L5 nerve root duplication in the setting of MRI-depicted L5-S1 disk herniation

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ABSTRACT

Lumbosacral nerve root anomalies are rare anatomic variations with a predilection for the lumbosacral spine. Among these, conjoined nerve roots are the most common with other rare variants such as nerve root duplication occurring far less frequently. While these anatomic variations are exceedingly rare, their presence has significant clinical ramifications. Undiagnosed lumbosacral nerve root anomalies are at risk for iatrogenic injury, may contribute to wrong-site surgery and contribute to continued postoperative symptoms. Herein, we present a case of a 74 year-old female with diskogenic back pain and L5 radiculopathy found to have a duplicated L5 nerve root intraoperatively. Interestingly, the L5-S1 disk was found to be normal and unlikely to contribute to her presentation. She underwent L5-S1 laminectomy and L5 foraminotomy with resolution of her L5 radicular symptoms postoperatively.

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1. Introduction

Lumbosacral nerve anomalies are a rare phenomenon with sporadic reports in the literature as far back as 1949. Among these, conjoined nerve roots (CNR) are by far the most common anomaly and this is a distinct entity from duplicated nerve roots which represent a very small subset of nerve root anomalies. Radiological evaluation of degenerative spine disease is notoriously insensitive for the detection of nerve anomalies and the diagnosis is often made intraoperatively or missed altogether. This is particularly true in anomalies other than conjoined nerve roots about which very little has been written or is known and altogether. This is particularly true in anomalies other than conjoined nerve roots about which very little has been written or is known and for which there are no specific clinical or radiographic diagnostic clues. The lack of adequate preoperative diagnosis, poses several risks to the patient including permanent iatrogenic injury to the nerves as well as ineffective procedures. Here we present a case of a patient with a right-sided L5 radiculopathy and preoperative diagnosis of disk herniation based on MRI. A duplicate L5 nerve anomaly was discovered intraoperatively resulting in modification of the intended surgical plan.

2. Case report

The patient is a 74-year-old woman presenting with new onset lower back pain with radiation to the right lower extremity. Straight leg raising test was positive suggesting symptomatic disk herniation on that side. Contrast-enhanced lumbar MRI from an outside institution was read as consistent with an L5-S1 extruded disk as shown in Fig. 1. MRI revealed a right L5-S1 paracentral disk extrusion, right L5-S1 facet arthropathies, subarticular and foraminal stenosis. No MR coronal reconstructions were available. She was consented and scheduled for L5-S1 hemilaminectomy and microdiscectomy.

L5-S1 laminotomy and mesial facetectomy revealed a hypertrophic ligamentum flavum crowding the L5 foramen. L5 foraminotomy revealed duplicate nerve roots consisting of a larger rostral root and a smaller caudal root exiting separately from the thecal sac and traveling to the L5 foramen within separate nerve root sleeves as shown in Fig. 2. A calcified L5-S1 disk was well-seated in the intervertebral space and was not removed. She reported resolution of her radicular pain and was ambulatory with the assistance of a walker by postoperative day 3 and discharged to inpatient rehabilitation on the fifth postoperative day.

3. Discussion

Neidre and MacNab [5] classified lumbosacral anomalies based on 16 surgical cases in which all patients presented with symptoms of sciatic radiculopathy. Type 1 anomalies, the most common type, consisted of conjoined nerve roots defined as nerves sharing a common sheath at any point along their course from the thecal sac proximally, to their exit at the foramen. Type 2 anomalies are more germane to the current case and occur when two nerve roots exit a single foramen. This is further subclassified into Types 2a and 2b. In the former, one root canal remains unoccupied while in the latter, all foramina contain nerves but one contains the duplicate. Type 3 anomalies are connected by an anastomosis and Type 4 anomalies consist of any combination of the previous three types. This case likely represents a Type 2b Neidre and MacNab

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anomaly with nerve roots present at both the L4 and S1 foramina with duplicated L5 roots.

The literature is replete with case reports and small case series of Type 1 lumbosacral anomalies involving conjoined nerve roots with focus on the radiologic and clinical features predictive of this anatomical variation. Deciphering between conjoined nerve roots and intervertebral disk herniations has been one specific area of interest [4]. Whether the diagnostic features used in conjoined nerve roots apply to other types of lumbosacral nerve root anomalies such as duplicated nerves in which there is also overcrowding within the foramen is unknown. It is certainly reasonable that the common pathoanatomy of Types 1 and 2 anomalies would both result in foraminal overcrowding and compression leading to inflammatory changes and positive straight leg raising sign but the effect of reduced mobilization from encasement in a single nerve sheath in the case of conjoined nerves may lead to subtle radiological and clinical changes. This is underscored in the current case in which the patient presented with a positive straight leg raising sign. Radiologically, several signs have been proposed to help in the preoperative diagnosis of conjoined nerve roots on MRI. These include the sagittal shoulder sign, the fat crescent sign, corner sign and the parallel sign [2–4] but the sensitivity of these findings has been contested.

Similarly, as these radiological signs were validated for conjoined nerve roots, it is unclear whether there is any generalizability to other forms of lumbosacral anomalies. Coronal reconstruction of MR images does appear to increase sensitivity of conjoined nerve roots and perhaps other lumbosacral nerve root anomalies but as this is not done routinely, there has to be some degree of clinical suspicion on the part of the radiologist who then requests such studies [1]. Unfortunately, such clinical suspicion remains abysmally low.

Outcomes of patients with lumbosacral nerve root anomalies depend on the nature of the anomaly, other comorbid spine disease and the extent of decompression performed. Disk herniations are a very common comorbid condition and are surmised to be the inciting event that brings the patient to clinical attention. Thorough inspection of the anatomy must be performed with the aim of identifying all active pathological processes leading to nerve root compression. The anomalous nerve roots are frequently fixed and inflamed and it is therefore prudent to perform laminectomy and facetectomy prior to diskectomy in order to free the roots completely to minimize retraction and iatrogenic injury. Pediculectomy is often performed as well if deemed necessary intraoperatively to maximize mobility of the involved roots. Continued symptoms after laminectomy and disectomy alone should always raise suspicion for a nerve root anomaly. With adequate decompression, outcomes are similar to patients requiring disectomy only [4].

With inadequate diagnostic tools within the armamentarium of the surgeon, one must remain cognizant of the differential diagnosis of disk herniation and maintain vigilance even in cases such as this where the clinical and radiological features support the diagnosis. This is a particularly salient point in the era of minimally-invasive spine surgery in which there may be limited visualization of surrounding tissue and perhaps a higher likelihood that a duplicated root would be mistaken for the pathologic disk. This will reduce preventable injury to the patient and enhance provision of more effective surgical management as an optimistic surgeon experiencing only one nerve root and an adjacent soft tissue mass could easily misinterpret the second root as a herniated disk with disastrous results.

4. Conclusion

Duplicate lumbosacral nerve roots are extremely rare anomalies. Clinical and radiographic presentation is often consistent with herniated lumbar disks which can be comorbid. The surgeon must remain cognizant of the broad differential diagnosis for herniated disks. This is particularly true when employing minimally invasive methods which
may limit the intraoperative view and further reduce the likelihood of making an intraoperative diagnosis.

References


