Surgical treatment of irreducible atlanto-axial dislocation with spinal cord compression

Case report

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The author reports the successful treatment of a case of irreducible atlanto-axial dislocation due to separation of the dens and secondary arthritic changes causing sagittal narrowing of the atlanto-axial spinal canal to 3 mm. Complete myelographic obstruction was present. A one-stage posterior decompression of the foramen magnum and atlas was performed and occipito-cervical fixation accomplished by wire encased in acrylic plastic.

KEY WORDS: spinal cord compression, os odontoideum, atlanto-axial dislocation, occipito-cervical fixation

The operative treatment of atlanto-axial dislocation is dependent upon its reducibility. Irreducible dislocation necessitates immediate decompression of spinal cord compression followed by fixation to prevent recurrence. In such cases, pathophysiological studies reveal extreme degeneration and thinning of the upper cervical cord. In reducible dislocations the cord compression is intermittent. However, continuing cord compression is a cause of high operative morbidity and much controversy continues as to its proper management.

This communication describes the successful treatment of an irreducible anterior dislocation secondary to long-standing separation of the odontoideum, basilar impression, and narrowing of the sagittal spinal canal.

Case Report

A 52-year-old farm woman had been in good health until 4 years before admission when she experienced sudden and frequent attacks of rotatory vertigo; these subsided gradually leaving a residuum of right-sided low-tone tinnitus. She was then asymptomatic for a period of 1½ years when there occurred gradual and progressive numbness of the left arm and leg and right hemiparesis; there was no sphincter disturbance.

Examination. The neck was of normal length and its movements were free except for limitation of rotation to the right. There was spastic weakness in all limbs, more marked on the right. Deep tendon reflexes were exaggerated, the abdominal reflexes sluggish, and the plantars extensor. All sensory modalities except two-point discrimination and position sense were diminished on
Treatment of irreducible atlanto-axial dislocation

FIG. 1. Lateral cervical spine films with the head held in flexion (left) and extension (center) showing anterior dislocation of the atlas on the axis, which remained unreduced. Note marked osteoarthritic changes on the atlanto-axial joint with anterior osteophyte from the body of the axis and block vertebra of C-2 and C-3. Diagram of the upper cervical spine (right) illustrates the anatomical relationships. b.o. = basiocciput; a.a. = anterior arch of the atlas; b.a. = body of axis fused with C-3; o.s. = occipital squama; s.d.a. = sagittal diameter of the bony spinal canal at the level of the atlas; p.a. = posterior arch of the atlas; m.s.d. = minimal sagittal diameter of the bony spinal canal at the atlanto-axial level.

the left below C-4. The cranial nerves were intact except for low-tone tinnitus on the right and a horizontal nystagmus directed to the right on far vision and upon looking to the right, as seen through the Frenzel glass. The cerebrospinal fluid contained 109 mg% of protein. Cervical spine films in flexion and extension showed an anterior dislocation of the atlas on the axis, which was nonreducible even by forcible extension with Crutchfield tongs. Osteoarthritic changes were noted in the atlanto-axial joint with an anterior osteophyte on the body of the axis and a posterior osteophyte on the atlas (Fig. 1). (Block vertebra of C-2 and C-3 was present). An open-mouth view of the axis showed no demonstration of the odontoid from the body of the axis. Lateral osteophytes were noted at the lateral margin of the superior and inferior articular facets (Fig. 2). Lamino grams of the atlanto-axial region demonstrated a corticated ossicle (14 × 15 mm), just posterior to the anterior arch of the atlas and well separated from the body of the axis. A linear calcification along the posterior aspect of the odontoid down to the C-2 body was noted. It seemed, therefore, that these osteoarthritic changes of the atlanto-axial joint with periarticular calcification made the dislocation irreducible. A basilar impression with elevation of the separate odontoid 5 mm above Chamberlain's line was noted (Fig. 3). Myelography showed severe obstruction to the Myodil column at the level of the dislocation (Fig. 4 left). Vertebral arteriograms through a retrograde brachial artery injection showed 90% narrowing of the lumen of the right vertebral artery at the level of the atlas upon rotating the head to the left. The sagittal diameter at the level of C-1 was 20 mm; C-2, 16 mm; and the minimal sagittal diameter at C-1 and C-2 was only 3 mm (Fig. 1).

Skeletal traction with Crutchfield tongs for 10 days failed to reduce the dislocation, and no clinical improvement was noted.

