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The Spine Journal ■ (2006) ■

THE SPINE JOURNAL

Case Study

Intradural lumbar disc herniation—Is it predictable preoperatively? A report of two cases

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Received 12 October 2005; accepted 11 February 2006

Abstract

BACKGROUND CONTEXT: contextIntradural disc herniations are thought to be rare events, and there have been relatively few literature reports of intradural disc herniations available with regard to magnetic resonance imaging findings.

PURPOSE: The authors describe two patients with intradural lumbar disc herniations, one with and one without preoperative diagnosis, who had different postoperative outcomes.

STUDY DESIGN: Case study

METHODS: The first patient underwent an extended L3 subtotal laminectomy followed by bilateral medial facetectomy and foraminotomy at L3–L4. A durotomy uncovered large disc fragments comprised of friable disc materials and end plates, after no clear disc herniation was found in the epidural space. The second patient underwent anterior lumbar interbody fusion after a preoperative diagnosis of intradural disc herniation.

RESULTS: The first patient experienced a marked reduction of pain and progressive recovery of sensory disturbance, but neurologic examination showed right foot drop postoperatively. Two years after surgery, she can not walk without a cane because the neurologic deficit of the right ankle has shown no improvement. Two days after surgery, the second patient was allowed to ambulate with a lumbar orthosis. Neurologic examination showed no motor deficit. Twenty-one months after surgery, the patient reports minimal back pain when sitting on a chair for prolonged periods of time.

CONCLUSION: Our cases highlight the importance of preoperative diagnosis in the treatment of intradural lumbar disc herniations. The potential presence of an intradural disc herniation must always be considered preoperatively on a patient whose magnetic resonance imaging study demonstrates the ''hawk-beak sign'' on axial imaging as well as abrupt loss of continuity of the posterior longitudinal ligament (PLL). This association results in an adequate surgical approach, thereby reducing the chance of postoperative neurologic deficit. Finally, anterior lumbar interbody fusion can be a reasonable alternative in the treatment of intradural lumbar disc herniations.

Keywords: Intradural lumbar disc herniations; Magnetic resonance imaging (MRI); Preoperative diagnosis; Anterior lumbar interbody fusion (ALIF)

Introduction

Intradural disc herniations are rare. They account for 0.27% of all herniations [1,2]. Only 3% occur in the cervical region, 5% at thoracic levels, and 92% in the lumbar region [1]. However, as a proportion of disc herniations, thoracic herniations are more likely (12–15%) to be intradural [3].

The term *intradural* remains erroneous. *Transdural* would be the better term for herniations that pierce the dura. However, there is a conventional understanding of the term in the literature, and the authors used the term *intradural* in this report.

Despite advances in neuroradiology imaging, there have been few reports of the magnetic resonance imaging (MRI) features of intradural disc herniations. Moreover, MRI findings for diagnosing intradural herniations are not fully

FDA device/drug status: not applicable.

Nothing of value received from a commercial entity related to this manuscript.

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doi:10.1016/j.spinee.2006.02.025

understood. Preoperative diagnosis is believed to be essential for an adequate surgical approach to be planned. An intradural examination also may be required to confirm clinical signs and symptoms or previous radiologic studies in the event that no clear disc herniation is found. This report describes two patients with intradural lumbar disc herniations, who had different postoperative outcomes, and discusses therapeutic implications. Preoperative diagnosis was made in only one case.

Case report

Case 1

A 65-year-old woman presented with a 3-month illness characterized by recent onset of severe low back pain followed by pain down both legs along the lateral thigh of 1 month in duration. She could not sleep at night, and at presentation, was not able to walk owing to intractable pain. Clinical examination revealed an incomplete neurologic deficit (Grade IV/V) of the right ankle, together with numbness on both lateral thighs and decreased sensation in the right perianal region. However, no bladder or bowel symptoms were noticed. Both the right patellar and achillean reflexes were absent.

Spinal MRI demonstrated a huge compressing lesion to the dural sac with marked cranial migration at the L3–L4 level on a T2-weighted sagittal image (Fig. 1). Axial images demonstrated an extremely large mass, located centrally to the right, which almost completely compressed the spinal canal at the cranial portion of disc migration (Fig. 2). One of the T2-weighted axial images revealed a sharp beak-like appearance (Fig. 2c). At that point in time, intradural disc herniation was not recognized.

