www.jkns.or.kr http://dx.doi.org/10.3340/jkns.2013.53.1.52
Print ISSN 2005-3711 On-line ISSN 1598-7876
J Korean Neurosurg Soc 53 : 52-56, 2013

Case Report

Transdural Nerve Rootlet Entrapment in the Intervertebral Disc Space through Minimal Dural Tear : Report of 4 Cases

Jeong Hoon Choi, M.D.,[1] Jin-Sung Kim, M.D.,[2] Jee-Soo Jang, M.D., Ph.D.,[1] Dong Yeob Lee, M.D.[1]

Department of Neurosurgery,[1] Wooridul Spine Hospital, Seoul, Korea
Spine Center, Department of Neurosurgery,[2] Seoul St. Mary's Hospital, The Catholic University of Korea College of Medicine, Seoul, Korea

Four patients underwent lumbar surgery. In all four patients, the dura was minimally torn during the operation. However, none exhibited signs of postoperative cerebrospinal fluid leakage. In each case, a few days after the operation, the patient suddenly experienced severe recurring pain in the leg. Repeat magnetic resonance imaging showed transdural nerve rootlets entrapped in the intervertebral disc space. On exploration, ventral dural tears and transdural nerve rootlet entrapment were confirmed. Midline durotomy, herniated rootlet repositioning, and ventral dural tear repair were performed, and patients' symptoms improved after rootlet repositioning. Even with minimal dural tearing, nerve rootlets may become entrapped, resulting in severe recurring symptoms. Therefore, the dural tear must be identified and repaired during the first operation.

Key Words : Nerve rootlet entrapment · Lumbar disc herniation · Laminectomy · Discectomy · Dura tear · Dura repair.

INTRODUCTION

Transdural nerve root entrapment in the intervertebral disc space after incidental durotomy during lumbar disc surgery very rarely causes severe recurring radiating pain. The treatment of dural tear has evolved through time. Bed rest alone is no longer the definitive treatment for dural tear[6]. There are several methods for the repair of dural tear including primary repair, tissue sealant, blood patch, and tissue grafting[10]. We have reported 4 cases of lumbar rootlet entrapment in the intervertebral space after lumbar disc surgery, discuss the postulated mechanism, and provide a literature review.

CASE REPORT

Case 1

A 52-year-old female presented with a 2-month history of low back pain and right leg pain. Preoperative magnetic resonance imaging (MRI) showed disc herniation at L4-5 on the right side (Fig. 1). The patient underwent hemilaminectomy and discectomy (HLD) at L4-5 on the right side. During the operation, we noted that the ventral dura was severely adhered to the surrounding tissue. During dissection, the thinned dura was minimally torn. We applied the TachoComb® at the dural tear site. There was no cerebrospinal fluid (CSF) leakage or rootlet herniation noted. The patient's symptoms initially improved considerably. Postoperative MRI showed good decompression (Fig. 1). However, after postoperative day 15, she developed extremely severe recurring radiating pain in the right leg. Repeat MRI showed that a rootlet was entrapped into the L4-5 disc space (Fig. 1). A transdural repair was adopted. We found a rootlet entrapment through a widened ventral dural defect. The herniated rootlet was adhered to the surrounding tissue. Meticulous dissection was performed and we repositioned the entrapped rootlet and performed duroplasty. The patient's symptoms improved postoperatively and finally disappeared after 6 months.

Case 2

A 66-year-old male presented with a 1-month history of back

• Received : January 19, 2012 • Revised : October 16, 2012 • Accepted : January 7, 2013
• Address for reprints : Jin-Sung Kim, M.D.
Spine Center, Department of Neurosurgery, Seoul St. Mary's Hospital, The Catholic University of Korea College of Medicine, 222 Banpo-daero, Seocho-gu, Seoul 137-701, Korea
Tel : +82-2-2258-6128, Fax : +82-2-594-4248, E-mail : mddavidk@dreamwiz.com

