OSTEOPLASTIC REPAIR OF THE ATLAS

MYRON A. ROGERS, ANDREW O. RANSFORD, H. ALAN CROCKARD

From the National Hospital for Neurology and Neurosurgery and University College Hospital, London

Fractures of the atlas constitute 4% to 12% of all bony injuries of the cervical spine; most are treated successfully by a cervical orthosis. Nonunion may be associated with neck or scalp pain on movement and is treated conventionally by some form of craniocervical fusion, which restricts head movement. The authors describe a case in which direct repair of the bony ring with a titanium plate and screws allowed bone healing, relieved the symptoms and maintained a full range of neck movements. The titanium plate interfered little with postoperative MR and CT imaging.

Fractures of the atlas comprise only a small percentage of injuries of the cervical spine. Those that do not result in atlanto-axial instability are well treated by conservative methods and sound bony union usually results with good mobility at the occipito-atlanto-axial joints (O to C1 to C2). Nonunion is rare, but can cause cervical pain, especially on movement, and can lead in the long term to progressive separation of the lateral masses and vertical translocation of the odontoid process (Crockard 1991a).

The problems to be addressed in cases of nonunion are the alleviation of pain and the prevention of late complications. The conventional solution has been posterior fusion between C1 and C2. This has proved successful in relieving pain but at the price of reduced mobility. Many patients are left with a stiff neck which may cause severe functional disability.

We describe direct repair of the bony ring of the atlas with a plate and screws.

CASE REPORT

A 21-year-old girl was dropped on to her head (vertex) while 'jiving' 8 months before presenting to us. She had not lost consciousness, but had immediately developed severe neck pain. She was seen that day at a local hospital where radiographs showed a fracture of the posterior ring of the atlas; there was no neurological abnormality. Her neck was immobilised in a hard collar.

Later, a CT scan of the upper cervical spine showed a fracture of the anterior as well as the posterior ring, but the treatment was not changed. She remained in the hard collar for 12 weeks but when it was removed she had severe pain when she attempted any movement of the head. She spent a further six weeks in the collar but pain on movement persisted. CT scans and three-dimensional (3-D) reconstructions were interpreted as revealing nonunion of both fractures (Fig. 1). When first seen by one of us (AOR) the patient was still wearing a hard collar, as head movement, especially rotation, caused pain. In view of her youth, and her unwillingness to accept a stiff neck, we proposed that the bony ring be reconstructed.

Operative technique. After anaesthesia and intubation, we placed the patient in the prone position and exposed the affected side of the posterior arch of the atlas. Rotating the patient's face to the right made the fracture more accessible by bringing the vertebral groove on that side nearer the midline. Subperiosteal dissection along the posterior arch allowed some mobilisation of the vertebral vessels. The fracture line was identified; there was no evidence of bony union as there was movement at the fracture site, and fibrous tissue was cleared from around the area. A titanium mini-plate (Leibinger, Muhlheim Stetten, Germany) of suitable length was secured in place with four titanium-coated stainless steel screws (Fig. 2) which passed through both cortices. To facilitate this part of the procedure a separate stab incision was made so that an AO drill guide could be passed through skin and muscle in the correct orientation.

Through a stab incision over the posterior iliac crest a bone biopsy trephine was used to collect a small amount of bone; this graft was laid around the plated fracture. The incision was then closed and the patient turned into a supine position.

We used a standard transoral approach to expose the anterior arch of the atlas. Under magnification, we
Figure 1a – CT scan (bone windows) showing the nonunited posterior ring fracture (arrow head). This scan was also interpreted (wrongly) as showing nonunion of the fracture in the anterior ring. Figure 1b – Three-dimensional CT reconstruction of the atlas showing the inferior surface of the posterior arch. An arrow indicates the fracture.

found that there was sound bony union of the anterior fracture.

The patient was fitted with a graphite halo-thoracic brace (PMT Corporation, Minnesota, USA) and discharged seven days after her operation. The brace was removed seven weeks later, 3-D CT having shown bony union of the plated fracture (Fig. 3). The patient was then able to enjoy full, painfree movements of the neck for the first time in nine months.

DISCUSSION

In 1920 Jefferson described the different combinations of atlas fractures that occur after trauma. The injury that bears his name is the ‘burst’ fracture in which there is disruption of both the anterior and posterior arches of the atlas. The biomechanical forces involved in the different types of atlas fracture have been well described (Jefferson 1920; Spence, Decker and Sell 1970; Han,
Witten and Musleman 1976; Levine and Edwards 1991) as have the combinations of atlas fracture with other injuries of the cervical spine (Segal, Grimm and Stauffer 1987; Hadley et al 1988; Landells and Van Peteghem 1988; Kesterson et al 1991; Levine and Edwards 1991). The atlas has been described as a ‘washer’ (Van Gilder, Menezes and Dolan 1987) lying between the cranium and the spinal column to allow their relative movement. Approximately 50% of flexion and extension of the head occurs at the O to C1 joint and a similar percentage of rotation takes place at the C1 to C2 articulation. Fusions involving C1 result in considerable disability.

In the past, polytomography has been the technique used to define fractures of C1 but the method gave, at best, a two-dimensional representation. The introduction of CT has greatly facilitated the definition of C1 fracture patterns. Three-dimensional CT allows reconstruction in any plane, and can therefore be adapted to each individual case.

In the past, most reports of isolated fractures of the atlas did not acknowledge any failures. Even where the radiographs suggested fibrous union the outcome was usually reported as excellent. Recently, however, several authors have reported cases in which treatment has failed (Segal et al 1987; Hadley et al 1988; Landells and Van Peteghem 1988). The symptoms which are associated with nonunion include pain on movement and scalp dysaesthesia and it has been suggested, as with injuries in other regions of the spine, that there is an association between the persistence of symptoms and unresolved litigation (Landells and Van Peteghem 1988).

Our patient had disabling pain on movement, an ununited fracture and no evidence of atlanto-axial subluxation. Although there was union of the anterior fracture, the persisting nonunion posterolaterally allowed small movements of the component of the atlas 'washer' immediately adjacent to the emerging C2 nerve root. This resulted in the neck and suboccipital pain. The aim of our operation was to preserve mobility above and below C1 while inducing bony fusion of the fracture. More conventional treatment would have used posterior fusion (C1 to C2 or O to C1 to C2) with a resultant loss of mobility.

The sites of the fractures determined the operative approach. The anterior fracture was readily accessible via the transoral route. Posterior arch fractures are usually through the groove for the vertebral artery, behind the lateral mass: in our case a midline posterior incision with head rotation enabled the fracture to be exposed. We had considered using the 'extreme lateral approach' to the craniocervical junction (Crockard 1991b). This has the advantage of allowing direct control of the vertebral artery as it passes through the foramina transversaria of C2 and C1. Since this was our first attempt at plating the atlas we were unsure whether a halo-body orthosis was necessary to ensure bony union. Further experience may show that a hard collar for six to eight weeks gives sufficient support.

Direct repair of ununited fractures of the atlas may have a place in the management of appropriately selected patients and should be considered before resorting to intersegmental fusions.

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REFERENCES


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