An extended L3 subtotal laminectomy was performed and followed by bilateral medial facetectomy and foraminotomy at L3–L4. Upon gentle palpation, a tense dura could be felt and abnormal swelling of the dural sac and root was noted. Root retraction was tried several times to examine beneath the dura and to expose the disc fragments. However, there was no abnormality in the epidural space and no clear disc herniation was found. At this point, a durotomy was performed, which uncovered large disc fragments comprised of friable disc materials and end plates in a portion of the right intradural space. The indicated disc fragments were compressing the rootlets and displacing them towards the left side within the dural sac (Fig. 3). After removing the disc fragments from within the dura, a hole was discovered in the ventral aspect of the dura. Through this hole, additional loose disc material was found. The dural tissue around the hole was firmly adhered to the posterior longitudinal ligament (PLL). The durotomy, as well as the hole, was closed, and the epidural space was explored on both sides. However, additional fragments were not found.

Postoperatively, the patient experienced a marked reduction of pain and progressive recovery of sensory disturbance, but neurologic examination showed right foot drop. Two years after surgery, the patient reports moderate back pain during exertion and when standing for prolonged periods of time. However, she can not walk without a cane because the neurologic deficit of the right ankle has shown no improvement.

Fig. 1. Spinal magnetic resonance imaging in Case 1 demonstrates a huge compressing lesion to the dural sac with marked cranial migration at the L3–L4 level on a T2-weighted sagittal image. Abrupt loss of continuity of the posterior longitudinal ligament is also noted (arrow).

Case 2

A 30-year-old man presented with a sudden onset of low back pain that radiated into both legs along the lateral thigh. His deep tendon reflexes and peripheral circulation were normal, although he had severe tenderness over the midline of the lumbar spine. The patient had a history of lifting a heavy object 2 months ago and began to experience severe low back pain and radicular leg pain from then on. Neurologic examination revealed a decreased sensation in the perianal region combined with numbness on both lateral thighs. The result of a straight leg raising test was positive, but there were no abnormalities in terms of motor strength and bladder or bowel function.