pain and left leg pain. Initial MRI showed disc bulging at L2-3 and L3-4 and foraminal stenosis at L4-5 bilaterally (Fig. 2). He underwent bilateral HLD at L2-3 and L3-4, together with the insertion of a DIAM (Medtronic, Inc., TN, USA). After brief improvement, he experienced a severe recurrence of symptoms. Over a 5-month period, he underwent HLD, percutaneous endoscopic lumbar discectomy (PELD), and unilateral transforaminal lumbar interbody fusion (TLIF) at L4-5 on the left side. However, the left leg pain persisted. Repeat MRI showed rootlet entrapment in the L2-3 disc space (Fig. 2). Magnetic resonance myelography showed continuity of the CSF within the disc space (Fig. 2). We suspected that the severe recurring leg pain was caused by rootlet entrapment that had developed after the first operation. We performed unilateral TLIF at L2-3. There was a ventral dural defect, which was not observed during the first operation, and rootlet entrapment in the intervertebral disc space. We repositioned the entrapped rootlet and closed of the dural defect. During the operation, we noted that the L2-3 disc space was filled with CSF. The patient's symptoms improved and finally disappeared after 6 months.

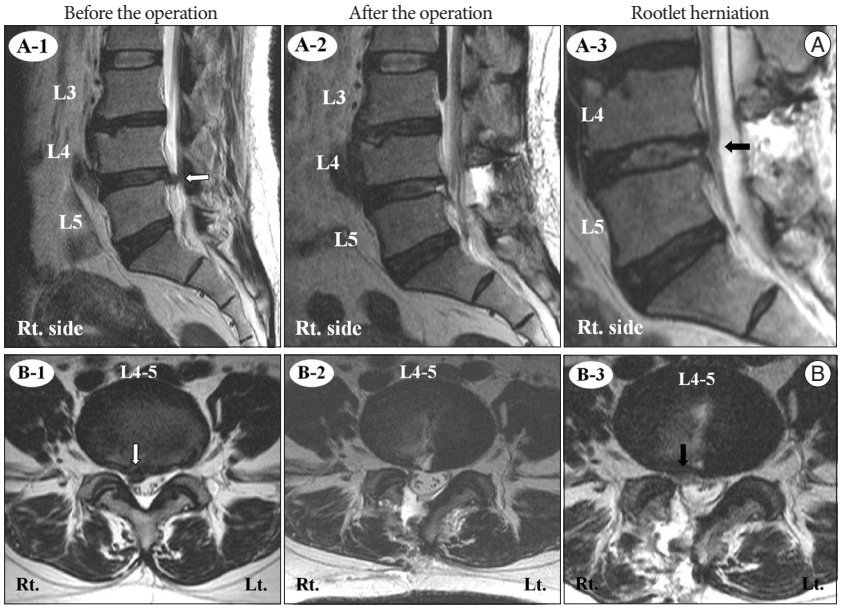

Fig. 1. Before the operation : disc herniation at L4-5 on the right side (white arrow). A-1. Sagittal magnetic resonance image. B-1. Axial magnetic resonance image. After the operation : good decompression of L4-5. A-2. Sagittal magnetic resonance image. B-2. Axial magnetic resonance image. Rootlet herniation : rootlet herniating into the intervertebral disc space at L4-5 on the right side (black arrow). A-3. Sagittal magnetic resonance image. B-3. Axial magnetic resonance image.

