■ CASE REPORT

Occipital condylar fractures

REVIEW OF THE LITERATURE AND CASE REPORT

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Fractures of the occipital condyle are rare. Their prompt diagnosis is crucial since there may be associated cranial nerve palsies and cervical spinal instability. The fracture is often not visible on a plain radiograph. We report the case of a 21-year-old man who sustained an occipital condylar fracture without any associated cranial nerve palsy or further injuries. We have also reviewed the literature on this type of injury, in order to assess the incidence, the mechanism and the association with head and cervical spinal injuries as well as classification systems, options for treatment and outcome.

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Occipital condylar fractures were first described by Bell in 1817 after the post-mortem examination of a trauma victim.¹ The patient had sustained his fracture after falling backwards off a wall. He attended hospital and on his departure turned his head to bid farewell to his carers. He died immediately because of the instability of his neck injury. A number of cases have subsequently been reported, particularly in the last two decades.²⁻⁵⁵ The reason for the increase in reports may be the availability of sophisticated imaging techniques, combined with an increased awareness of this potentially lethal fracture.

Anatomy

The craniocervical ligamentous anatomy can be subdivided into intrinsic and extrinsic ligaments.^{2,3}

The extrinsic ligaments include the anterior atlanto-occipital membrane, which is a broad and dense fibrous structure representing the upward continuation of the anterior longitudinal ligament and the broad, but relatively thin, posterior atlanto-occipital ligament. The intrinsic ligaments, within the spinal canal, provide most of the ligamentous stability and form three layers anterior to the dura. The odontoid (alar and apical) ligaments are anterior. The paired alar ligaments are thick cords, each about 11 mm long. Their main function is considered to be the limitation of atlantoaxial rotation, the left becoming taut on rotation to the right and *vice versa*. In the middle, the cruciate ligament lies posterior to the dens. The paired transverse atlantal component of the cruciate ligament is its strongest part. Posterior

to the other intrinsic ligaments lies the tectorial membrane. This broad, strong band represents the upward continuation of the posterior longitudinal ligament. Craniocervical flexion is limited by the bony anatomy, while extension is limited by the tectorial membrane. Rotation and lateral flexion are restricted by the contralateral alar ligaments and distraction of more than 2 mm is prevented by the tectorial and alar ligaments.

Classification of occipital condylar fractures

The most commonly used classification is that of Anderson and Montesano,⁵⁶ which was proposed in 1988 after examination of six patients with condylar fractures. A Type-I fracture is a comminuted impaction fracture resulting from axial loading, while Type II is a condylar fracture with extension into the base of the skull. Both are thought to be stable. Type III is an avulsion-type fracture at the insertion of the alar ligament and is considered to be unstable.

Tuli et al⁴ proposed a new system of classification. The reason for this was the difficulty in predicting stability simply by the displacement of the occipital condylar fracture without confirmation by other means, such as MRI, to establish whether there was any ligamentous injury. In this system, Type I fractures are undisplaced and stable and Type II are divided into A and B. Type IIA is a displaced fracture of the occipital condyle with stability at the occiput-C1/2 levels. In Type IIB fractures there is instability at the occiput-C1/2 levels as demonstrated by radiography,

Fig. 1a

Fig. 1b

Fig. 1c

Figure 1a – Radiograph showing pre-vertebral swelling (arrow). Figure 1b – Diagram showing the available normal variation in the thickness of the pre-vertebral soft tissues. Figure 1c – Coronal CT slice of a left occipital condylar fracture (arrow).

CT or MRI. There may be more than one fracture suggesting instability.

Incidence

Estimates of the incidence of this fracture vary widely. Hanson et al⁶ estimated the incidence to be 1 to 2 per 1000 in patients with an injury severity score > 8.⁷ Bloom et al⁸ reported an incidence of 19%; their inclusion criteria were high-energy blunt trauma to the head and neck with either axial compression, or lateral flexion/rotation, or a direct blow. Noble and Smoker⁷ reported an incidence of 1% after examination of CT scans of trauma patients performed in the emergency department.