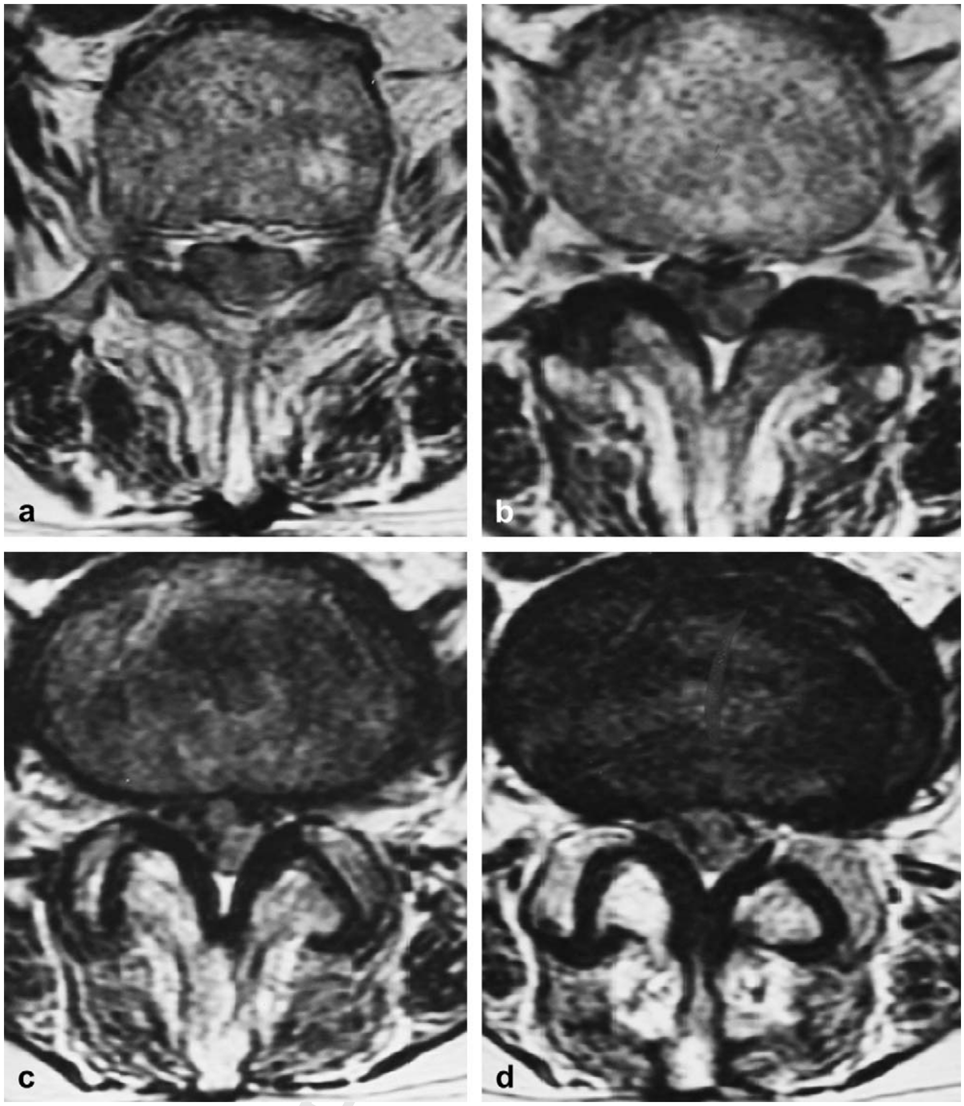

Fig. 2. A series of axial images in Case 1 from the cranial portion (a) to the caudal portion (d) of disc migration reveals an extremely large mass, located centrally to the right, which nearly compresses the entire spinal canal at the cranial portion of disc migration. [EQ1]

A T2-weighted sagittal image of the spinal MRI demonstrated a wedge-shaped disc herniation suspicious for intradural extension of disc fragments at the L4–L5 level (Fig. 4). Axial images revealed a sharp compressing lesion with a beak-like appearance to the dural sac on a T2-weighted sequence, which was located centrally (Fig. 5). Based on this finding, a preoperative diagnosis of intradural disc herniation was made and an anterior lumbar discectomy followed by interbody fusion was planned.

During surgery, a mini-open laparotomy via a left anterior retroperitoneal approach was performed to expose the anterior surface of the spine. The anterior longitudinal ligament was divided transversely, and the discectomy was carried out. The disc was removed with pituitary forceps, down-biting curettes, and long-shafted ring curettes. The discectomy was extended more deeply to completely remove all disc material from the disc space. When we approached the posterior annulus, a lump of disc fragments was removed and the dural defect was identified. At this stage, cerebrospinal fluid started to leak. The intradural space was gently explored through the dural defect, disclosing large disc fragments composed of mainly sharp cartilaginous end plates on the intradural side, which was compressing the rootlets (Fig. 6a). After the complete removal of disc fragments, the dural defect was repaired with fatty tissue and commercially available BioGlue (CryoLife, Inc., Kennesaw, GA). The cleaned intervertebral space was visually inspected, and a Fidji cage (Spine Next, Bordeaux, France) was placed into the intervertebral space (Fig. 6b). The anterior rectus sheath was reapproximated, and the subcutaneous and skin layers were closed layer by layer.

Postoperatively, the patient experienced a marked reduction of pain and the recovery was uneventful. Two days after surgery, the patient was allowed to ambulate with a lumbar orthosis. Neurologic examination showed no motor deficit. Twenty-one months after surgery, the

