

Double Crush Syndrome of the Lower Limb in L5 Radiculopathy and Peroneal Neuropathy: A Case Report

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Abstract

Double crush syndrome (DCS) is a clinical condition involving impingement of the spinal and peripheral nerves. DCS of the lower limbs has been recognized; however, no detailed reports have been published. Herein, we report a rare case of the coexistence of L5 radiculopathy and peroneal nerve entrapment neuropathy. The patient suffered from pain in the left lower leg and left foot combined with muscle weakness in the left leg without a Tinel-like sign in the peroneal tunnel area. MRI showed a deficit in the left L5 nerve root sleeve, and X-ray imaging revealed L5 spondylolysis. Lumbar fusion surgery was performed at L5-S1. Subsequently, the patient's symptoms were partially improved, but the pain and toe and ankle motor weakness persisted. In addition, a Tinel-like sign appeared at the entrapment point of the peroneal nerve. The entrapped peroneal nerve was decompressed, and the patient's symptoms improved. The patient had L5 radiculopathy owing to the improvement in his symptoms in the upper leg before and after lumbar surgery. It is unclear why no Tinel-like sign was detected before the first surgery, but we hypothesized that L5 nerve disorder may mask the symptoms triggered by compression of the peroneal nerve due to the complex pathology of DCS and dynamic factors. Distinguishing between radiculopathy and relative peripheral neuropathy should always be a consideration. DCS may mask characteristic symptoms, and it is important to carefully follow up the patient to detect changes in his or her condition.

Keywords: double crush syndrome, L5 radiculopathy, peroneal neuropathy

Introduction

Double crush syndrome (DCS) consists of impingement of the spinal and peripheral nerves. This syndrome results in a complex clinical presentation in which a single lesion in the proximal portion of a nerve predisposes that nerve to a second lesion distally, especially when the nerve passes through a narrow anatomical canal.¹⁾ Some combined disorders of the upper limbs involving cervical radiculopathy and peripheral nerve root lesions have been reported. Upton and Macomas reported that 7% of patients with carpal tunnel syndrome or cubital tunnel syndrome also had cervical radiculopathy.²⁾

In contrast, there are few detailed reports on the coexistence of L5 radiculopathy and peroneal nerve entrapment neuropathy (PNEN). L5 radiculopathy causes sensory disorders on the lateral surface of the leg and the dorsum of the foot as well as muscular weakness in ankle and toe dorsiflexion, similar to the clinical presentation of peroneal neuropathy. Therefore, close attention is needed to distinguish between these disorders in clinical practice. Herein, we describe a rare case of DCS of the lower limb that presented with L5 radiculopathy and peroneal neuropathy.

Case Description

The patient was a 69-year-old man who suffered from pain in the left buttocks, posterior surface of the left whole leg, lateral surface of the left lower leg and dorsum of the left foot. He rated the pain of the upper leg pain as 3 and lower leg pain as 8 on a

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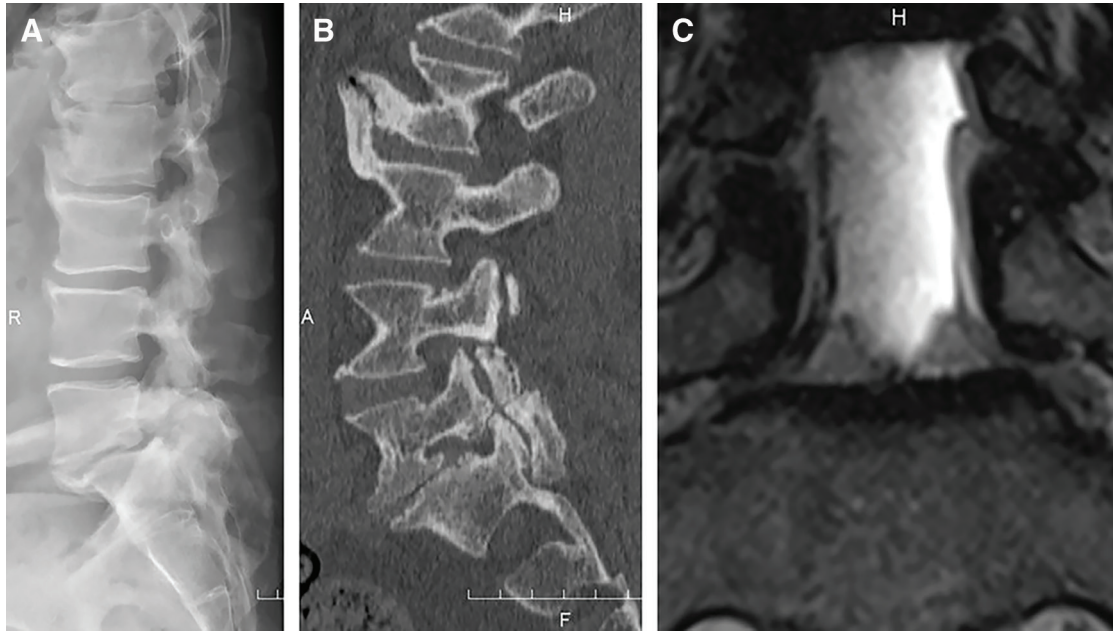