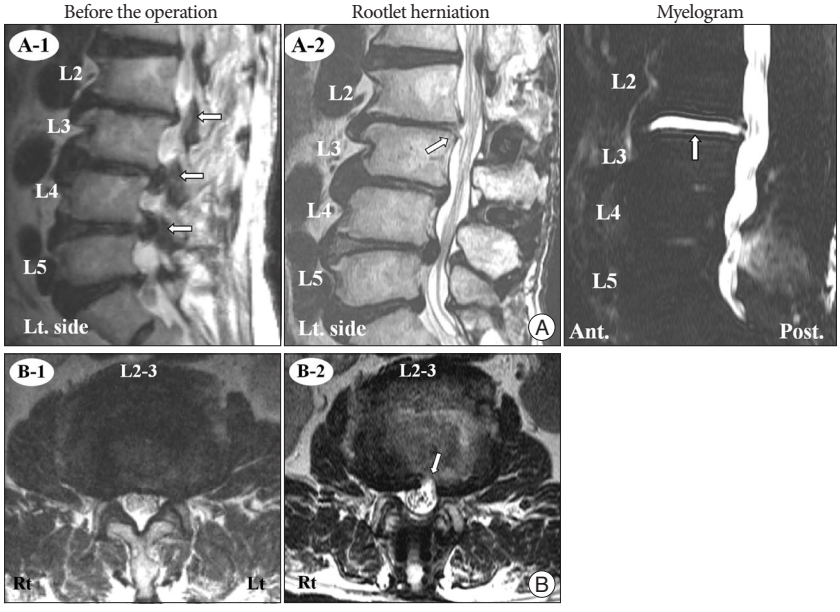

Fig. 2. Before the operation : disc herniation at L2-3, L3-4, and L4-5. A-1. Sagittal magnetic resonance image. B-1. Axial magnetic resonance image showing disc herniation at L2-3 on the left side. Rootlet herniation : rootlet herniating into the intervertebral disc space at L2-3 on the left side (white arrow). A-2. Sagittal magnetic resonance image. B-2. Axial magnetic resonance image of L2-3. Myelogram : magnetic resonance myelogram showing intradiscal leakage of cerebrospinal fluid (white arrow).

Case 3

A 49-year-old female had back pain and left leg pain for 6 months. Initial MRI showed extraforaminal disc herniation at L4-5 on the left side (Fig. 3). She underwent PELD at this location. Her symptoms improved but recurred after 2 months. Repeat MRI showed recurrence of extraforaminal and paramedian disc herniation at the L4-5 level on the left side (Fig. 3). She underwent HLD on the left side with interspinous soft stabilization at the L4-5 level. During the operation, a severe ventral dural adhesion was observed that was attributed to prior endoscopic surgery. The patient's symptoms improved after surgery. However, she again complained of left leg pain after 20 days. Repeat MRI showed rootlet entrapment through a dural defect at the L4-5 level on the left side (Fig. 3). During subsequent operation, L5 nerve root entrapment through the dural defect was confirmed. The small ventral dural defect may not have been identified during the previous operation. We repositioned the entrapped rootlet and performed duroplasty. Her symptoms improved and finally disappeared after 6 months.

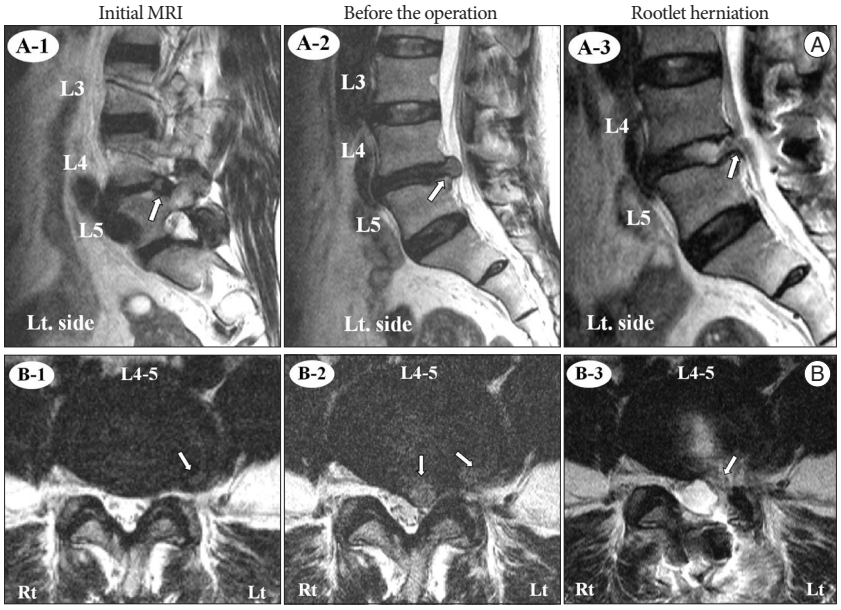

Fig. 3. Initial magnetic resonance image : extraforaminal disc herniation at L4-5 on the left side. A-1. Sagittal magnetic resonance image. B-1. Axial magnetic resonance image of L4-5. Before the operation : paramedian disc herniation and extraforaminal disc herniation at L4-5 on the left side. A-2. Sagittal magnetic resonance image. B-2. Axial magnetic resonance image of L4-5. Rootlet herniation : rootlet herniating into the intervertebral disc space at L4-5 on the left side (white arrow). A-3. Sagittal magnetic resonance image. B-3. Axial magnetic resonance image of L4-5.