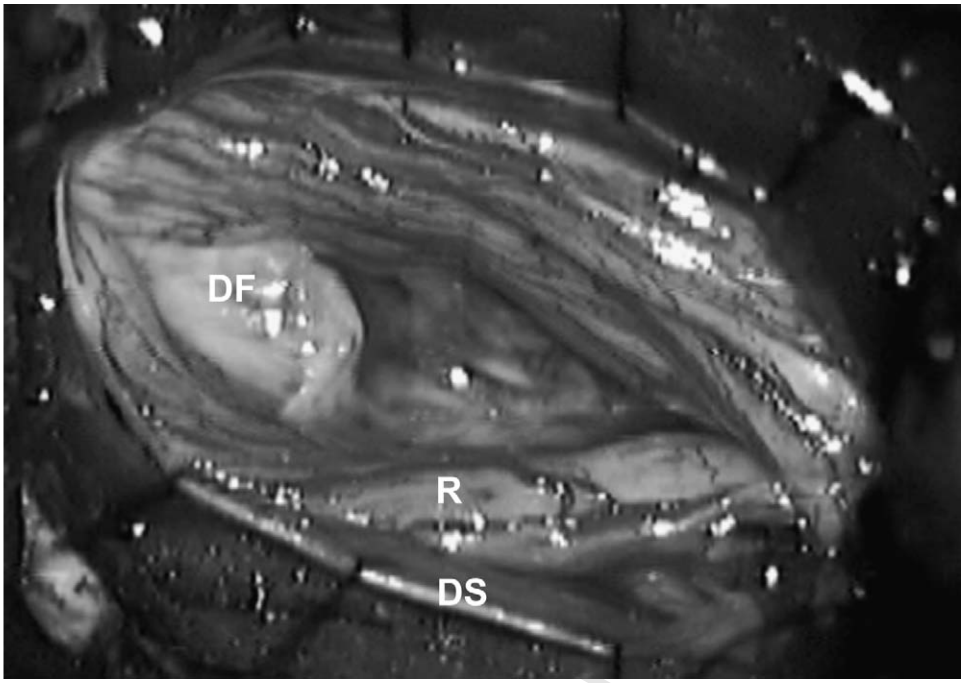

Fig. 3. Intraoperative image of the Case 1 herniation after partially removing intradural disc fragments. DF=disc fragment; R=rootlet; DS=dural sac.

Fig. 4. A T2-weighted sagittal image in Case 2 demonstrates a wedge-shaped disc herniation suspicious for intradural extension of disc fragments at the L4–L5 level.

patient reports minimal back pain when sitting on a chair for prolonged periods of time.

Discussion

Intradural disc herniations are thought to be rare events that occur mainly in patients in their fifth decade [4,5]. The site most frequently affected by intradural lumbar disc herniations is L4–L5 (55%), followed by L3–L4 (16%), L5–S1 (10%), L2–L3, and L1–L2 [2,6]. It therefore seems clear that the most affected sites differ from those of extradural lumbar disc herniations. Intradural disc herniations are found less frequently in the cervical spine, where, in the majority of cases, patients present with a severe neurologic deficit such as Brown Sequard syndrome. Incomplete or transient quadriparesis is also observed [5,7]. In the lumbar spine, they can mimic the radiologic finding of a spinal cord tumor [4]. Neurologic deficits, as reported herein (Case 1), are exceptional.

Mechanism

The mechanism that causes disc herniations to penetrate the dura mater is unclear. However, it is possible that a primary or preexisting abnormality is present that predisposes for lesion formation, and the following theories have been proposed [2,8,9]: a) the existence of adhesions between the ventral wall of the dura mater and the PLL, possibly due to some local inflammatory processes, may lead to spontaneous perforation or rupture; b) congenital union between the dura mater and the PLL; c) the ventral dura mater and the PLL are usually loosely apposed, but adhesions