Fig. 1 (A) X-ray imaging shows L5-S1 spondylolisthesis. (B) CT reveals L5 spondylolysis and vertebral canal stenosis caused by a bone spur. (C) Coronal MRI shows that the L5 nerve root is compressed.

numeric rating scale (NRS), ranging from 0 (“no pain”) to 10 (“extremely painful”). This pain occurred without any trigger and had gradually worsened over the course of 3 months. He also presented with muscle weakness of the left leg, with the following scores on manual muscle testing (MMT): gluteus medius muscle 4, hamstrings 3, tibialis anterior 4- and extensor hallucis longus muscle 4+. Movement disorders of foot inversion and eversion were mild and were not significantly different. His deep tendon reflexes were normal. The straight leg raise test was negative. At the first visit, no Tinel-like sign was observed at the peroneal tunnel. His preoperative Japanese Orthopedic Association (JOA) score was 16. He had no past history with the exception of diabetes, for which he had been taking medication. X-ray imaging revealed mild spondylolisthesis at L5-S1 due to L5 spondylolysis, and CT revealed left L5-S1 spinal stenosis (Fig. 1A and 1B). MRI showed a deficit of the left L5 nerve root sleeve (Fig. 1C). We diagnosed the patient with left L5 radiculopathy; peroneal nerve disorder was excluded because the patient had comparable symptoms in not only the lower leg but also the upper leg and lacked the characteristic clinical presentation, such as the Tinel-like sign in the peroneal tunnel area. His symptoms were not improved by medical treatment, and L5 root decompression by posterior lumbar interbody fusion and percutaneous pedicle screw fixation at L5-S1 was performed. The L5 nerve root was compressed in the whole vertical interpedicular zone by granulation tissue and bone

spurs resulting from L5 spondylolysis. The dorsal root ganglion was identified at the inner edge of the pedicular line. Through surgery, the L5 nerve root was sufficiently decompressed (Fig. 2). After this lumbar surgery, the motor weakness of the hip abductors and hamstrings was improved, with the following

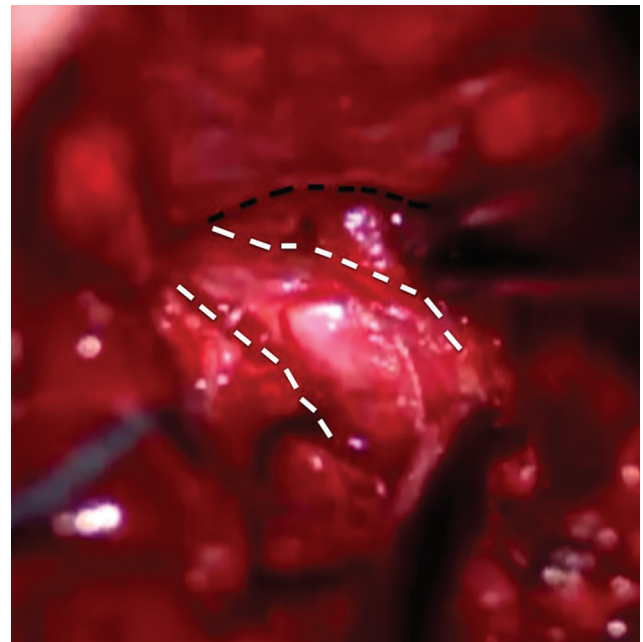


Fig. 2 Photomicrographs show decompression of the left L5 nerve root (white dotted line). Black dotted line shows the lateral border of the dura.