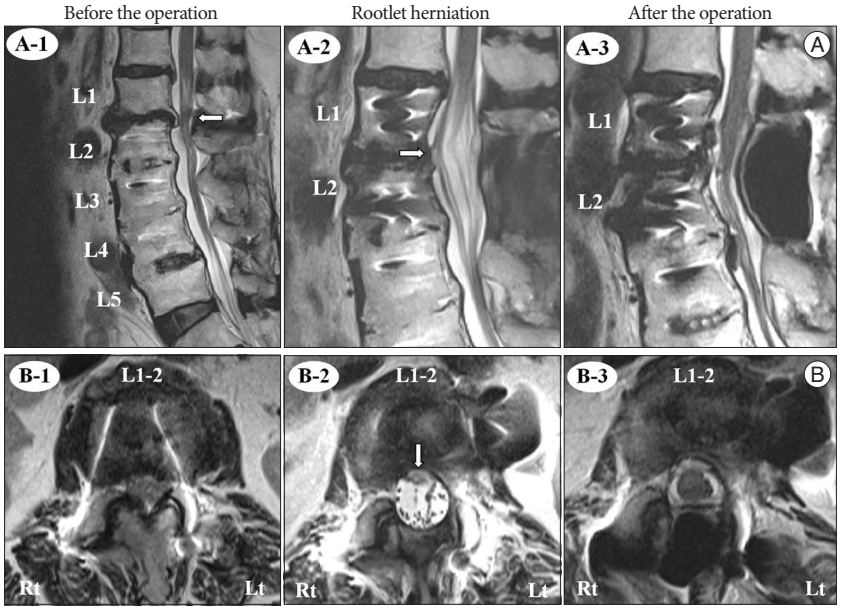

Fig. 4. Before the operation : disc herniation with osteophyte at L1-2 (white arrow). A-1. Sagittal magnetic resonance image. B-1. Axial magnetic resonance image of L1-2. Rootlet herniation : rootlet herniating into the intervertebral disc space at L1-2 (white arrow). After the operation : herniated rootlets were reposited.

Case 4

A 59-year-old female presented with a 1-month history of back pain and bilateral leg pain, more severe on the left. Preoperative MRI showed disc herniation at L1-2, ossification of the posterior longitudinal ligament (OPLL), central spinal stenosis at L1-2, and fusion of L2-3-4-5 with pedicle screws (Fig. 4). We performed anterior lumbar interbody fusion (ALIF), lateral screw insertion, and OPLL removal at L1-2. During ALIF, the ventral dura was torn and this dural defect was compactly sealed with TachoComb® and fibrin glue. This treatment stopped the CSF leakage, and the patient's symptoms improved postoperatively. However, after 2 months, she complained of severe recurring pain in both legs. Repeat MRI showed rootlet entrapment through the ventral dural defect site at L1-2 (Fig. 4). We repositioned the entrapped rootlet and performed duroplasty. Her symptoms improved and finally disappeared after 6 months.

DISCUSSION

The recurrence of radiating pain after spinal surgery has many causes. Recurrent disc herniation, remnant herniated disc material, postoperative epidural hematoma, and nerve root inflammation can all cause recurrence of this radiating pain. A few studies have reported rare causes of postoperative recurrence of radiating pain, such as the presence of a pseudomeningocele and posttraumatic spinal cord or nerve root herniation through a dural defect site[2,3,9,11-13,15,17]. However, only a few cases of nerve root entrapment in the intervertebral space after lumbar disc surgery have been reported[17]. In most cases, the occurrence of a pseudomeningocele and posttraumatic spinal cord or nerve root herniation after spinal surgery is due to the presence of a dural tear that arises from the dorsal aspect. However, in the case of nerve root entrapment in the intervertebral space, the iatrogenic dural tear is located on the ventral side.

