

Atlanto-occipital dislocation: Case report and discussion

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Traumatic atlanto-occipital dislocation is an uncommon injury that frequently results in either a fatal outcome or severe neurologic deficit. This diagnosis must be considered for any patients who may have had cervical spine damage after high trauma, even in the absence of neurologic signs, as there have been reports of cases without neurologic impairment. In addition to radiographic examination, including lateral cervical radiographs, supplemental imaging with CT or MRI may be required to confirm diagnosis in equivocal cases, and to help in evaluation of bone and nervous structures. This case report presents and discusses imaging findings that will assist in the diagnosis of atlanto-occipital dislocation.

Case report

A 25-year-old male was a restrained rear passenger in a high-speed motor vehicle crash. On arrival at the Emergency Department, he was unconscious, with a Glasgow coma scale of 3, respiration of 16, blood pressure of 104/47, and heart rate of 141. The airway was secured. There was no neurological activity, and rectal tone was absent. He was in cardiorespiratory arrest shortly after arrival to the Emergency Department, where ACLS medications were given for a transient return of pulses.

After aggressive resuscitation, vital signs were stabilized adequately for a CT imaging. CT of the cervical spine without contrast showed a complete atlanto-occipital dislocation (AOD) with approximately 8mm of distance between the occipital condyles and the condylar surface of the atlas (Figs. 1, 2). There was an anterior displacement of the occiput in relation to C1, with a vertical basion-to-dens

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Figure 1. Coronally reformatted CT image and [CT movie file](#) (QuickTime, 1.1 MB) show dislocation of both atlanto-occipital joints.

distance of approximately 22 mm. There was no evidence of fracture of the skull base or cervical spine. The patient was admitted to the Surgical Intensive Care Unit with poor prognosis and expired shortly afterward.

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Figure 2. Sagittally reformatted computed tomography images and [CT movie file](#) (QuickTime, 1.1 MB) show dislocation of the A) right and B) left atlanto-occipital joints.

Discussion

AOD is a rare medical condition, with incidence of 0.7 to 1.3% in all cervical spine injuries, but it accounts for 15% of all fatal spinal traumas (1-2). It results from a significant deceleration injury resulting in disruption of ligaments at the level of the articulation between the occipital bone and the first cervical vertebra (atlas). Traumatic rupture of the apical-dental and paired-alar ligaments and the tectorial membrane allows the cranium to be displaced with respect to the cervical spine. The primary mechanism of injury is believed to be hyperextension, while some consider lateral flexion to be a necessary component as well (3).

The clinical pattern is variable, with the predominant presentations usually being neurologic or cardiovascular. The neurologic presentation can range from no deficits to tetraplegia with ventilator dependency (1, 4). As a result of occipitovertebral dissociation, the medulla oblongata is exposed, and injury to this area frequently results in cardiopulmonary arrest. Vascular lesions at the level of the vertebral and carotid artery and asphyxia secondary to phrenic or bulbar nerve palsy are also usually fatal.

The type of dislocation is usually classified according to Traynelis et al (5). Type I, the most common, involves anterior displacement of the cranium with respect to the atlas. Type II, which is the most unstable, involves a longitudinal distraction, while Type III denotes posterior displacement of the occiput on the atlas.

Injury to the craniocervical junction is typically diagnosed using radiographic imaging; however, signs of AOD may be subtle at times. The index of suspicion should in-

crease with the identification of upper-cervical, prevertebral, soft-tissue swelling, and prompt further examination should be conducted.

It is critical to diagnose and treat AOD as quickly as possible to prevent devastating outcomes, including severe neurological damage and death. The following findings indicate the presence of AOD on lateral cervical radiography:

1. A displacement of more than 10 mm between the basion and dens (6).
2. Abnormal "Powers ratio" (a ratio of basion-posterior atlas arch divided by the opisthion-anterior atlas arch distance that is greater than 1) (7).
3. A distance of more than 13mm between the posterior mandible and anterior atlas, or 20mm between the posterior mandible and dens (8).
4. Failure of a line from the basion to the axis spinolaminar junction to intersect C2, or of a line from the opisthion to the posterior inferior corner of the body of the axis, to intersect C1 (9).
5. The distance between the occipital condyles and the condylar surface of the atlas is widened to more than 5mm (10).
6. Harris criteria: A) the basion is not within 12mm of the superior continuation of a line drawn along the posterior cortex of the body of the axis, and B) the distance between the basion and the tip of the odontoid is more than 12mm (10).

The basion-axial interval—basion-dental interval proposed by Harris et al (10) is currently the most reliable

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method for identifying AOD on lateral radiographs, but no radiographic measurement has complete sensitivity. Hence CT, particularly with sagittal and coronal reconstruction, is the definitive modality for diagnosis and evaluation of AOD. CT and MRI are required not only to confirm diagnosis but also to evaluate the overall alignment of the craniocervical junction and to measure the magnitude of displacement. Apart from measuring magnitude of displacement, MRI can also indicate injuries to neurologic and ligamentous structures.

The treatment of choice for AOD is internal fixation: wiring the first cervical spine to the occiput. An external immobilization device has been sufficient for some patients; however, neurological worsening and late instability have been reported more often in association with this approach as compared to surgical fixation. Consequently, a spinal fusion with internal fixation is the best method.

AOD is an uncommon traumatic injury with devastating outcomes. Early and accurate recognition is essential to prevent delayed treatment. Proper knowledge of diagnostic criteria on a lateral cervical spine radiograph is critical, and further evaluation with CT and MRI should be obtained when conventional radiography is not sufficient for accurate assessment. A high index of suspicion and careful management are required until surgical stabilization of this injury, if patient survival is to be achieved. Craniocervical fusion with internal fixation is the recommended treatment for patients with traumatic AOD.

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