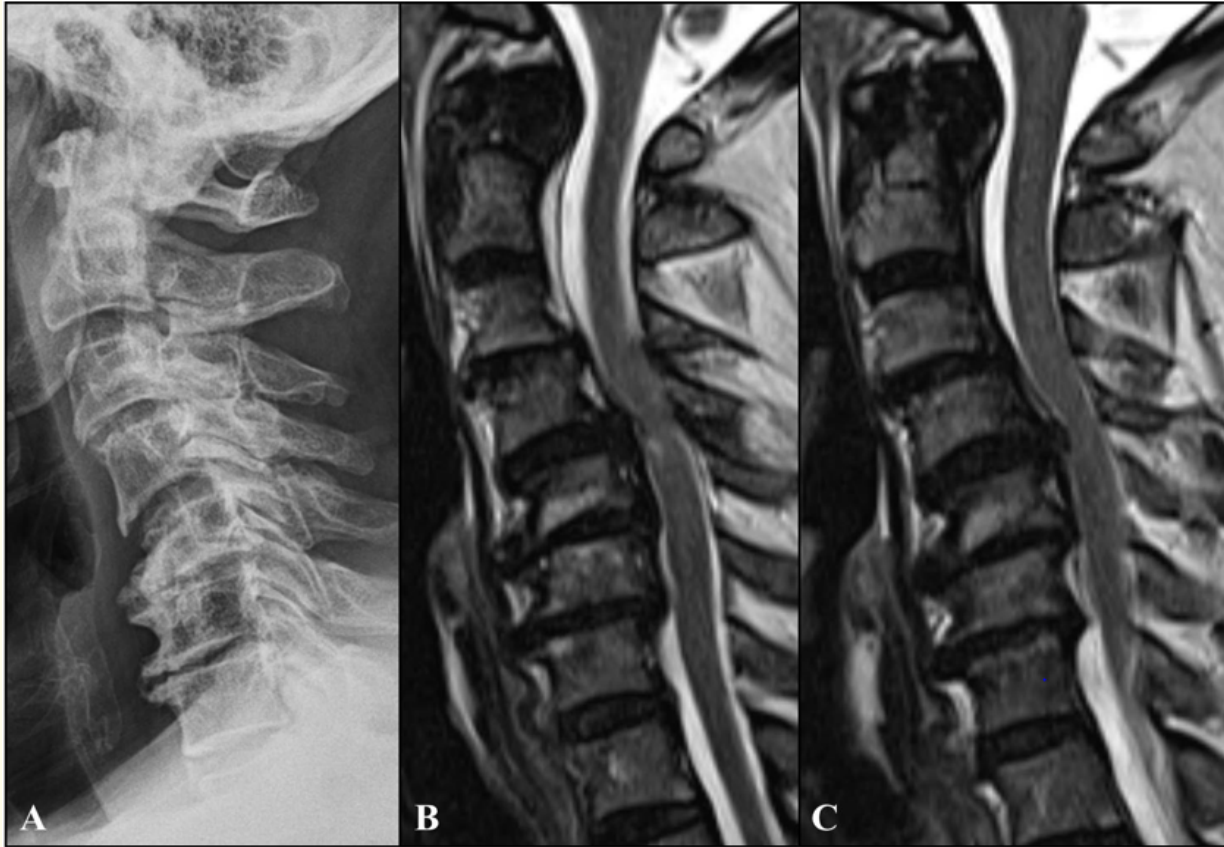


Figure 1: Preoperative lateral cervical plain radiography revealing a narrowed intervertebral disc space and kyphosis (A), and sagittal T2-weighted MRI of the cervical spine (B), (C). No evidence of ligament flavum buckling is seen.

The patient underwent C4-5-6 anterior cervical discectomy and fusion. After general anesthesia, microscopic C4/5 and C5/6 discectomy was performed by inserting a five-degree lordotic angled allobone graft. A second procedure comprising reinforcement with a screw plate construct restored the graft position and cervical curvature.

No inconvenient surgical or general medical events occurred during surgery. Postoperative cervical X-rays revealed good instrumentation placement and restored cervical lordosis (Figure 2). An immediate postoperative neurologic examination revealed that the patient had no change when compared to before the surgery. However, five days after surgery, the patient suddenly developed motor weakness in both the shoulder and triceps (motor grade: 2/5). Urgent cervical spine MRI revealed posterior spinal cord compression due to buckling of the ligament flavum into the spinal canal at the C4/5 level (Figure 3). The patient underwent emergency surgery for decompression at the C3 to C5 level. The surgery comprised laminectomies and posterior lateral mass screw fixation. During surgery, we found a posterior in-folding ligament flavum that compressed the thecal sac. The in-folded ligament flavum was excised and sufficient spinal cord decompression was performed.



Figure 2: Postoperative lateral cervical plain radiography after ACDF surgery demonstrated reduction of kyphosis.