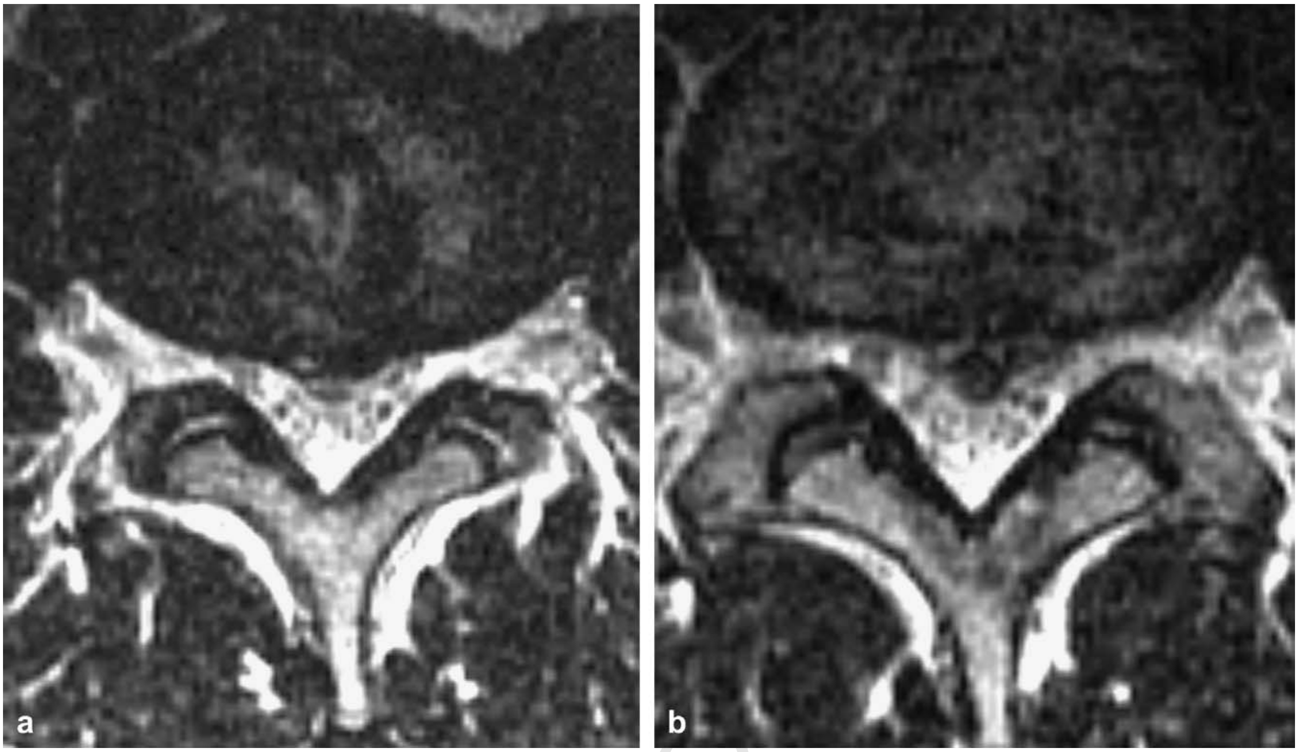

Fig. 5. Axial images in Case 2 showing a sharp compressing lesion to the dural sac on a T2-weighted sequence, which was located centrally (a and b).

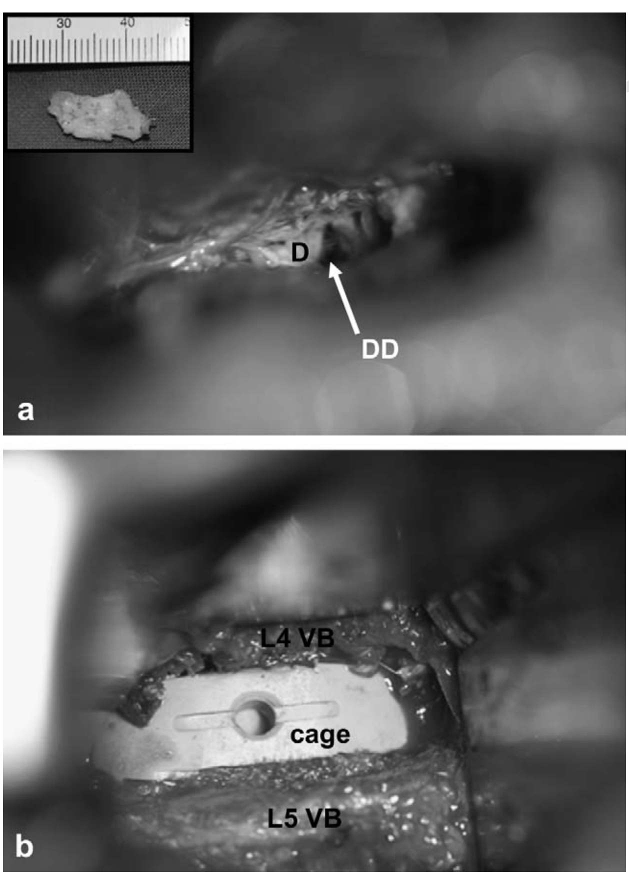

Fig. 6. (a) Intraoperative image in Case 2 after removing a lump of disc fragments composed mainly of sharp cartilaginous end plates (inset). (b) Cage placement into the intervertebral space after removing disc fragments completely and repairing the dural defect using fatty tissue and glue. D=dura; DD=dural defect; L4 VB=L4 vertebral body; L5 VB=L5 vertebral body.

may form as a result of traumatic irritation such as previous surgery or herniated disc.

