L3-L4 Dislocation Without Neurological Lesions

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Abstract

Vertebral dislocations are high energy injuries that rarely occur in the low back, but are found more frequently at the level of the thoracolumbar and sacrolumbar junctions. Dislocations of the mid-lumbar vertebrae are exceptional, with only 16 cases found in the literature. All previously reported cases were treated surgically. In four of these cases, the patients had no initial neurological lesions, and most of those who did have a neurological deficit exhibited some degree of recovery. We present the case report of an L3-L4 dislocation, without neurological lesions, resulting from an airplane crash. The anatomopathological mechanism of injury is discussed, together with treatment, which consisted of an initial closed reduction using a halo-bifemoral system, followed by pedicle instrumentation and arthrodesis from L2 to L5.

Case Report

History

A 40-year-old female was brought to our hospital after an airplane crash. She had been ejected from the plane when the aircraft hit the ground while still strapped to her seat. Six passengers were traveling on the plane, a Cessna 421. Two persons died in the crash, and the remaining four suffered injuries of varying seriousness. The accident, caused by weather conditions, involved a gradual loss of altitude of the plane, which did not plummet to the ground too sharply.

Examination

At the time of admission, the patient exhibited multiple contusions and abrasions, but no visceral or vascular lesions. Motor and sensitive balance of the lower limbs were normal, as well as patellar and Achilles reflexes. Assessment of genital and perianal sensitivity, and anal sphincter tone, produced completely normal results. Plain radiographs, computerized axial tomography (CAT) scan, and magnetic resonance imaging (MRI) did not reveal fractures, except for a dislocation at L3-L4. This dislocation involved a fracture of the superior end-plate of L4 and complete obliteration of the spinal canal (Figs. 1, 2).3

Treatment and Surgical Findings

Halo-bifemoral traction was put in place immediately. Traction, of up to 6 kg cranially and 7 kg on each leg, was applied gradually and under continuous neurological supervision. The dislocation was almost completely reduced after 48 hours (Fig. 4).

Low-molecular-weight heparin, in doses of 40 mg, was used for antithrombotic prophylaxis from the time that traction started.
was applied until the patient was discharged 10 days later.

Cefazolin was used for antibiotic prophylaxis from 2 hours before surgery, in doses of 1 g every 6 hours, until 24 hours after the procedure.

Seventy-two hours after the accident, a posterior surgical approach was performed. The posterior elements were exposed, revealing an anterior, rotational dislocation of the superior articular processes with regard to the inferior processes, as well as a lesion of the interspinous and supraspinous ligaments.

Manual reduction was attempted by applying traction to the superior spinous process, while rotating against the dislocated end-plates. Although reduction was achieved in this way, it was lost when manual pressure was released. In view of the situation, laminectomy and facetectomy of the superior end-plates were performed, until complete exposure of the sac and the bilateral roots of L3 and L4 had been achieved. Stenosis was made significantly worse by the ligamentum flavum and the interarticular capsular remnants.

A fistula containing cerebrospinal fluid was discovered on the ventral aspect of the dura, but was not repaired directly. Instead, a DuraGen® patch was placed on the defect by slipping it into place.

Reduction was completed by means of pedicle instrumentation and posterolateral arthrodesis from L2 to L5. A cross-link device was used to increase the strength of the construct. Graft material consisted of “leftovers” from the laminectomy, together with autologous bone from the right iliac crest, harvested through the fascia using the same incision.

**Postoperative Course**

The postoperative course was satisfactory. After 72 hours, the patient was allowed to walk, using a full-support plastic brace, which was kept in place for 3 months. Three years later, radiological controls remain unchanged, and the patient

### Table 1  Reported Luxations in Mid-lumbar Segments

<table>
<thead>
<tr>
<th>Citations</th>
<th>Age (Years)</th>
<th>Level</th>
<th>Treatment</th>
<th>Sequelae</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abdell-Fattah, et al.⁶</td>
<td>18</td>
<td>L4-L5</td>
<td>Surgical</td>
<td>Neurologically intact from the beginning</td>
</tr>
<tr>
<td>Cho, et al.⁷</td>
<td>26</td>
<td>L2-L3</td>
<td>Surgical</td>
<td>Recovery allowing de-ambulation</td>
</tr>
<tr>
<td>Crawford, et al.⁸</td>
<td>6</td>
<td>L3-L4</td>
<td>Surgical</td>
<td>Complete neurological lesion and deat.</td>
</tr>
<tr>
<td>Hauge, et al.⁹</td>
<td>71</td>
<td>L4-L5</td>
<td>Surgical</td>
<td>Complete neurological lesion.</td>
</tr>
<tr>
<td>Kaufer and Hayes¹⁰</td>
<td>L3-L4, two cases</td>
<td>L4-L5, one case</td>
<td>All patients underwent surgery</td>
<td>Two recoveries.</td>
</tr>
<tr>
<td>Kiyamaz, et al.¹¹</td>
<td>35</td>
<td>L2-L3</td>
<td>Surgical</td>
<td>One case neurologically intact from the beginning</td>
</tr>
<tr>
<td>Kreichati, et al.¹²</td>
<td>30</td>
<td>L4-L5</td>
<td>Surgical</td>
<td>Partial cauda equina syndrome</td>
</tr>
<tr>
<td>Levine, et al.¹³</td>
<td>27</td>
<td>L4-L5</td>
<td>Surgical</td>
<td>Some degree of recovery</td>
</tr>
<tr>
<td>Smith and Love¹⁴</td>
<td>44</td>
<td>L4-L5</td>
<td>Surgical</td>
<td>Neurologically intact from the beginning</td>
</tr>
<tr>
<td>Song and Lee⁵</td>
<td>47</td>
<td>L3-L4, one case</td>
<td>Surgical</td>
<td>Neurologically intact from the beginning</td>
</tr>
<tr>
<td>Vlahovitz, et al.¹⁵</td>
<td>L3-L4, two cases</td>
<td>L4-L5, two cases</td>
<td>Surgical</td>
<td>Neurologically intact from the beginning</td>
</tr>
</tbody>
</table>

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**Figure 1** Initial radiographs in the lateral (A) and AP (B) views showing the anterior displacement of L3 over L4 together with a slight lateral (rotational) slip.
is free from symptoms (Fig. 5).

