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Conjoined lumbosacral nerve roots: current aspects of diagnosis

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Abstract Conjoined lumbosacral nerve roots (CLNR) are the most common anomalies involving the lumbar nerve structures which can be one of the origins of failed back syndromes. They can cause sciatica even without the presence of an additional compressive impingement (such as disc herniation, spondylolisthesis or lateral recess stenosis), and often congenital lumbosacral spine anomalies (such as bony defects) are present at the “conjoined sheaths”. This congenital anomaly has been reported in 14% of cadaver studies, but myelographic or computed tomographic studies have revealed an incidence of approximately 4% only. Diagnostic methods such as magnetic resonance imaging (MRI) are helpful for determination of the exact

anatomical relations in this context. We present five typical cases of conjoined nerve roots observed during a 1 year period, equivalent to 6% of our out-patients without a history of surgical treatment on the lumbar spine. In all cases with suspicious radiological findings MRI or lumbar myelography combined with CT and multiplanar reconstructions is recommended.

Keywords Conjoined nerve roots · MRI · Lumbosacral spine anomaly · Sciatica

Introduction

Lumbosacral nerve roots are arranged strictly segmentally. Deviations can be observed and are considered to be congenital in origin, arising during the fetal development of spinal structures [2]. Most common are conjoined lumbosacral nerve roots (CLNR), which have been reported in 14% of the cases in a post-mortem study [11]. Since the first description in 1949 [22], about 120 cases of conjoined nerve roots have been published. Most had anomalies of the nerve roots L4–S1. A very rare constellation is bilateral CLNR [3], involving the roots of L4/L5 or L5/S1. CLNR may be either asymptomatic or cause spontaneous lumbar and radicular pain [6]. The presence of additional abnormalities [16] or degenerative changes, such as disc

herniation or lateral recess stenosis [19, 21], support the development of low back pain.

Summary of classifications

A first classification was developed by Cannon et al. [4]. This scheme, together with recent modifications by Neidre and MacNab [1, 12, 14, 19], focuses on four types of nerve root anomalies. The first type shows conjoined nerve roots arising from a common dural sheath, separating and leaving the spinal canal through the foramen intervertebrale. In the second and most common type, two nerve roots exit through the same foramen [1]. In this case either one neural foramen remains unoccupied or nerve roots can be observed in all neuroforamina, including an addi-

tional root. The third type describes a group of anastomotic nerve roots in which adjacent nerves are connected in the form of a transverse or vertical anastomosis. The fourth type includes all cases with a combination of the above descriptions [14].

Clinical aspects

Clinical symptoms appear regularly beyond the second decade of life and show no gender preference. Between the second and fourth decades patients complain of low back symptoms without radicular pain, whereas older patients often describe a progressive course of sciatica [15]. At that time symptoms are mainly present for less than 4 months and often show a recurrence [5, 15]. Sometimes the onset of symptoms is initiated by trauma or a trauma provokes intense radicular pain causing severe disability [3]. All kinds of neurological deficits and clinical symptoms may occur on the basis of this nerve irritation. Besides the different phenotypes of low back or sciatic pain, the most common complaints of these patients are numbness and muscular weakness involving the corresponding dermatome. Physical examination reveals tenderness of the paraspinal muscles and pain during palpation of the sacroiliac joint or the sciatic notch. Sometimes decreased sensation to pinprick in the corresponding dermatome or reduced tendon reflexes are described. Regarding decreased sensation, there is often a difference between sensory deficits and pain radiation [15]. Furthermore a significant discrepancy exists between the progressive phenotype of pain and a negative Lasègue's sign or a crossed negative straight-leg raising sign [4].

Illustrative cases

Case 1 (conservative treatment)

An 18-year-old mechanic developed for the first time excruciating low back pain with sciatica in his left leg for 3 weeks. He did not describe motor and sensory deficits. There was no evidence of weakness or atrophy. Neurological examination was within normal limits. A suboptimal-quality CT scan of the lumbar spine revealed a space-occupying process which might have been caused by a herniated disc at the L5/S1 level on the left side (Fig. 1). The plain radiographs showed a partial defect of the median neural arch of the lumbarised S1 and the following parts of the sacrum, in the sense of a spina bifida occulta. In the additional MRI examination a common passage of the left nerve roots L5 and S1 through the neuroforamen L5/S1 was found but no sign of disc herniation (Fig. 2). Additionally we identified a wide lateral recess with an abnormal dural sac configuration on the side of the conjoined nerve roots (Fig. 3). In this case we recommended conservative treatment with stabilizing

Fig. 1 Case 1. Suboptimal CT scan showing a space-occupying process on the left side (*arrow*); a herniated disc was assumed at level L5/S1

Fig. 2 Case 1. Axial T2-weighted MR image with abnormal dural sac configuration (*arrow*) on the side of the conjoined nerve roots

gymnastics, backstroke swimming and transcutaneous nerve stimulation. Under this conservative therapy, the patient was able to return to work.

