Stable fractures of the atlas and axis in children

PG Richards

From the Regional Department of Neurosurgery, Central Middlesex Hospital, London, UK

SUMMARY Three cases of stable fractures of the atlas and axis in children are presented. All patients presented with pain, spasm of neck musculature and head tilt along with a neurological deficit. All fractures were apparently stable; with conservative treatment all symptoms and signs resolved.

Fractures of the atlas and axis without dislocation are rare, being particularly rare in children. Three cases are presented here along with discussion of their diagnosis and management.

Case reports

Case 1 A 7-year-old girl was knocked down by a motorcycle in October 1981. She was unconscious for five minutes and suffered a simple, undisplaced fracture of the left ulna and a compound fracture of the left tibia. On recovering consciousness she complained of pain in the neck which was associated with spasm of the cervical muscles giving head tilt to the right. There was a grade 4 (MRC Scale) global weakness of the left arm with absent biceps and supinator reflexes, but no sensory loss. Standard antero-posterior and latero cervical radiographs were repeated along with A-P and lateral tomography. These revealed an abnormally high odontoid peg with tilting to the left, separation of the lateral masses of the atlas and a possible crush fracture of the right lateral mass of the axis (Fig). It was concluded that she had suffered a forced flexion injury on the right side, fracturing the anterior arch of the atlas and the right lateral mass of the axis. These injuries were thought to be associated with a mild traction injury of the left brachial plexus. She had been wearing a soft cervical collar from the time of injury which was replaced by a firm collar. She began to show signs of recovery of neck movements 8 weeks after injury. After supporting her neck in the firm collar for a further 3 weeks she was pain free with full neck mobility. During this period her arm weakness recovered completely.

Case 2 A 5-year-old boy was admitted in November 1981 having been knocked down by a car. He was unconscious moments. On admission he was fully alert and orientated. He complained of pain in the left side of the neck and hip. Examination revealed tenderness of the left upper cervical region with spasm of the cervical muscles and head tilt to the right. There was a grade 4+ (MRC Scale) right hemiparesis with normal reflexes and sensation. Cervical spine radiographs showed a compression fracture of the left lateral mass of the atlas with separation of the lateral masses. The odontoid was tilted to the right. As in case 1 it was felt that he had fractured the lateral mass and the anterior arch of the atlas. The hemiparesis was thought to be due to a mild cord contusion. He was placed in a firm cervical collar which was changed several days later to a plaster-of-Paris Minerva jacket. His hemiparesis rapidly recovered. The Minerva jacket was removed 6 weeks after injury and he was found to be pain free with no limitation of neck movement and no neurological signs.

Case 3 A 4-year-old girl was knocked down by a car in May 1983. She was unconscious for a few minutes after impact but on admission to hospital was found to be fully alert with a left hemiplegia. She was immediately transferred to the Regional Neurosurgical Unit. On arrival she was alert, orientated but distressed. There was no chest or abdominal injuries and no limb fractures. There was spasm of the cervical muscles with head tilt to left. The left arm showed no movement and there was a grade 3 (MRC Scale) weakness of the left leg. Reflexes were brisk with an extensor plantar response. There was a right sided diminution of pin-prick sensation to a level of C2. Plain radiographs of the cervical spine and tomography showed fracturing of the posterior arch of the atlas (Fig). Computed tomography of the brain was normal but fracturing of the anterior arch of the atlas was visible on extending the cuts downward to show the upper cervical spine. It was concluded that she had suffered disruption of the ring of the atlas with cord contusion. She was placed in a firm collar and initially given strict bed rest. After one week she began to move her neck, being able to straighten it two weeks after injury. By six weeks she had full pain-free neck movement and her neurological state had almost completely recovered, showing only slight weakness of the left hand. At this stage the collar was removed and she was discharged from hospital.
limitation of neck crush a review

782

On review at three months she had fully recovered with no limitation of neck movement and no neurological signs.

Discussion

Fractures of the atlas and axis without displacement are very rare, particularly so in children. Jefferson¹ in 1920 reported 46 cases of fracture of the atlas. All types of fracture were described in this work, but only fractures in which disruption of the ring with separation of the lateral masses are commonly accorded the eponym "Jefferson Fractures". Jefferson's paper was primarily a review of the literature, only four of the 46 cases being his own. One of the reported cases, originally described by Sir Astley Cooper² in 1822, was of a 3-year-old boy. This, and a case of Marlin, Williams and Lee³ are the only two cases in the literature of fractures of the atlas in children. Isolated fractures of the lateral masses of the axis are even rarer,⁴ fractures of this bone usually involving the odontoid or the pedicles.⁵ The presentation of three Jefferson fractures to a single neurosurgical unit within eighteen months suggests that the fractures are not as uncommon as previously thought.

In all three cases the patients presented to district general hospitals and the diagnosis was missed. Secondary referral in Case 1 was on the basis of persisting neurological deficit, while in the other two cases referral was on the basis of neurological deficit following recent head trauma. The cardinal clinical features in all cases were pain, spasm of cervical muscles and limitation of neck movement. This triad should alert the clinician to the possibility of an upper cervical spine fracture even in the absence of neurological signs.

Antero-posterior and lateral plain cervical spine radiographs may demonstrate a fracture of the posterior arch of the atlas but may not demonstrate any abnormality. An open mouth view of the odontoid is the best view in order to demonstrate an abnormally high or tilted odontoid and separation of the lateral masses of the atlas. Unfortunately, in a distressed child with painful spasm and head tilt this may be very difficult to perform. Tomography may add to the information but again will require co-operation from the patient which may be difficult to obtain. Computed tomography has been suggested as the investigation of choice⁶ and in Case 3 it confirmed disruption of the ring of the atlas. More modern high definition scanners allow clearer visualization of the upper cervical spine. The examination can be performed rapidly and cooperation can be achieved with the aid of a little light sedation.

Jefferson concluded that fracturing of the ring of the atlas was due to combined downward and upward forces on it from the occiput and spine respectively.⁷ This could be caused by a child being thrown in the air by initial impact with a vehicle and then taking a secondary impact on the vertex of the skull. Flexion of the head to one side at the time of secondary impact would transmit forces to the ipsilateral lateral mass causing it to fracture. This mechanism would account for the associated brachial plexus injury in Case 1. It can be concluded that although there is bony disruption the ligaments must remain mainly intact preventing fatal dislocation of the odontoid. The fractures are probably
stable although pain and muscular spasm make this impossible to demonstrate radiologically.

The clinical course of the three cases described here, along with the cases of Cooper\(^2\) and Marlin et al.\(^3\) suggests that they have a good outcome even when associated with neurological deficit. In Case 1 no other treatment than a soft collar was given for 6 weeks and although a hard collar was substituted recovery was beginning to be seen by eight weeks. In Case 2 a Minerva jacket was applied in view of his neurological disability, but in Case 3 was treated simply with a firm collar despite an incomplete Brown-Sèquard syndrome. All three cases recovered completely and it can be postulated that in Case 2 the Minerva jacket was not necessary and that a firm collar would have been adequate. In the case reported by Marlin, Williams and Lee,\(^3\) treatment consisted of immobilisation in a custom-made plastic brace with full recovery. Although children tolerate these braces and Minerva jackets well it would be less uncomfortable for them to wear a firm collar. The benign nature of these fractures suggests that this is the treatment of choice.

I am grateful to Mr RD Illingworth and Mr JM Rice-Edwards for permission to report the cases and for helpful advice.

References