CASE REPORT

Cauda equina incarceration secondary to dural tears after lumbar microsurgical discectomy

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Summary
Even minor surgery can cause unexpected complications and symptoms. We report an unusual case of nerve root herniation after microsurgical discectomy. A patient who presented with low-back pain and right sciatica underwent microsurgical discectomy. Two days after the operation and after initial improvement, he suddenly experienced severe low-back pain and right sciatica again. Additionally, persistent muscle cramps and fasciculations in the right lower limb were noted. Magnetic resonance imaging revealed not only the recurrent ruptured disc fragment, but also a cerebrospinal fluid-like intensity accumulating within the epidural space and paraspinal muscle. At surgery, it was observed that nerve roots of the cauda equina were squeezed into the cavity of the intervertebral space. Surgical reposition of nerve roots and dural repair were performed, and the patient eventually recovered. Dural tears should be repaired at the time of the original operation even when the arachnoid appears intact. Dural substitution using polyglycolic acid mesh and fibrin glue is an alternative method for dural repair. An increase in abdominal pressure may play a role in cerebrospinal fluid leakage and extrusion of the cauda equina. The presence of muscle cramps and fasciculations after microsurgical discectomy or any intraspinal procedure may indicate a nerve pinch and entrapment. Nerve root incarceration should be considered in the differential diagnosis.

1. Introduction
Dural tears, which are defined as unintended incidental durotomy, are an unfortunate but significant complication of lumbar spine surgery. Dural tears are infrequent during microsurgical discectomy. These tears are usually small, heal without complications, and are primarily closed with sutures. However, occasionally a small tear may not be recognized during the procedure, which may lead to severe postoperative complications, such as pseudomeningocele, nerve root entrapment, cerebrospinal fluid (CSF) fistula, and even central nervous system (CNS) infection. The
prevalence of these problems is unknown. Cauda equina entrapment in the pseudomeningocele is a rare complication in spinal surgery. It is known that a burst fracture is the most common cause of cauda equina entrapment.\textsuperscript{3,9,10}

2. Case report

A man 76 years of age presented with progressive low-back pain and right-sided sciatica for 2 weeks. A magnetic resonance imaging (MRI) scan of the lumbar spine revealed a herniated disc at the level of L2-3 on the right, with a caudally migrated ruptured disc fragment situated in the L3 right lateral recess. This caused compression on the dural sac and right L3 nerve root. Microsurgical discectomy was performed. The procedure was uncomplicated and uneventful. There was no visible dural tear or CSF leakage. The patient had initial improvement, but the low-back pain and right-sided sciatica recurred 2 days after the operation. The pain was sharp and radiated to the right thigh in the same manner as before the operation. He had severe muscle cramps in the right thigh and lateral aspect of the right lower leg. Neurologic examination showed fasciculations of the right vastus lateralis and fibularis longus muscles, which are innervated by L3, L4, L5, S1 nerves, respectively. Then, he was unable to walk and became bedridden.

Recurrent disc herniation was suspected. MRI revealed a free disc fragment at the L2-3 level with caudal migration. T2-weighted images suggested CSF accumulation within the epidural space and paraspinal muscle (Fig. 1). The diagnosis was recurrent disc herniation and dural tear, resulting in a CSF leak at the L2-3 level.

We then undertook on L2-3 laminectomy and dural repair. A free disc fragment was removed. We found a 0.5-cm longitudinal dural tear on the ventral surface at the L2-3 level, and swollen and congested nerve roots of the cauda equina were seen to herniate through the small longitudinal opening into the cavity of the removed nucleus pulposus (Fig. 2). The nerve roots were firmly trapped and not movable. We opened the dural sac extensively to reposition the roots. The tear was covered by a piece of dural substitute using polyglycolic acid (PGA) mesh and fibrin glue (Fig. 3).

The severe radicular pain ceased after the second surgery, but mild dysesthesia persisted in his right leg. Neither muscle cramps nor fasciculations were noted any longer. There was no residual weakness in his right leg. A laxative was administrated to prevent constipation. He was kept in bed for 3 days after surgery to avoid CSF leakage. At the last follow-up examination, which occurred 6 months after the operation, the patient had no neurologic deficits.

3. Discussion

The incidence of inadvertent dural tears with CSF leakage during microsurgical lumbar discectomy has been reported to be approximately 4% of cases.\textsuperscript{2} However, dural tears...
resulting in a small dural defect that involves herniation and incarceration of cauda equina nerve roots are extremely rare after nontraumatic spinal surgery.\textsuperscript{3,10} Only seven cases of iatrogenic nerve root herniation after discectomy have been previously described. All of the patients underwent reoperation, and transdural nerve root incarceration resulted in complete recovery in five cases. Of the three patients who had a dural defect at the ventral side, two were left with a permanent neurologic deficit (Table 1).

In this patient, the dural tear and CSF leakage were not recognized during the initial operation. It was presumed that a small dural tear did not rupture the arachnoid membrane. Because of the thin, delicate nature of the arachnoid, incidental increases in cerebrospinal pressure inevitably lead to a postoperative rupture of the arachnoid as well as CSF leakage. Kothbauer and colleagues\textsuperscript{3} and Nishi and colleagues\textsuperscript{4} reported that increased abdominal pressure plays a role in the development of cauda equina herniation. This occurs in the same manner as abdominal wall hernias.