**Discussion**

Dislocations of the mid-lumbar segments are truly exceptional injuries. They are invariably caused by high-energy trauma, mostly in connection with traffic accidents, and occasionally result from falls from heights. In some instances, lumbar dislocations have been associated with other underlying conditions, such as spina bifida or rheumatoid arthritis, which may facilitate dislocations in cases of less violent trauma.

In the case presented here, the injury occurred through pure hyperflexion against a seat belt with a two-point waist strap, of the common type whose use is compulsory for air passengers in certain situations. In such circumstances, the seat belt is designed not so much to protect passengers from direct trauma as to prevent injuries resulting from turbulence. In the event of particularly severe trauma, seat belts may also cause associated vascular and abdominal lesions, together with bruising of the skin, due to pressure. These presenting injuries have given rise to what is known as the seat-belt syndrome. In this patient, there is little doubt that the seat belt contributed to saving her life when she was ejected from the aircraft, still in her seat although it also caused the previously described dislocation.

Provided a patient’s medical condition allows it, treatment of dislocated lumbar vertebrae, with or without associated neurological lesions, should begin immediately. If neurological injury is present, early treatment is aimed at recovery of the cauda equine. If no such lesions exist, the aim is to achieve stability of the spine and to avoid neurological deterioration resulting from hematoma or from nursing care maneuvers.

Although no consensus exists as to the appropriate time to perform decompression in the event of neurological lesions, it would seem logical to assume that it should be carried out as early as possible. Critical recovery time for an injured spinal cord seems to range from 6 to 8 hours, according to obser-
Beyond that period of time, there are no differences in terms of neurological recovery between early and late decompression, although a higher morbidity level and longer hospital stay are associated with early procedures, when compared to the results of groups of patients in whom definite treatment was deferred. At any rate, results seem to be better in cases involving lesions of the roots than in those where the spinal cord is involved.22 In this regard, some investigators have stated that lesions of the cauda equina should be treated within a period of 48 hours after the injury.25 Some others have reported improvements in incomplete neurological lesions after a period of 3 months from the time of injury.26

The physical condition of the patient, as well as the potential existence of associated lesions, should always be taken into account before attempting the procedure. It is also important for patients to be stabilized before surgery, and for the right personnel to be available at the time of decompression and reduction of these injuries.

The halo-bifemoral treatment applied in our case is a classic system for the reduction of spinal deformities,27-28 and fractures and dislocations.29,30 It has been less in use since the recent development of powerful new surgical techniques and instrumentations, and the widespread adoption of pedicle screws. Immediate reduction of the lesion by means of a slow, gradual application of this method was considered appropriate in order to achieve at least a partial reduction of the dislocation, which would then make it possible to perform a milder, less forceful intraoperative reduction.

One advantage of the traction system is that it allows immediate placement by emergency personnel with no specific expertise in spine surgery, thus facilitating some degree of early reduction, which avoids the subsequent need for extensive, forceful and potentially dangerous intraoperative manoeuvres. The use of halo-bifemoral traction is nevertheless not entirely free from possible complications, especially as a result of overstretching of the lumbar roots or the brachial plexus,31 or as a consequence of immobilization, which can cause deep vein thrombosis.32 Its judicious and careful application, however, can be very useful in the initial treatment of this type of lesion.

Reduction, whether open or closed, should be performed with great care and with the aid of preoperative and postoperative imaging tests, in order to detect and avoid interposition or herniation (or both) of disc material during reduction maneuvers.4,12 Although not available in our case, the use of intraoperative neurological monitoring by means of somatosensory and motor evoked potentials and free electromyogram can help to avoid iatrogenic lesions caused by stretching.33,34

Like other investigators,2,8 we believe the use of rigid instrumentation that allows for subsequent arthrodesis is compulsory in this type of lesion. The injury is, in itself, seriously unstable and becomes even more so as a result of surgical treatment, which involved laminectomy and facetectomy in this patient. We decided to complete the reduction and follow it with arthrodesis, in order to bring together the levels above and below the dislocation. This plan was determined because the possibility of performing an arthrodesis of the L3-L4 space alone, although considered, was deemed inadequate unless it was combined with an interbody arthrodesis. However, an interbody arthrodesis was ruled out, because of the fracture at L4 and the existence of an anterior dural lesion, which might have developed into a fistula more readily. This reasoning was why we decided to follow the classic procedure of instrument-
ing and fusing two levels above and below the lesion. Since the disc was involved, we performed an instrumentation and arthrodesis from L2 to L5.

**Disclosure Statement**

None of the authors have a financial or proprietary interest in the subject matter or materials discussed, including, but not limited to, employment, consultancies, stock ownership, honoraria, and paid expert testimony.

**References**