Adhesions were found in each of our two cases, but the local pathology differed in each. In our first case, the adhesions between the dura and PLL were prominent and may have been attributed to preexisting degenerative spondylotic changes and the herniated disc itself. Perhaps the most likely cause was mechanical irritation against the ventral wall of the dura. In the second case, the patient had a history of lifting a heavy object when the symptoms started, and the disc fragments on the intradural side were composed of mainly sharp cartilaginous end plates, even though adhesions were less severe. The patient's history and the disc fragments comprised mainly of sharp cartilaginous end plates may have been locally significant factors predisposing the patient for adhesions and the subsequent rupture of disc materials through the ventral wall of the dura.

Magnetic resonance imaging of intradural disc herniation

Different imaging techniques can be used for diagnosing intradural disc herniations. Hidalgo-Ovejero et al.

pointed out the significance of gas within the spinal canal, which was associated with intradural disc herniations [10]. They concluded that the potential presence of an intradural disc herniation must always be considered in a patient whose computed tomography study showed the presence of epidural gas. There have only been a few MRI reports of intradural disc herniations available with regard to MRI findings. Hida et al. stressed the usefulness of gadolinium–diethylenetriaminepentacetic acid enhanced MRI in making an accurate diagnosis preoperatively by showing a beak-like mass with rim enhancement at the level of the intervertebral space [11]. Holtas et al. reported that T2-weighted imaging showed an increased signal intensity area surrounding the herniation [12]. They interpreted the increased signal intensity as adhesions and inflammatory reactions. In our cases, an area with increased signal intensity on T2-weighted imaging was not observed. Unfortunately no gadolinium was administered. Instead, we would like to place emphasis on two points of MRI findings suspicious for intradural extension of the disc fragments. The first point is abrupt loss of continuity of the PLL (Fig. 1), as was demonstrated in our case. This finding is presumed to result from the PLL tear and subsequent dura tear when unusually high pressure at the involved level caused the rupture of disc materials. The second point is a sharp beak-like appearance on T2-weighted axial imaging (Figs. 2c and 5b). We believe the beak-like appearance—we suggest this appearance is