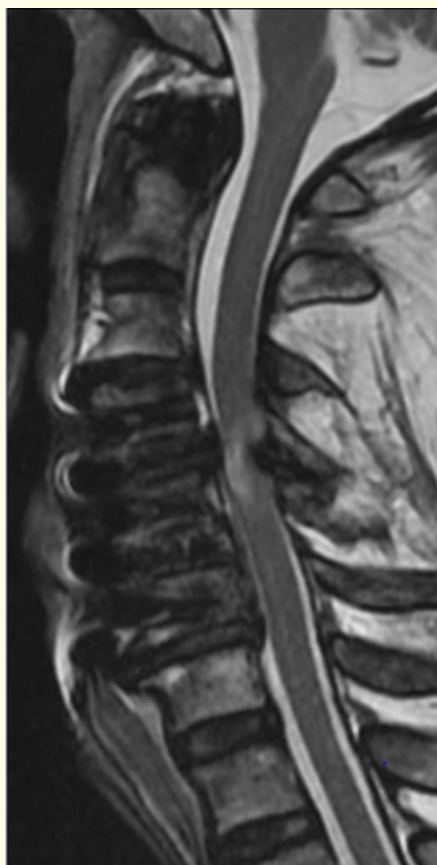


Figure 3: Postoperative sagittal T2-weighted MRI revealed secondary spinal cord compression due to buckling of the ligament flavum into the spinal canal at the C4/5 level.

The patient showed rapid motor power improvement (3/5) in the upper extremities bilaterally within a day after the second surgery. Cervical spine MRI performed after two weeks revealed complete spinal cord decompression (Figure 4). Six months after the surgery and following rehabilitation, the patient's upper extremity muscle strength was fully recovered (5/5).

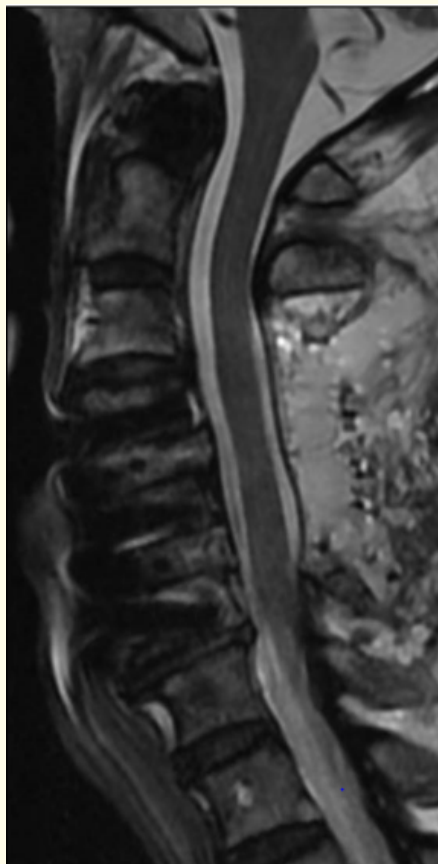


Figure 4: Sagittal MRI two weeks after decompressive laminectomy demonstrated complete spinal cord decompression.

Discussion

ACDF is a well-established and commonly performed procedure for the treatment of cervical disc disease. Most studies have shown that clinical outcome after ACDF is good or excellent.

ACDF is indicated in cases wherein the canal is more significantly compromised and can be performed effectively in patients with reduced cervical lordosis [2]. Although rare, complications associated with the ACDF procedure, such as postoperative hematoma, spinal cord injury, nerve root injury, recurrent laryngeal nerve palsy, dysphagia, dural tearing, esophageal perforation and vertebral artery injury can be very hazardous and can sometimes lead to catastrophic outcomes [3]. However, secondary central canal stenosis due to an in-folding ligament flavum after surgery is extremely rare. In fact, there are only two case reports of this condition to date.

Rhee, *et al.* first reported two neurological intact individuals in whom neurological injury occurred due to in-folding of the ligament flavum and spinal cord compression after reduction facet subluxation [4]. In this report, the ligament flavum was ruptured preoperatively and buckled during reduction. However, in our patient, no obvious radiological evidence of ligament flavum rupture or significant in-folding was found by preoperative MRI.

Taghvaei, *et al.* reported a patient who developed neurological deterioration immediately after C5/6 ACDF due to in-folding of the ligament flavum and spinal cord compression. They concluded that the use of a height cage that was too small led to a narrow disc space, which in turn resulted in ligament flavum protrusion [5].

In our case, the patient had kyphotic deformity of the cervical spine preoperatively. We used a lordotic angled cage for kyphosis reduction, which rendered the posterior part of the disc space and the inter-spinous distance narrower than they were before the surgery. The distance between the anterior lower part of C4 vertebra body to the anterior upper part of C5 vertebra body was increased (5.34 mm to 7.09 mm), while that between the posterior lower part of the C4 vertebra body and the posterior upper part of the C5 vertebra body (6.16 mm to 5.84 mm) and the C4/5 inter-spinous distance (6.22 mm to 5.32 mm) were decreased postoperatively when compared to the same distances on the MRI scan. This may have led to the in-folding of the ligament flavum, which was lengthened due to kyphosis, into the spinal canal after surgery.

Guppy, *et al.* have reported the usefulness of flexion-extension dynamic MRI, which is very helpful in diagnosing spinal cord compression [6]. The authors reported two patients who presented with myelopathy in whom the posterior buckling of the ligament flavum in the cervical extension resulted in severe stenosis and spinal cord compression without any compressive lesion noted in neural MRI. In our case, we did not perform dynamic MRI before surgery. However, simply performing flexion-extension MRI prior to surgery may yield additional information and assist in establishing a surgical decision.

Conclusion

Here we describe the case of a rare but potentially serious complication of ACDF. We suggest that choosing an appropriate size for the intervertebral cage based on pre-operative imaging may help avoid this complication. Furthermore, preoperative flexion-extension dynamic MRI is needed to estimate the potential risk of secondary stenosis due to ligament flavum buckling after ACDF, especially in patients with cervical kyphosis.

Acknowledgements

None.

Conflict of Interest

There are no conflicts of interest.

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