Case 2 (operative treatment)

A 58-year-old physical scientist developed progressive pain in his back and both legs with reduction of mobility

Fig. 3 Case 1. Axial T1-weighted MR image with combined passage of the nerve roots L5 and S1 (arrow) through the neuroforamen L5/S1

Fig. 4 Case 2. Myelography with prolapsing disc L4/L5 and associated spinal channel stenosis. Conjoined nerves L4/L5 (arrow) are seen on the left side

over the previous 18 months. He could walk only 150 m before he had to stop because of pain and weakness in both legs. Physical examination revealed only a decreased pinprick sensation in the left L5 dermatome without pathological findings regarding muscular strength and the tendon reflexes. The MRI examination of the lumbar spine demonstrated a spinal canal stenosis associated with a huge disc protrusion in L4/L5 and intense compression of the nerve structures. Moreover the T2-weighted coronal and axial MR images showed conjoined nerve roots on the left side. Lumbar myelography with postmyelo-CT tech-

nique confirmed the existence of conjoined nerve roots (Fig. 4). The patient underwent an operative decompression by laminectomy combined with discectomy and left foraminotomy at level L4/L5. After surgery neither radiculopathy nor low back pain remained, and the patient achieved approximately normal mobility.

Additional cases

Another patient (54 years old) revealed a combination of herniated disc in the left portion of the segment L5/S1 and a conjoined nerve root anomaly of S2 and S3 on the same side. Neurological findings were an absence of the left ankle jerk with decreased sensation to pinprick over posterior part of left calf and the left sole, and mild paresis of the left gastrocnemius muscle with accentuated pain on straight-leg raising. Radiological findings were herniation of the disc in the left segment L5/S1 on CT and in addition conjoined nerve roots of S2 and S3 on the left side, together with guiding bony spinal canal changes caused by impression of the lateral recess on the ipsilateral side (bone window in CT imaging, Fig. 5). Therapy consisted of hemilaminectomy combined with unroofing of the lateral recess and medial facetectomy in L5/S1. After additional stabilizing physiotherapy including muscle training, the patient returned to work.

Another two patients (43 and 28 years old) with progressive pain in the low back without sciatica, loss of right ankle jerk and mild sensory deficits, had conjoined right L5 and S1 nerve roots on myelography (Fig. 6) and postmyelo-CT images without the presence of another compressive impingement. Both patients underwent con-

Fig. 5 Axial CT scan, bone window. Conjoined nerve anomaly of S2 and S3 on the left side with impression (arrow) of bony structures

Fig. 6 Myelography with conjoined nerves L5/S1 (arrow) on the right side

servative treatment with stabilizing physiotherapy, analgesics and transcutaneous nerve stimulation, which preserved their ability to work.

Discussion: diagnostic methods

Unsuspected CLNR can provoke lesions and trauma of the nerve roots during operative treatment. Since the introduction of myelography it has become possible for the first time to diagnose the anomaly preoperatively [2]. In this context Pecker et al. [17], using water-soluble contrast media, described the appearance of conjoined nerves as “rifle barrel fusion of spinal roots”. In cadaver studies CLNR had an incidence of 14%, whereas myelography with water-soluble contrast media detected CLNR in 4% of examined patients only [11]. Myelography is often too insensitive for a high-quality preoperative preparation of the patients [8]. If this method is performed exclusively, it also cannot reliably ascertain the coexistence of lateral recess stenosis or other associated factors causing neural entrapment besides the conjoined nerves [3].

CT is often the first method for evaluation of low back pain due to suspected disc herniation. CT imaging of nerve root anomalies often causes misinterpretation of anatomical variations such as disc herniations [9, 18]. In CT scans

the presence of conjoined nerve roots may be suspected if isodense or slightly hyperdense tissue (compared with the dural sac and not clearly separable from it) replaces the anterolateral area of the epidural space. Sometimes two separate, conjoined round structures, which can be followed in the next slices through the intervertebral foramen, can be observed. Another helpful tool is the estimation of attenuation values allowing the differentiation of denser herniated discs from dural sac structures [20]. Additionally, conjoined nerve roots are typically located close to the pedicle level in axial slices, whereas herniated discs can only be found in this location in the case of migrated disc fragments. A secondary sign of CLNR is an abnormal configuration of the dural sac and/or impression of associated bony structures [10]. If CLNR alone is present, typical air-trapping effects, such as in disc degeneration, will not be observed. The constellation of combined lumbosacral anomaly and herniated disc or the associated presence of lateral recess stenosis leads to difficulties in differential diagnosis between herniated disc formations and conjoined nerve roots in CT imaging [3, 13, 19]. To overcome these difficulties CT with intravenous injection of contrast media [7] or myelography followed by CT scanning [13] may provide a clearer differentiation.

MRI is the gold standard for differentiating the presence of conjoined nerve root anomalies from other space-occupying processes. Gomez et al. [8] emphasize that both the coronal T2-weighted MR image and the X-ray myelogram of the lumbar spine demonstrate the nerve anomalies noninvasively and with an equal sensitivity. Coronal MR images exactly describe the course of each nerve root. In addition, the use of native T1- and T2-weighted axial MRI sequences exhibits better resolution and more precise differentiation between conjoined nerve roots and other space-occupying processes. In doubtful cases or for postoperative scans we recommend the additional application of gadolinium contrast media in MRI for better identification of scar tissues. Additional conventional myelography will be a helpful tool if MRI can not be performed or does not offer reliable results.

Conclusion

We emphasize the importance of MRI as the gold standard for detection of CLNR. Additionally lumbar myelography with postmyelo-CT in all cases with questionable radiological findings is recommended.

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