FIG. 2. Open-mouth projection of the axis. Note the flat superior margin of the axis without demonstration of the odontoid; note also lateral osteophytes (arrows).
Operation. Because of the patient's poor condition a single operation combining de-compression of the atlas and foramen magnum and occipito-cervical fixation was undertaken. On July 14, 1971, while skeletal traction was provided by Crutchfield tongs, an endotracheal tube was inserted with minimal neck movement and general anesthesia administered. The patient was then placed in a prone position; a lateral cervical film confirmed the unreduced dislocation. The squama occipitalis, and C-1, C-2, and C-3 laminae were exposed. Then 1 cm of the posterior and posterolateral rim of the foramen magnum was removed by an electric drill and rongeurs to relieve pressure on the cord. The posterior arch of the atlas was removed with great caution. A transverse fibrous band indenting the dura and cord at the level of the foramen magnum and atlas was cut and stripped off permitting the dura to pulsate freely. The dura was not opened. A heavy wire was passed through bilateral burr holes from the subocciput and twisted around the C-2 lamina (Figs. 4 right and 5). This wire matrix and the subocciput and C-2 posterior surface were then encased in acrylic plastic. A large piece of Gelfoam was placed over the dura, and constant saline irrigation was used to neutralize the heat of polymerization. The condition of the patient remained satisfactory throughout the operation, at the end of which the Crutchfield tongs were removed.

Postoperative Course. The patient's re-
covery was surprisingly uneventful. Within 24 hours she perceived pinprick and vibration and had no more numbness or tinnitus. The only neurological deficits on discharge (August 7, 1971) were the pyramidal tract signs. Since then the patient has remained asymptomatic for 11 months and leads a normal life, including farm work.

Discussion

It is interesting to speculate as to what mechanism makes the atlanto-axial dislocation irreducible. List described atlantal facet arthritis in a 21-year-old man with irreducible dislocation. Recently Sherk and Nicholson described progressive changes in an atlanto-axial instability secondary to an ossiculum terminale, initially noted when the patient was 6 years old; at 15 years she became quadriplegic and the dislocation irreducible, and 3 years later she died of respiratory failure. Autopsy revealed that failure of fusion of the odontoid permitted the transverse ligament of the atlas to ride up over the body of the axis, locking the atlas in an anterior dislocated position. The posterior arch of the atlas was practically in contact with the odontoid, causing fatal compression of the cord to a thickness of 1 mm.

In our case the chronic atlanto-axial instability with excessive mobility probably resulted in the gradual development of arthritis, osteophytes, and calcification; when combined with probable ligamentous anomalies, this led to an irreducible dislocation.

### TABLE 1

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Age, Sex</th>
<th>Dislocation of Atlas on Axis</th>
<th>Associated Bone Anomalies</th>
<th>Etiology Described</th>
</tr>
</thead>
<tbody>
<tr>
<td>List (1941)</td>
<td>21 M</td>
<td>anterior</td>
<td>occipitalized atlas</td>
<td>arthritic changes of atlas, and fusion of spinal process of C-1 and C-2</td>
</tr>
<tr>
<td>Dastur, et al. (1965)</td>
<td>16 M</td>
<td>anterior</td>
<td>rudimentary odontoid, occipitalized atlas, C2-3 block vertebra</td>
<td>tough &quot;ligamentous&quot; tissue surrounded the odontoid</td>
</tr>
<tr>
<td></td>
<td>19 M</td>
<td>anterior</td>
<td>rudimentary odontoid, occipitalized atlas, basilar impression</td>
<td>tough ligamentous and capsular tissue surrounded the odontoid</td>
</tr>
<tr>
<td>Sherk, et al. (1969)</td>
<td>18 M</td>
<td>anterior and rotatory</td>
<td>ossiculum terminale</td>
<td>transverse ligament locked into the defect between C-2 body and ossiculum terminale</td>
</tr>
<tr>
<td>Dunbar, et al. (1961)</td>
<td>35 M</td>
<td>anterior</td>
<td>none</td>
<td>Marie-Strümpell arthritis</td>
</tr>
<tr>
<td></td>
<td>56 M</td>
<td>anterior</td>
<td>none</td>
<td>rheumatoid arthritis</td>
</tr>
<tr>
<td>Greenberg (1968)</td>
<td>32 F</td>
<td>anterior</td>
<td>ossiculum terminale</td>
<td>dyschondroplasia</td>
</tr>
<tr>
<td>Nagashima (1973)</td>
<td>52 F</td>
<td>anterior</td>
<td>os odontoidesum, C2-3 block vertebra</td>
<td>osteoarthritic changes with periarticular calcification of atlas and axis</td>
</tr>
</tbody>
</table>
Congenital fusion of C-2 and C-3 may have enhanced the excessive mobility of C-1. Comparable reports (Table 1) have described such factors as arthritis, ligamentous anomalies, and associated developmental changes in bone.

Our case emphasizes that, regardless of the cause of the irreducible dislocation of the atlas on the axis, the treatment must include immediate decompression and fixation before irreversible spinal cord changes have occurred.

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References


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