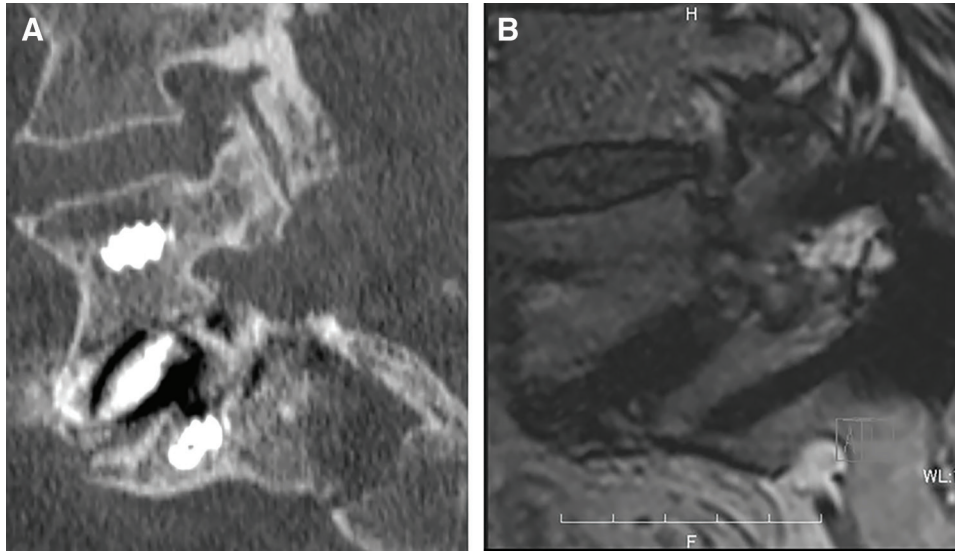


Fig. 3 (A) Postoperative sagittal CT and (B) magnetic resonance images show an enlarged intervertebral canal.

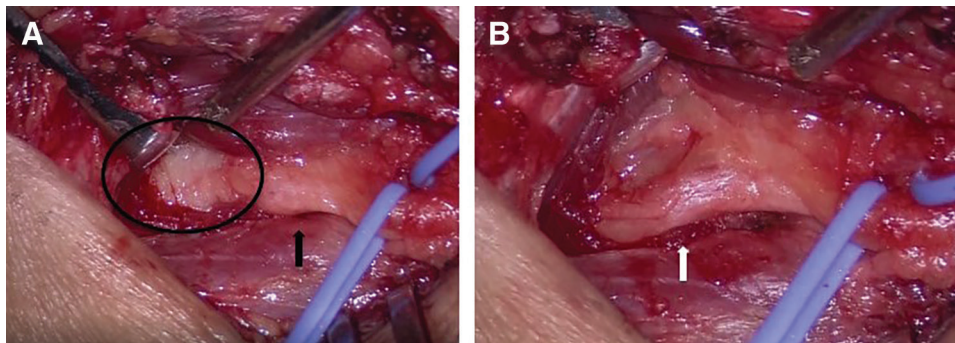


Fig. 4 (A) Photographs show the surgical field surrounding the peroneal nerve (arrow) and the site of entrapment (circle) by the peroneus longus muscle and fascia. (B) Photograph taken after decompression of the peroneal nerve (white arrow).

scores on MMT: gluteus medius muscle 5 and hamstrings 5. Moreover, the pain in the buttocks and thigh was reduced, both receiving an NRS pain score of 0. Postoperative CT and MRI showed an enlarged intervertebral canal (Fig. 3). In contrast, pain in other areas and toe and ankle motor weakness persisted. The pain of the lower leg was given an NRS score of 8, and the JOA score was 17. At this time, percentage improvement in the JOA score was 7.7%. One month after the first surgery, a Tinel-like sign appeared at the entrapment point of the peroneal nerve. At that time, a nerve conduction study (NCS) was performed, and loss of motor nerve conduction velocity was observed. For that reason, we inferred that his persistent symptoms resulted from peroneal nerve entrapment. Thus, second-stage surgery was performed to decompress the entrapped peroneal nerve. The superficial peroneal nerve was confirmed to be strongly compressed

by the intermuscular septum, peroneus longus muscle and associated fascia, and aponeurosis of the soleus muscle (Fig. 4A). They were dissected and peeled off, and the strain on the nerve was relieved (Fig. 4B). After the second surgery, the patient's pain was reduced to half of its preoperative intensity or less, and the motor disorder was partially relieved; the patient took painkillers and entered rehabilitation. Finally, he assigned an NRS score of 2 to the pain of the lower leg, and the JOA score was 22. The final percentage improvement in the JOA score was 46.2%.

Discussion

Herein, we report a rare case of L5 radiculopathy and PNEN in which the patient underwent bimodal surgical treatment. Undoubtedly, the patient had L5 radiculopathy despite the improvement in his

symptoms in the upper leg before and after lumbar surgery; however, the conditions in the lower leg were unchanged from those before the first surgery, and the percentage improvement in the JOA score was 7.7%. Postoperatively, we detected PNEN because of the new sign and the additional study; this was the result of careful follow-up. DCS is a clinical condition that involves multiple compression sites along a single peripheral nerve that can coexist with other conditions and synergistically increase symptom intensity.³⁾ Theoretically, the coexistence of dural compressive lesions along the course of the nerve may occur anywhere, including the nerves of the lower limbs. Most prior reports focused on the combination of cervical radiculopathy and carpal or cubital tunnel syndrome of the upper limbs. Although DCS of the lower limbs has been previously identified, to date, no detailed reports have been published. Our case revealed that treating practitioners should be aware of the possibility of concomitant lumbar radiculopathy and lower peripheral nerve neuropathy.