Case report

A 21-year-old man fell from a motor cycle striking the right side of his face. He lost consciousness for less than two minutes. On arrival, his neck was protected by a rigid splint and he complained of head and neck pain. There were no airway or cardiovascular problems. His neurological examination was unremarkable. Palpation of the spine revealed tenderness exclusively over the C2/3 region. Anteroposterior, lateral and odontoid radiographs of the cervical spine and radiographs of the skull failed to show a fracture. However, there was pre-vertebral swelling of soft-tissue from the cervico-occipital junction to the level of the third vertebral body (Fig. 1). A CT scan of the head and neck was therefore performed and showed an Anderson-Montesano⁵⁶ Type III fracture of the left occipital condyle with minimal inferomedial displacement. He was treated conservatively in a Philadelphia collar for eight weeks and made an uncomplicated recovery regaining full

occipitocervical movement with no residual pain or headaches.

Review of the literature

We carried out a literature search on the Medline/PubMed database using the key words ‘occipital condylar fractures’ to identify all reported cases up to the year 2005 in English-language journals. We identified 96 papers and excluded 19 non-English publications. For each case of occipital condylar fracture the following details were noted: 1) the age and gender of the patient; 2) the mechanism of injury; 3) any history of loss of consciousness; 4) the Glasgow coma score (GCS) at presentation; 5) associated intracranial findings; 6) cervical spinal injuries; 7) palsy of the cranial nerve. The types of imaging technique used were also recorded, and the classification (Anderson-Montesano⁵⁶) of the fracture. The treatment and its duration, complications, follow-up and outcome were noted.

Of 219 fractures,⁴⁻⁶² 209 were occipital condylar with sufficient information reported in survivors. In one series, ten patients reportedly died before treatment.⁵ However, the results were summarily presented as a total group and it was not possible to remove these ten patients from our data pool. Overall, there were 147 men and 69 women and in three reports⁵⁴ the gender was not stated. The youngest patient was only seven months of age,⁸ although this injury was a fracture at the base of the skull which did not cross the occipital condyle. The next youngest patient was three years of age and the eldest was 88 years,^{2,5,7} the mean age being 32.4 years. All fractures occurred as a direct result of trauma and the most common cause was a road-traffic accident in 153 cases (69.8%). Falls accounted for 33 fractures

(15%), whilst in 18 patients there were other causes of trauma and in 15 the mechanism of injury had not been specified.

The GCS was recorded on admission in only 83 of the 219 patients. Of these, the head injury was mild in 47 (GCS 14 to 15), moderate in 13 (GCS 9 to 13) and severe in 23 (GCS 3 to 8). Of the total group, 24 patients (11%) were reported to have lost consciousness and 100 had associated intracranial injuries. Associated injuries to the cervical spine occurred in 49 (22%). Of these, there were 21 fractures of C1, ten of C2, and ten odontoid fractures. There were eight other fractures within the cervical spine. Subluxation occurred in seven patients and two had spinal cord contusion.

Examination of the cranial nerves was recorded in 119 patients and 55 had a nerve palsy; 15 made a full recovery, 20 had partial recovery and 14 had no recovery at all. In six there was no follow-up information. There were 115 separate cranial nerve palsies in total. In 12 patients the diagnosis was delayed. The most commonly affected was the XIIth nerve (34 cases) due to the close relationship of the hypoglossal canal to the occipital condyles. Palsy also occurred in the IIIrd, IVth, VIth, VIIth, VIIIth, IXth, Xth and XIth nerves with 1, 1, 9, 10, 3, 19, 22 and 16 cases, respectively.

Where radiographs only were available (92 cases), 72 were interpreted as negative for fractures or soft-tissue swelling. In 11, pre-vertebral soft-tissue swelling was noted. In eight, the radiographs showed associated cervical spinal fractures. In only one patient was the occipital condylar fracture evident on the plain radiographs. Flexion/extension views of the cervical spine were recorded in six patients and in all cases the neck was stable. Tomography was performed in three patients and the remainder had CT scans to diagnose their fractures. In five, the initial CT scan did not show the fracture and a repeat scan was performed. This was because the slices of the initial scan did not reach the condyles and also because of poor resolution and interpretation errors. In addition to radiography and CT, 57 of the 219 patients had MRI to assess the soft tissues.