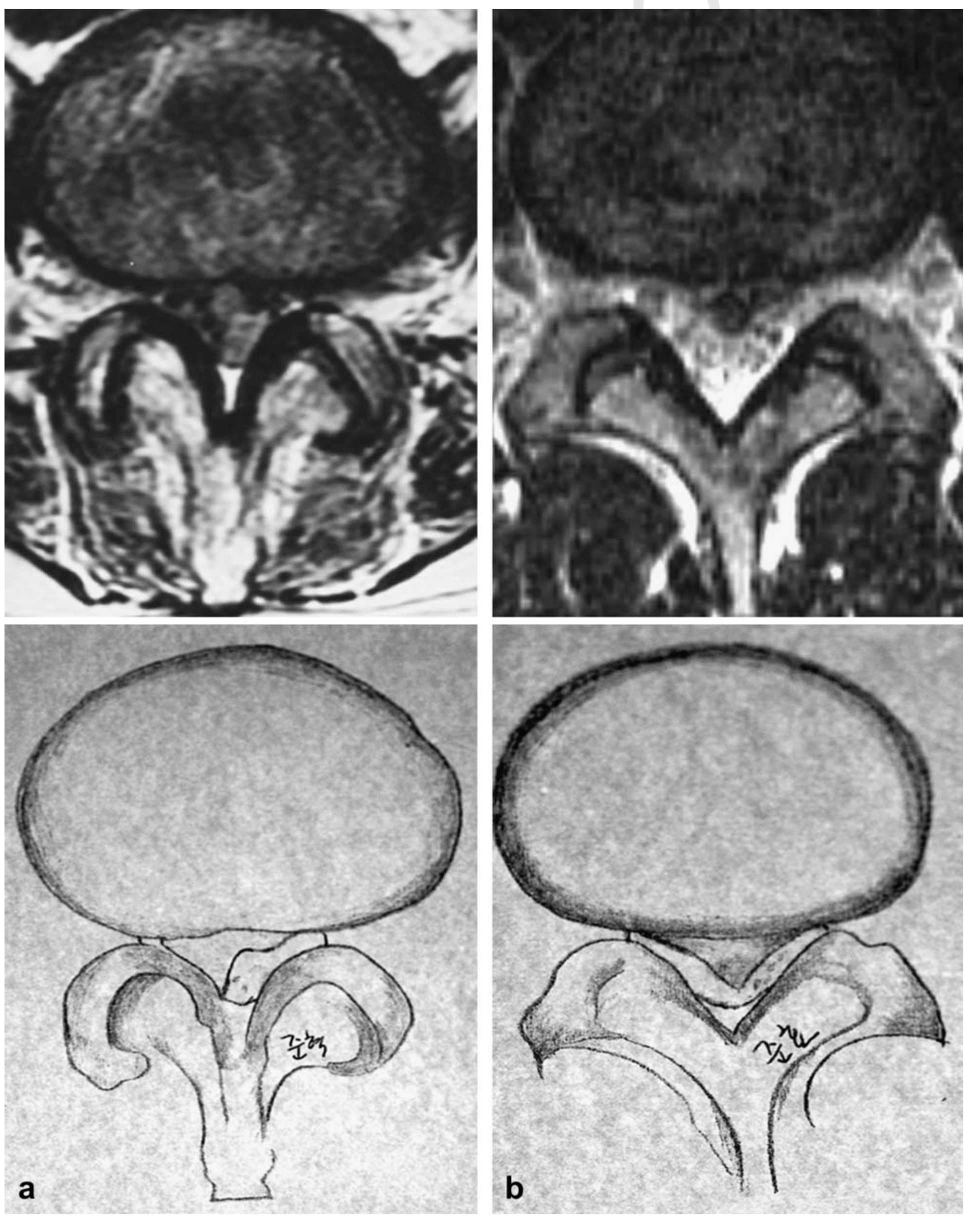

Fig. 7. Schematic drawings of the axial view demonstrate a sharp beak-like appearance of intradural disc herniation (a: Case 1, b: Case 2)—the ‘‘hawk-beak sign’’. The corresponding axial images accompany each drawing.

designated as the ‘‘hawk-beak sign’’ (Fig. 7)—on axial imaging to be reflective of disc fragments comprised of sharp cartilaginous end plates, which was confirmed in both cases upon operation.

Preoperative diagnosis and postoperative outcome

Preoperative diagnosis is thought to be very significant in the prevention of postoperative neurologic deficit. In the first case, root retraction was attempted several times to examine beneath the dura and to explore the epidural space. During surgery, we considered the possibility of intradural disc herniation after dural sac manipulation several times. We believe the postoperative complete neurologic deficit (right foot drop) may be the result of nerve damage caused by dural sac manipulation, possibly because the intradural disc herniation went unnoticed. Thus, when there is no abnormality in the epidural space, a durotomy needs to be performed and an intradural examination may be needed to justify clinical signs and symptoms or previous radiologic studies in the event that no clear disc herniation is found. In contrast, anterior lumbar interbody fusion was adequately planned before surgery in the second case, thus allowing for an uneventful surgical procedure. This illustrates why intradural disc herniations should be diagnosed adequately by means of preoperative studies. Moreover, to the best of our knowledge, this is the first case description of a patient with intradural lumbar disc herniations treated with anterior lumbar interbody fusion in the English literature.

Anterior lumbar interbody fusion, first described by Burns in 1933 [13], accomplishes multiple goals simultaneously in the treatment of intradural lumbar disc herniations [14–16]. It avoids unnecessary retraction of the nerve root and dura that are vulnerable to nerve damage. Moreover, intradural manipulation is reduced allowing for the prevention of postoperative neurologic deficit. In addition, the dural defect is easily repaired with fatty tissue and commercially available glue.

Our cases highlight the importance of preoperative diagnosis in the treatment of intradural lumbar disc herniations. The potential presence of an intradural disc herniation must always be considered preoperatively when planning a surgery on a patient whose MRI study demonstrates the ‘‘hawk-beak sign’’ on axial imaging, as well as abrupt loss of continuity of the PLL. This association results in an adequate surgical approach, thereby reducing the chance of postoperative neurological deficit. Finally, anterior lumbar interbody fusion can be a reasonable alternative in the treatment of intradural lumbar disc herniations.

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