Occipital-axis posterior wiring and fusion for atlantoaxial dislocation associated with occipitalization of the atlas

Technical note

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The authors present their technique of occipital-axis posterior wiring and fusion for atlantoaxial dislocation associated with an occipitalized atlas. The technique consists of drilling a 3 × 1-cm horizontal groove in the occipital bone 1 cm posterior to the foramen magnum and building up a bony bridge along the posterior margin of the foramen magnum. This bony bridge is referred to as an "artificial atlas." Conventional wiring and fusion is performed between the artificial atlas and the C-2 lamina, interposing a strut bone graft. Since the compression force on tightening the wire is vertical, a very high degree of stability for the occipital-C-2 complex is achieved, facilitating early mobilization without postoperative redislocation.

Key Words • atlantoaxial dislocation • occipitalization of the atlas • spinal fusion • cervical spine

The occurrence of atlantoaxial dislocation associated with occipitalization of the atlas is fairly common. Occipitalization of the atlas is found in approximately 1% of the population and atlantoaxial dislocation occurs in about 60% of patients with this anomaly. However, on the other hand, about 40% of cases of congenital atlantoaxial dislocation are associated with occipitalization of the atlas. However, a method for fusion of this type of dislocation has not been firmly established. Simple fusion by posterior C-1–2 wiring is not possible. Several fusion techniques have been described for posterior stabilization of such dislocations. One technique consists of placing a wire between burr holes in the occipital bone and the C-2 lamina. However, tightening of the wire pulls the C-2 lamina in the posterosuperior direction, which often results in redislocation. Alternative methods for fusion using rectangular rods or loops are more stable, but the techniques are much more complex.

This report discusses our simple method of occipital-C-2 posterior wiring and fusion. This method provides excellent stability of the occipital-C-2 complex.

Operative Technique

If amenable, the atlantoaxial dislocation is first reduced by traction. When this is not possible, reduction is achieved by transoral surgery prior to posterior fusion.

Posterior fusion is performed with the patient in the prone position. Reduction is achieved with Crutchfield's long traction and verified by intraoperative lateral radiography. A vertical posterior midline incision is made, extending from the midocciput to the spinous process of the C-3 vertebra. Sharp subperiosteal dissection is used to expose the occipital squama, the occipitalized posterior ring of C-1, and the C-2 lamina. A 3 × 1-cm horizontal groove is made in the occipital bone 1 cm posterior to the foramen magnum using a high-speed drill (Figs. 1 and 2 right). This groove is deepened to the dura of the posterior fossa, creating a bony bridge of occipital bone and posterior arch of the occipitalized atlas along the posterior margin of the foramen magnum. This bony bridge is referred to as an "artificial atlas." Once the artificial atlas has been created, the fusion technique is the same as in the conventional fixation procedure described by Brooks and Jenkins (Figs. 1 and 2 right).

The recipient graft site is prepared by decorticating the inferior edge of the artificial atlas and the superior portion of the C-2 lamina with a high-speed drill. A tricortical bone graft, approximately 3 cm long and 1.5 cm wide, is harvested from the posterior iliac crest. The graft is sculptured to fit horizontally between the arti-
Modification of occipital-axis fusion technique

Fig. 1. Drawing of the present posterior fusion technique. The artificial atlas is seen below a horizontal groove made in the occipital bone by means of a high-speed drill. Conventional Brooks-type fixation is performed thereafter.

Fig. 2. Drawings showing two methods of posterior wiring and fusion. Left: In the original technique, wiring passed between occipital burr holes placed posteriorly results in an oblique compression force when the wire is tightened. This often results in redislocation. Right: The creation of an artificial atlas results in a vertical compression force when the wire is tightened, and provides superior stability.

The artificial atlas and the C-2 lamina. A loop of No. 22 twisted wire is passed in the midline beneath the artificial atlas and the C-2 lamina and cut into halves. The bone graft is placed so that it fits snugly. The wires are tightened, exerting vertical compression force. Tightening the wire also reduces the risk of rotational dislocation of C-2. Postoperatively, the patient is mobilized within 3 days, and a hard cervical collar is worn for 3 months.

Operative Results
We have performed occipital-C-2 posterior wiring and fusion for congenital atlantoaxial dislocation associated with occipitalization of the atlas in 15 patients since June, 1989. Dislocation was reduced by traction alone in 10 patients and by transoral surgery in the other five. These patients had fibrous tissue in the atlantodental joint preventing reduction by traction. The anterior arch of the atlas, together with the fibrous tissue, were decompressed to obtain good reduction. The odontoid process was also decompressed when a basilar impression was present. Posterior decompression was not necessary in any cases following reduction by traction or transoral surgery. This fusion technique produced excellent results. The only complication occurred in one of the first patients in the series whose artificial arch broke because the artificial atlas was made too thin. One other patient experienced transient tetraparesis, probably due to spinal cord trauma during sub laminar wiring, but recovered completely.

Discussion
This report describes a simple and reliable method of occipital-axis posterior wiring and fusion for atlantoaxial dislocation associated with occipitalization of the atlas. Prior to this, the posterior occipital burr-hole method was used. This technique requires that a wire be passed between these burr holes and the C-2 lamina and tightened with an interpositional strut bone graft. In this method, the C-2 laminae are pulled in the posterosuperior direction and recurrence of the dislocation was more common (Fig. 2 left). In the present technique, however, tightening of the wire produces a vertical compression force which provides much greater stability (Fig. 2 right).

The present method can be applied to patients with atlantoaxial dislocation without occipitalization of the atlas, but the posterior C-1 arch has to be resected for posterior decompression. The technique of creating an artificial atlas can be applied to other posterior fusion methods. Titanium wire can be used to allow postoperative magnetic resonance imaging. We prefer the Brooks-type sublaminal wiring to Gallie's method because it provides better stability. The risk of trauma during sub laminar wiring, however, can be reduced by a Gallie-type posterior fusion technique or by using Halifax interlaminar clamps.

In summary, this simple technique using an artificial atlas provides excellent stability of the occipital-C-2 complex in patients with atlantoaxial dislocation associated with an occipitalized atlas. Furthermore, the procedure facilitates early postoperative mobilization of the patient.

Disclosure
The authors have no financial interest in the instrumentation or methodology being advanced by their contribution.

References

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