The fractures were classified according to the Anderson-Montesano⁵⁶ system. We largely accepted the classifications quoted by authors; in some cases we classified the fracture according to its description or appearance on the CT scan. There were 127 Type III (64.1%), 48 Type II (24.2%) and 23 Type I fractures (11.7%) and the remaining cases could not be classified reliably. Bilateral condylar fractures occurred in eight of the 219 patients. Three patients with airway obstruction required intubation.

We found useful information on treatment for 108 patients. The fracture received no specific treatment in 21 patients. Nine of these had a persistent cranial nerve palsy. Three recovered fully and in a further nine there was no record of the outcome. A halo-vest was worn by 20 patients for two to three months; of these, nine had a persistent cranial nerve palsy, one had a persistent hemiparesis, four fully recovered and in six, no records were available.

Cervical collars were the most popular treatment and were given to 58 patients, 22 of whom wore a Philadelphia collar and three used a soft collar. In the remainder, either a hard collar was used or the type of device was not specified. However, there was insufficient information about the duration of the treatment in most cases. Of these 58 patients, 37 made a full recovery, 12 had a residual cranial nerve deficit, one had persistent neck pain and one had reduced neck movements. No information on outcome was available for seven patients. A Minerva brace was used to treat five patients and four of these made a full recovery. One had a persistent cranial nerve palsy.

Surgery was undertaken in three patients to remove fragments of the fracture. The indications for surgery were pressure on the vertebral artery,⁹ marked displacement of the fracture with lower cranial nerve palsies, without signs of compression of the brain stem¹⁰ and compression of the brain stem and the vertebral artery.¹¹ The patients in the first and third instance made a full recovery after surgery. However, the patient in the second case-report had only partial improvement of cranial nerve palsies.

Occipitocervical fusion was performed for one patient who had a dislocation at the C1-C2 level, with displacement of 7 mm.⁴

Discussion

Despite reports from some authors suggesting that occipital condylar fractures cannot be diagnosed on plain radiographs, we believe that plain radiography does have a role in the diagnosis of this rare injury.¹⁷ The radiographs should be scrutinised for associated soft-tissue swelling which should alert clinicians to possible causes and prompt further imaging such as CT scans. Current advanced trauma life support guidelines suggest a maximum allowable pre-vertebral soft-tissue thickness of < 5 mm at any level above C6 specifying the level of C3 as a particular reference at which to apply this parameter.⁶³ Another source suggests a maximum soft-tissue thickness of 7 mm, or approximately 30% of the adjacent width of the vertebral body at C1-C4, and 22 mm, or approximately 100% of adjacent vertebral body width at C5-C7.⁶⁴ Although our case fulfilled these guidelines, we recognise that these figures are arbitrary. Relative pre-vertebral soft-tissue thickness, both in relation to the adjacent pre-vertebral soft tissue and to the adjacent corresponding vertebral body is an important factor to be borne in mind. In a patient with blunt trauma to the head and neck with an altered level of consciousness, CT is essential in order to exclude occipital condylar fracture, even if the cervical radiographs are normal. The suspicion of an occipital condylar fracture increases in the presence of palsy of the lower cranial nerves.

Although it is not the most popular classification system, the Tuli classification⁴ is useful. In this system, the fractures are classified, essentially by examining radiographs, CT and MR scans for features of instability. However, the best treatment for unstable fractures is still not clear. Anderson-

Montesano Type-III fractures, regarded as potentially unstable, have been treated in various ways with differing outcomes.⁵⁶ Type I and Type II injuries are considered to be stable. There were no reported fatalities after any type of treatment in any patient group.

On surveying the three open operations performed for pressure-related symptoms associated with fracture fragments, it appears that removal of these fragments was justifiable in spite of the technical difficulty and potential complications. In these three patients, the operation was successful in relieving pressure from the brain stem and vertebral artery in two patients, and was partially effective in decompressing the lower cranial nerves in the third. However, it is not certain that surgery was responsible for the recovery of nerve function. The literature suggests that some cranial nerve palsies recover completely, or at least partially, with conservative treatment and therefore, it would seem reasonable to defer surgery.

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