The incidence of unintended intraoperative durotomy is between 0.3% and 17.4% and varies depending on the type of surgical procedure[1,4,5,8,10,12-14,16]. Because many patients do not show symptoms, the exact incidence of postoperative pseudomeningocele is not known, but the overall incidence is reported to be less than 2%[1,5,9,11,15]. An iatrogenic pseudomeningocele can also occur after a lumbar puncture[7]. However, iatrogenic entrapment of the nerve root in the intervertebral

space through a ventral dural defect is extremely rare. One article reported 2 cases of nerve root entrapment in the intervertebral space after lumbar disc surgery[17]. The author noted that a small dural defect, particularly one that was located at the level of the intervertebral space, could lead to transdural root herniation and root entrapment in the intervertebral space. This is the only article reporting nerve root entrapment in the intervertebral space after lumbar disc surgery.

The mechanism postulated for nerve root entrapment in the intervertebral space is a water-hammer effect resulting from the difference between the intradural pressure and the intervertebral space pressure[7,12]. Intradural pressure may increase while standing or straining[12]. This increased intradural pressure may cause compression of the spinal cord leading to widening of small unrepaired dural defects. Increased intradural pressure forces the dura and the nerve rootlet into the intervertebral space. The nerve rootlet can become entrapped in the intervertebral space through the dural defect, causing rootlet irritation, leading to severe radiating pain.

Rootlet entrapment can be diagnosed by MRI. The typical appearance of rootlet entrapment is a beak-like appearance of the ventral dura and rootlet in the sagittal view. In the axial view, the entrapped rootlets are located in the intervertebral disc space. A magnetic resonance myelogram can also show CSF leakage into the involved disc space. However, the diagnostic value of myelography is limited if the subarachnoid space does not extend outside the dural space. Before exploration, it is important to obtain a radiographic image to confirm the location of the dural defect.

An iatrogenic dural tear causes a poor clinical outcome[16]. It may cause fistula formation, meningitis, arachnoiditis, or an epidural abscess. In addition, a pseudomeningocele may entrap nerve roots or the spinal cord and cause radicular symptoms[1,9,13,15,16]. One study reported that of 6 patients with a dural defect that was not repaired during the first operation, 5 developed psuedomeningocele, and all 6 patients eventually underwent dural repair because of failure of conservative therapy[4]. Another study reported a case of cauda equina syndrome resulting from a pseudomeningocele; the cauda equina syndrome was caused by herniation of the cauda equina roots through the dural defect[1]. Another study reported that patients with incidental durotomy had poorer outcomes after surgery; in this 10-year follow-up study, a significant number of patients with incidental durotomy complained of headaches after surgery[16]. In addition, patients with incidental durotomy tended to undergo repeat operations and were unable to work for a longer duration. These patients also had increased back pain and functional limitations related to back pain.

Surgically accessing the ventral or lateral side of the dura is difficult[5]. CSF leakage does not usually occur in these cases, particularly in the cases of small dural tears on the ventral side. Therefore, a surgeon may neglect the risk of complications. Although conservative treatments such as bed rest and closed subarachnoid drainage have been attempted, midline durotomy and meticulous surgical dural repair remain the definitive treatment. Treatment with gelfoam and fibrin glue alone may not prevent persistent CSF leakage[17]. One study reported that bed rest is not a definitive treatment; in this study, the patients who did not undergo dural repair developed complications[6]. These patients eventually underwent dural repair. Another study reported that the Valsalva maneuver may help identify the dural tear in suspected cases[10]. The authors also reported that prompt identification and careful closure of the dural tear during the first surgery leads to a successful outcome.

In our four cases, prompt diagnosis and operation were performed in all cases except case number 2. In case 2, correct diagnosis was delayed and the patient suffered from radiating pain for several months. However, postoperatively, there was no neurologic deficit, and there was good improvement in all cases. If a patient presented with recurrent pain after brief improvement, the surgeon must cautiously watch the operated level first.

