Intra-operative identification of conjoined lumbosacral nerve roots: a report of three cases

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ABSTRACT

We report 3 cases of conjoined nerve root anomalies identified during micro-endoscopic discectomy (MED). Between 2009 and 2010, 61 men and 20 women aged 18 to 84 (mean, 42) years underwent MED for symptomatic lumbar disc herniation of L3–4 (n=1), L4–5 (n=44), and L5–S1 (n=36). Magnetic resonance imaging (MRI), myelogram, and post-myelo computed tomography did not identify the anomalies. All 3 patients were male and had type 2A S1 conjoined nerve roots, with a herniated disc at L5–S1. None of them had any preoperative pseudolocalising neurological signs, but all demonstrated stiffer positive straight leg raise sign and deterioration of the Achilles tendon reflex. Postoperatively, all 3 patients achieved excellent clinical outcomes.

Key words: diskectomy; intervertebral disc displacement; spinal nerve roots

INTRODUCTION

Anomalous nerve roots are due to aberrant migration of the involved roots during embryonic development. The most common anomaly is a conjoined nerve root, in which 2 adjacent nerve roots share a common dural envelope during procession from the thecal sac. Most such anomalies occur unilaterally at the level of L5 to S1. The prevalence of lumbosacral nerve root anomalies at autopsy is around 8.5% to 30%, which is much greater than the 1.9 to 4% reported in imaging studies. Diagnosing conjoined nerve root anomalies is difficult. The lack of preoperative awareness may lead to iatrogenic root injury, particularly during minimally invasive surgeries with limited visualisation.

We report 3 cases of conjoined nerve root anomalies identified during microendoscopic discectomy (MED). Between 2009 and 2010, 61 men and 20 women aged 18 to 84 (mean, 42) years underwent MED for symptomatic lumbar disc herniation of L3–4 (n=1), L4–5 (n=44), and L5–S1 (n=36). Magnetic resonance imaging (MRI),
myelogram, and post-myelo computed tomography did not identify the anomalies.

CASE REPORTS

All 3 patients were male and had type 2AS1 conjoined nerve roots (according to the Neidre classification), with a herniated disc at L5-S1: subligamentous extrusion (n=1), transligamentous extrusion (n=1), and sequestration (n=1). Postoperatively, all 3 patients achieved excellent clinical outcomes. They were discharged within one week, and returned to work after 3 weeks.

Patient 1
In April 2009, a 37-year-old man presented with low-back pain radiating to the left leg with a positive straight leg raise (SLR) test to 20°. One year and 10 months earlier, the patient had undergone transforaminal lumbar interbody fusion for disc herniation of L4–5. On examination, the left Achilles tendon reflex was weak, and the Japanese Orthopedics Association (JOA) score was 9. Neuroradiological images showed a left L5-S1 herniated disc with a distally migrated fragment (Fig. 1). Intra-operatively, the herniated disc with sequestration was incarcerated to the adjacent conjoined S1 nerve roots (Fig. 1). At postoperative week 4, the JOA score improved to 27, and the JOA score recovery ratio was 90%.

Patient 2
In July 2009, a 71-year-old man presented with low-back pain radiating to the right leg with a positive SLR test to 60°. The right Achilles tendon reflex was weak, and the JOA score was 10. Neuroradiological images revealed a right L5-S herniated disc with subligamentous extrusion ventrally oppressed the conjoined nerve roots (Fig. 2). At postoperative week 4, the JOA score improved to 29, and the JOA score recovery ratio was 100%.

Patient 3
In August 2009, a 35-year-old man presented with low-back pain radiating to the left leg with positive SLR test to 15°. The left Achilles tendon reflex was weak, and the JOA score was 14. Neuroradiological images revealed a left L5-S herniated disc and a distal migrated fragment with transligamentous extrusion ventrally and laterally oppressed the conjoined nerve roots (Fig. 3). At postoperative week 4, the JOA score improved to 27, and the JOA score recovery ratio was 87%.

DISCUSSION
According to the Neidre classification, there are 3 types of conjoined nerve roots (Fig. 4). Further
subdivision is based on their appearance in the dura. In type 1A, the 2 nerve roots arise from a common dural sheath. The cephalad nerve root component departs from the conjoined nerve root at an acute angle and passes below its respective pedicle. The inferior nerve root component traverses inferiorly within the canal and lies below the subadjacent caudal pedicle. In type 1B, the cephalad nerve root lies at a 90º angle from the conjoined nerve root, similar to an exiting cervical nerve root. In type 2, 2 separate nerve roots exit through one foramen. This may leave one foramen unoccupied (type 2A), or in rare instances, some nerve rootlets may depart from one of the nerve roots and exit above the pedicle so all foramina have exiting nerve roots (type 2B). In type 3, adjacent nerve roots are connected by a vertically connecting anastomotic segment.

MRI is the gold standard for differentiating conjoined nerve root anomalies from other space-occupying processes. The density of nerve roots is almost identical to that of the thecal sacs, and is considerably less dense than that of disc materials. The location of the root anomaly is often above the intervertebral disc space at the level of the pedicle, whereas herniated disc fragments are usually located at the level of the disc space. An asymmetry or pouching out of the subarachnoid space in the axial view is suggestive of a conjoined nerve root.8,13 Lumbar myelography with post-myelo computed tomography in addition to MRI is recommended in cases with questionable findings.14 Nonetheless, these anomalies are frequently missed radiologically and are usually identified intra-operatively, as in our patients.

Congenital anomalies of lumbosacral nerve roots may manifest radiculopathy symptoms, even in the absence of mechanical impingement of the lumbosacral nerve roots.10 Moreover, conjoined nerve root anomalies may decrease the space available for lumbosacral nerve roots at the lateral recesses in the spinal canal. Therefore, smaller herniated discs may present with relatively more severe radicular symptoms. None of the 3 patients had preoperative pseudolocalising neurological signs, but all demonstrated stiffer positive SLR sign and weak Achilles tendon reflexes.

When a conjoined nerve root is identified intra-operatively, extruded disc material may be missed because it may be hidden in the secondary axilla of the conjoined nerve root. In addition, conjoined nerve roots are considerably less mobile and thus much more difficult to retract than a normal nerve root compressed by disc material.14 Nonetheless, when the interlaminar space is extended proximally, the conjoined nerve root is exposed. This facilitates

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**Figure 3** Patient 3: (a) a left L5-S herniated disc with a distal migrated fragment; (b) the herniated disc with transligamentous extrusion ventrally and laterally opposed the conjoined nerve roots.

**Figure 4** Classification of conjoined nerve roots.
retraction of the anomalous nerve roots and herniomyotomy or nucleotomy. None of our patients had iatrogenic nerve root injury or insufficient nerve root decompression; all achieved excellent outcome. Surgeons must be cognizant of a nerve root anomaly during surgery. When nerve root anomalies are identified during MED, decompression should be extended proximally to provide sufficient space for the operation. This minimises the risk of intraoperative nerve root injury.

REFERENCES