When treating L5 radiculopathy, it is important to distinguish it from peroneal neuropathy. PNEN is an entrapment neuropathy that results from mechanical compression of the nerve at or near the points where the nerve pierces the fascia to travel within the subcutaneous tissue: the intermuscular septum, peroneal muscle fascia, entrance to the fibular tunnel, fibrous band surface of the deep head of the peroneus longus and fibrous band deep to the peroneus longus.⁴⁻⁶⁾ PNEN has certain clinical features in common with L5 radiculopathy: pain or paresthesia of the lateral aspect of the affected lower thigh and instep and/or motor weakness of the extensors of the toes and ankle. However, unlike those of L5 radiculopathy, the symptoms of PNEN occur in only the lower leg, and PNEN may present with weakness during foot eversion versus weakness with foot inversion, as seen with L5 radiculopathy; these key characteristics can be used to distinguish the two conditions.^{7,8)} In addition, the detection of Tinel-like signs at the entrapment point is diagnostically useful, as are NCSs and transient improvements elicited by nerve block injection (NBI).⁹⁾ Although the presence of characteristic symptoms and a positive Tinel-like sign at the peroneus tunnel are useful, simple, and convenient for distinguishing L5 neuropathy from PNEN, they may be unreliable for patients with DCS, as in our case. NCS and/or NBI are impractical as first-line examinations for DCS patients without characteristic symptoms or a positive Tinel-like sign because they are invasive and complex. Thus, the diagnosis of DCS with L5 radiculopathy and PNEN is challenging. In cases of

dissatisfaction after treatment at one site, careful follow-up considering persistent pathology at another site is needed. In such cases, additional NCSs and NBI examinations for diseases with similar conditions should be conducted, even if the patient has no characteristic symptoms.

Regarding this case, it was unknown why no Tinel-like sign was detected before the first surgery. DCS is known to be difficult due to this complex combination of damage.¹⁰⁾ The complex pathology of DCS has previously been acknowledged; experimental models by Baba et al., Horiuchi and Nemoto have shown that two low-grade compression sites along a nerve trunk are more harmful than a single lesion.¹¹⁻¹³⁾ However, through the experience with this case, we think that DCS can not only multiply each characteristic symptom but also cancel each other by various factors. A Tinel-like sign is considered an indicator for the diagnosis of peripheral nerve entrapment neuropathy, including PNEN. Past reports regarding DCS of the upper limb showed that the positive rate of Tinel's sign was lower in DCS than in single radiculopathy.¹⁴⁾ They concluded that a possible reason for these findings may be attributed to the addition of symptoms from cervical lesions, which may cause the patient to visit the clinic before carpal tunnel syndrome becomes sufficiently severe to cause provocation signs. In addition, PNEN is known to be associated with dynamic factors, as the efficacy of the repetitive plantar flexion test for PNEN patients without the Tinel-like sign has been reported.¹⁵⁻¹⁷⁾ In our case, the improvement in the patient's symptoms by L5 nerve decompression changed his gait and activity, which might have influenced the PNEN. Thus, we hypothesized that L5 nerve disorder may mask the symptoms triggered by compression of the peroneal nerve. For that reason, some patients with masked diseases may be misdiagnosed. In patients without any characteristic symptoms at the first visit, changes may occur due to a related surgery. Therefore, a careful physical examination is important not only at the initial visit but also after surgery.

Bimodal surgery is recommended as a surgical strategy for DCS. Some reports have indicated the efficiency of surgical treatment for PNEN.^{5,7,9,18)} However, previous reports regarding DCS of the upper limbs showed that the surgical outcome of peripheral nerve disorder with DCS was worse than that without DCS.¹⁹⁾ Peripheral neuropathy may coexist with compressive neuropathy and contribute to suboptimal outcomes following nerve decompression. In this case, the improvement in his symptoms was limited, and his lower extremity pain was persistent; the total percentage improvement in the

JOA score was 46.2%. We surmised that our case was less responsive to surgical treatment than patients with single lesions, especially in the first surgery. Bimodal decompression for DCS is more efficient than unimodal surgery.¹⁰⁾ If multiple pathologies are revealed step by step, each pathology should be treated individually as soon as it is confirmed.

Conclusion

DCS is less common in the lower limbs than in the upper limbs. We report a case of a patient diagnosed with PNEN accompanied by L5 radiculopathy after lumbar surgery. Distinguishing between radiculopathy and relative peripheral neuropathy should always be a consideration. DCS may mask characteristic symptoms, and it is important to carefully follow up the patient to detect changes in his or her condition, especially for those with poor improvements in the condition or the appearance of new symptoms after treatment.

Conflicts of Interest Disclosure

None of the authors has a conflict of interest.

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