Direct posterior reduction in a case of posttraumatic irreducible lateral atlantoaxial dislocation

Case report

PRAVIN SALUNKE, M.CH.,1 SUSHANTA K. SAHOO, M.S.,1 RAMESH DODDAMANI, M.S.,1 CHIRAG K. AHUJA, D.M.,2 AND KANCHAN K. MUKHERJEE, M.CH.1

Departments of 1Neurosurgery and 2Radiodiagnosis, Postgraduate Institute of Medical Education and Research, Chandigarh, India

Posttraumatic true irreducible C1–2 lateral dislocation is rare. The mechanism of injury is likely to be different for this kind of dislocation. The management of such an injury and the technique for direct posterior reduction remain unclear because of its rarity. The authors describe the case of a 34-year-old man who sustained injury in a vehicular accident, leading to neck pain. Radiological studies revealed fixed right lateral and posterior C1–2 dislocation. Direct posterior open reduction was achieved by distracting the facets and rotating them in a counterclockwise direction. Care was taken to avoid direct or indirect injury to the vertebral arteries. Segmental C1–2 fusion was performed. Distraction with lateral extension injury possibly gives rise to this unique fracture dislocation. Preoperative imaging including angiography for vertebral arteries helps in defining the cause of fixity and in surgical planning. Direct posterior reduction is possible in such fixed C1–2 lateral dislocation, circumventing transoral surgery—provided the facets are preserved.

Key Words • atlantoaxial joint • traumatic • lateral dislocation • direct posterior reduction • surgical technique • cervical

Traumatic atlantoaxial (C1–2) dislocation with Type II odontoid fracture is not uncommon. This usually occurs in the anteroposterior or sagittal plane. However, rotational and lateral C1–2 dislocation is rare.5,9 The C1–2 facets may get locked, making the dislocation irreducible. We describe a rare case of irreducible C1–2 posterior and true lateral dislocation that was managed successfully by a direct posterior approach. The mode of injury and the method used to achieve intraoperative reduction are discussed.

Case Report

History and Examination. This 34-year-old man sustained injury in a motor vehicle accident. His face got compressed against the left windowpane due to sudden deceleration, giving rise to distraction and lateral extension of the spine. After a brief period of blackout, he got up and walked around. Apart from mild neck pain he had no other complaints. He did not seek any medical help immediately following injury, because his only symptom of neck pain was not significant. However, 4 weeks later his neck pain worsened and he experienced restricted neck movements. Neurological examination revealed no deficits.

A lateral radiograph of the cervical spine showed Type II odontoid fracture with posterior C1–2 dislocation. Admission CT scans of the craniovertebral junction (CVJ) showed true right lateral C1–2 dislocation and locked facets with odontoid fracture (Fig. 1). The fracture line at odontoid base and facets showed no malunion. Skull traction was applied but failed to reduce the dislocation. Besides, the patient’s neck pain worsened with skull traction. Because the transverse foramina appeared intact and there were no congenital bone anomalies, we assumed that the vertebral arteries (VAs) were normal, with the redundant V3 segment compensating for the lateral stretch. We were fortunate not to have any vascular complications. Nevertheless, a preoperative CT angiogram would have been preferable.

Operation and Postoperative Course. Direct open posterior reduction was undertaken. Closed reduction

*Abbreviations used in this paper: CVJ = craniovertebral junction; VA = vertebral artery.*
under general anesthesia was not attempted, because we feared more damage in the presence of locked facets. The cervical spine was exposed through a midline posterior incision from the occiput to C-4. The C1–2 articulation was exposed to its lateral border. The C1–2 joints were widely exposed bilaterally after cutting the C-2 ganglion. The right joint was opened first because the right VA was away from the site of dissection due to the dislocation. The VA exiting from the C-2 transverse foramen was seen and traced laterally. Dissecting over the superior and medial surface of the C-2 pars interarticularis, the medial portion of the C-2 facet was reached. The C-2 facet was now dissected from its medial to lateral aspect, opening the C1–2 joint and avoiding inadvertent injury to the VA.

Anterior reduction was achieved after lateral mass screw and rod placements, using a rod holder as a lever. Extension caused retrolisthesis of fractured dens, as seen on C-arm. Bone grafts were placed in the C1–2 joints and between the C-1 and C-2 just posterior to the facets, after decortication. Additional C1–2 sublaminar wiring would have increased extension with retrolisthesis of fractured dens within the canal. Postoperative images showed complete reduction (Fig. 2). The patient was doing well at 3-month follow-up and the CT study showed bony fusion.