CONCLUSION

Iatrogenic thinning and tearing of the dura can cause rootlet entrapment even if the dura is minimally torn. The results obtained for our cases indicate that complete surgical repair of the ventral dura defect is required to prevent nerve rootlet entrapment and other complications, even if the dural defect is minimal. If a dural tear is suspected, a Valsalva maneuver should be performed before wound closure even if there is no CSF leakage.

References

1. Asha MJ, George KJ, Choksey M : Pseudomeningocele presenting with cauda equina syndrome : is a 'ball-valve' theory the answer? **Br J Neurosurg 25** : 766-768, 2011
2. Aydinli U, Karaeminoğullari O, Tişkaya K, Oztürk C : Dural tears in lumbar burst fractures with greenstick lamina fractures. **Spine (Phila Pa 1976) 26** : E410-E415, 2001
3. Cammisa FP Jr, Eismont FJ, Green BA : Dural laceration occurring with burst fractures and associated laminar fractures. **J Bone Joint Surg 71** : 1044-1052, 1989
4. Cammisa FP Jr, Girardi FP, Sangani PK, Parvataneni HK, Cadag S, Sandhu HS : Incidental durotomy in spine surgery. **Spine (Phila Pa 1976) 25** : 2663-2667, 2000
5. Couture D, Branch CL Jr : Spinal pseudomeningoceles and cerebrospinal fluid fistulas. **Neurosurg Focus 15** : E6, 2003
6. Eismont FJ, Wiesel SW, Rothman RH : Treatment of dural tears associated with spinal surgery. **J Bone Joint Surg Am 63** : 1132-1136, 1981
7. Hasegawa K, Yamamoto N : Nerve root herniation secondary to lumbar puncture in the patient with lumbar canal stenosis. A case report. **Spine (Phila Pa 1976) 24** : 915-917, 1999
8. Hodges SD, Humphreys SC, Eck JC, Covington LA : Management of incidental durotomy without mandatory bed rest. A retrospective review of 20 cases. **Spine (Phila Pa 1976) 24** : 2062-2064, 1999
9. Hosono N, Yonenobu K, Ono K : Postoperative cervical pseudomeningocele with herniation of the spinal cord. **Spine (Phila Pa 1976) 20** : 2147-2150, 1995
10. Khan MH, Rihn J, Steele G, Davis R, Donaldson WF 3rd, Kang JD, et al. : Postoperative management protocol for incidental dural tears during

degenerative lumbar spine surgery : a review of 3,183 consecutive degenerative lumbar cases. **Spine (Phila Pa 1976) 31** : 2609-2613, 2006
11. Lee KS, Hardy IM 2nd : Postlaminectomy lumbar pseudomeningocele : report of four cases. **Neurosurgery 30** : 111-114, 1992
12. Nishi S, Hashimoto N, Takagi Y, Tsukahara T : Herniation and entrapment of a nerve root secondary to an unrepaired small dural laceration at lumbar hemilaminectomies. **Spine (Phila Pa 1976) 20** : 2576-2579, 1995
13. O'Connor D, Maskery N, Griffiths WE : Pseudomeningocele nerve root entrapment after lumbar discectomy. **Spine (Phila Pa 1976) 23** : 1501-1502, 1998
14. Park DK, Khurana N, Ellman MB, Singh K : Perioperative complications in lumbar spine surgery. **Contemp Spine Surg 10** : 1-6, 2009
15. Pavlou G, Bucur SD, van Hille PT : Entrapped spinal nerve roots in a pseudomeningocoele as a complication of previous spinal surgery. **Acta Neurochir (Wien) 148** : 215-219; discussion 219-220, 2006
16. Saxler G, Krämer J, Barden B, Kurt A, Pförtner J, Bernsmann K : The long-term clinical sequelae of incidental durotomy in lumbar disc surgery. **Spine (Phila Pa 1976) 30** : 2298-2302, 2005
17. Töppich HG, Feldmann H, Sandvoss G, Meyer F : Intervertebral space nerve root entrapment after lumbar disc surgery. Two cases. **Spine (Phila Pa 1976) 15** : 249-250, 1994