The classical symptoms of radiculopathy caused by a herniated lumbar disc include pain, numbness, and muscle weakness in the area supplied by the affected nerve roots. Radiculopathy is seldom characterized by persistent muscle cramps and fasciculations. Cramps and fasciculations may occur in lower motor neuron disease and may further implicate anterior horn cell dysfunction.\textsuperscript{5} The irritation to the cauda equina and hyperactivity of the stimulated motor neuron may cause muscle fasciculations.\textsuperscript{6} In our patient, the entrapment of the nerve roots may have played a role in his persistent muscle cramps and fasciculations, which were possibly due to continuous nerve root pinching and twitching.

When dural injury occurs and is intraoperatively detected, primary repair is mandatory. Moreover, the quality of the dura may affect whether primary repair can be performed. It is always necessary to augment the repair with autologous, allogeneic, or synthetic grafts to achieve watertight closure.\textsuperscript{2,7} It is possible to use a muscle, fascial, or fat grafts; fibrin patch or glue; blood-soaked Surgicel (Ethicon, Inc., Somerville, NJ USA); or gelatin matrix. Fibrin glue, which is made from pooled blood, carries a risk of disease transmission. Harvesting an autologous dural substitute can also lead to longer operating times, although this risk is regarded as safer than disease transmission. A collagen matrix sponge is an effective means of closing the large dural defect without the use of suture.\textsuperscript{16,17} The ideal

### Table 1
Summary of seven cases of nerve root herniation after discectomy.

<table>
<thead>
<tr>
<th>Author</th>
<th>Age/sex</th>
<th>Level Interval</th>
<th>Symptoms</th>
<th>Dural defect</th>
<th>Surgical findings</th>
<th>Repair</th>
<th>Prognosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hadani\textsuperscript{12}</td>
<td>41/M</td>
<td>L5-S1 5 y</td>
<td>L5 pain</td>
<td>Dorsal</td>
<td>Nerve root herniation</td>
<td>Surgical closure</td>
<td>Recovered</td>
</tr>
<tr>
<td>O’Connor\textsuperscript{13}</td>
<td>16/F</td>
<td>L4-L5 8 y</td>
<td>L5 S- and pain</td>
<td>Dorsal</td>
<td>Nerve root herniation</td>
<td>No mention</td>
<td>Recovered</td>
</tr>
<tr>
<td>Pavlou\textsuperscript{14}</td>
<td>59/F</td>
<td>L4-L5 7 y</td>
<td>Bilateral L5 M- and pain</td>
<td>Dorsal</td>
<td>Nerve root herniation</td>
<td>Surgical closure, covered with Duragen and Tisseel glue</td>
<td>Recovered</td>
</tr>
<tr>
<td>Nishi\textsuperscript{6}</td>
<td>63/M</td>
<td>L3-L4 9 d</td>
<td>S1 pain</td>
<td>Unspecified</td>
<td>Nerve root herniation</td>
<td>Surgical closure</td>
<td>Recovered</td>
</tr>
<tr>
<td>Kothbauer\textsuperscript{3}</td>
<td>60/F</td>
<td>L4-L5 1 d</td>
<td>L5 S- and M- and pain</td>
<td>Ventral</td>
<td>Cauda equine herniation</td>
<td>Sutured with a graft, covered with Gelfoam and fibrin glue</td>
<td>Recovered</td>
</tr>
<tr>
<td>Töppich\textsuperscript{15}</td>
<td>62/F</td>
<td>L4-L5 5 d</td>
<td>S1 pain</td>
<td>Ventral</td>
<td>Nerve root herniation</td>
<td>Surgical closure</td>
<td>S1 S- and M-</td>
</tr>
<tr>
<td>Töppich\textsuperscript{15}</td>
<td>78/M</td>
<td>L4-L5 4 d</td>
<td>L5 S- and pain</td>
<td>Ventral</td>
<td>Nerve root herniation</td>
<td>Repaired with Gelfoam and fibrin glue</td>
<td>L5 M-</td>
</tr>
</tbody>
</table>

F = woman; L = lumbar; M = man; M- = motor deficit; S = sacral; S- = sensory loss.
dural substitute remains to be determined because of the small numbers of patients in previous reports.18

Dural tears and CSF leakage may not be visually apparent intraoperatively. In our patient, it proved to be essential to carry out safe and effective closure strategies for adequate exposure and visualization of the involved area. It was necessary to open the dural sac extensively to reposition the nerve roots because the roots were firmly trapped and incarcerated. Due to the difficulties in obtaining appropriate access and the fragility of the dura on the ventral surface, we repaired the tear by covering it with a piece of dural substitute using PGA mesh and fibrin glue, which is an effective method to prevent CSF leakage in spinal surgery.8

Dural tears should be repaired at the time of the original operation even though the arachnoid appears intact.4 Occasionally, it may not be possible to repair the tear with sutures. In such instances, the tear may be repaired by packing with a fascial graft or using a tissue plug, PGA mesh, and fibrin glue as an alternative method. An increase in abdominal pressure may play a role in CSF leakage and extrusion of the cauda equina. Postoperative care should be meticulous to avoid increasing intra-abdominal pressure. Muscle cramps and fasciculations are a rare presentation of radiculopathy associated with lumbar disc herniation. Such symptoms suggest the possibility of a nerve pinch and entrapment. Nerve roots involved in cauda equina incarceration should be considered in the differential diagnosis if the patient develops unexpected postoperative sciatic pain and neurologic deficit after lumbar microsurgical discectomy.

References