**Discussion**

True lateral C1–2 dislocation with odontoid fracture is rare.\(^5^,\(^9\) Such injuries do not find a place in the commonly described classifications for atlantoaxial injuries.\(^3\) The mechanism of injury is unique in these patients. Rapid deceleration with distraction and lateral flexion or extension probably gives rise to such unusual fracture dislocation. Associated capsular injury compounded with this kind of trauma leads to overriding of facets with lateral locking. Granulation tissue, callus around the dens, scarring between the dens and axis, and locking of the atlantoaxial lateral joints are the major reasons for irreducibility of dislocation.\(^5\) The reconstructed CT images of the CVJ give a fair idea about the cause of fixity apart from the extent of injury. The presence and extent of facet fractures are important factors in deciding the management. Besides, malunion between overriding facets can be better appreciated on reconstructed CT images. The locked facets are unlikely to reduce by traction.

In the absence of congenital anomalies, the VAs are presumably normal. The \(V_3\) segment is redundant to accommodate rotational movement between C-1 and C-2.\(^1^,\(^8\) This redundant loop compensates for the stretch in lateral or anteroposterior dislocation. However, a preoperative CT angiogram is likely to be helpful in guiding the operation;\(^6\) apart from the dominant VA, the presence of thrombosis and/or dissection can be determined. Besides, an angiogram avoids last-minute surprises due to anomalous VAs. The vascular injury may not be symptomatic due to good flow from the opposite VA and the circle of Willis. The intraoperative manipulation of such vessels may result in a catastrophe. The presence of thrombosis in the nondominant VA is unlikely to lead to emboli because the backflow prevents it, especially with anticoagulation. Besides, the nondominant VA can be sacrificed (with radiointervention or intraoperatively) in the presence of dissecting aneurysm. The manipulation needs to be extremely gentle if there is involvement of the dominant VA. The operative steps needed to safeguard the VA while performing intraoperative reduction in traumatic atlantoaxial dislocation are described below. In case of catastrophe due to dissection or thromboembolic phenomena from the dominant VA, stent insertion or thrombolysis in the immediate postoperative period is probably the only option.
Direct posterior reduction and fusion using lateral mass screws confers a stable construct. Although it has been mentioned for cases of lateral C1–2 dislocation, the exact technique, especially safeguarding the VA, has not been described. To achieve intraoperative reduction, thorough knowledge of the distorted anatomy and the relationship of facets is of paramount importance. The C1–2 joints need to be exposed to their lateral border. The cutting of C-2 root ganglion provides a panoramic view. The C-2 facet that is medial to the C-1 (for example, the right C-2 facet in our case) should be dissected first to safeguard the VA except in the presence of an anomalous VA, dissection injury, or thrombosis—especially of the dominant VA. The visualization of VA exiting from C-2 transverse foramen increases the surgeon’s confidence. The preoperative CT angiogram is helpful in determining these unusual conditions.

Tracing the joints along the superior medial border of the C-2 pars interarticularis and then dissecting them open from medial to lateral prevents inadvertent injury to the VA. After cutting open the joint capsule, the facet relationship is obvious. It is important to drill the locked edges of facets to provide space for engagement of a distracter between them. Besides, the granulation or callus between injured facets maluniting C1–2 can be drilled until they are free. An osteotome can be inserted between C-1 and C-2 facets as shown in Fig. 2. The osteotome can then be rotated clockwise (when the C-1 facet lies on the left of C-2) or counterclockwise (when the C-1 facet lies on the right of C-2). This movement provides distraction as well as correction in the coronal plane. The width of the osteotome should be less than the width of the facet (approximately 0.8–1 cm). A wider osteotome is likely to cause excessive distraction, stretching the V3 segment beyond physiological limits and indirectly injuring the VA. The reduction in the anteroposterior plane can be achieved by the technique described by Suh et al. The rod holder securing the rod in a perpendicular plane acts as a T-shaped lever.

Direct posterior reduction may not be possible if there is abnormal union between dens and C-2 body or if the facets are greatly damaged. This report highlights

![Fig. 2. Schematic diagram depicting intraoperative exposure of facets (A) with distraction and counterclockwise rotation of osteotome used as a distracter (B), achieving reduction in coronal plane (C).](image)

![Fig. 3. A: Sagittal CT scan showing anteroposterior reduction. B: Coronal CT scan showing lateral reduction. C: Parasagittal CT scan showing facets in reduced position with bone graft in joint space. Lateral mass screws can be seen in position.](image)
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an unusual atlantoaxial injury and the importance of detailed preoperative imaging for successful reduction of the dislocation via a direct dorsal approach. Distracters can be used for relative movement of C1–2 facets in the coronal plane to achieve reduction in lateral dislocation.

Disclosure

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

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