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Fracture of the vertebral limbus

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Abstract An 18-year-old young man suffering from fracture of the limbus of L4 was admitted to the emergency ward after a car collision. Radiological evidence of the lesion was visible on plain film radiographs and CT scans. On surgery the posterior column was found to be intact. Treatment included a wide laminectomy, excision of the fragment, and osteosynthesis with Cotrel-Dubousset instrumentation. The characteristics of these lesions are reviewed on the basis of the latest reports. The

possibility of misreading these fractures is emphasized, especially in traumatic adult spine surgery.

Key words Lumbar fracture · Vertebral limbus · Apophyseal ring fracture

Introduction

Fracture of the vertebral limbus, also termed apophyseal ring fracture, is an uncommon diagnosis. These fractures are typically seen in adolescents or young adults.

Trauma resulting from strenuous sports activity has been reported as an important mechanism or predisposing factor for this injury.

Clinical signs usually imitate those of lumbar disc herniation, and include a history of low back pain and/or leg pain. Some cases have no symptoms that can be attributed to the fracture [11].

Limbus vertebral fractures have been classified into types I, II, and III by Takata et al. [11]; Epstein et al. [6] proposed an additional category, type IV (Fig. 1).

Case report

An 18-year-old young man was involved in a head-on car collision, while wearing a lap seat-belt. He was admitted to the emergency ward complaining of severe pain in the left thigh.

Physical examination revealed normal muscle strength with severe radicular pain of the L4 root associated with moderate low back pain. The patellar reflex was active in the right limb but absent in the left one. No other neurological deficit was observed. Plain lateral radiography showed a bony fragment projecting posteriorly from the posterior caudal limbus of the body of the fourth lumbar vertebra (Fig. 2). CT showed considerable narrowing of the anteroposterior diameter of the spinal canal caused by the fragment. An associated defect in the entire posterior rim of the vertebral body was seen (Fig. 3).

At surgery the posterior arch was found to be intact, and no ligamentous disruption was observed. Access to the large fragment was afforded by a generous laminectomy with partial left arthrectomy. Both right and left L4 roots were stretched over the fragment. This bony fragment was fixed firmly to the underlying disc.

Bone and disc fragments were removed and osteosynthesis with Cotrel-Dubousset instrumentation was performed (Fig. 4).

The young man returned to school 15 days later. At his 3-month follow-up, radicular symptoms were completely relieved, but slight low back pain persisted. Nine months later, the patient has done very well, with relief of all pain and return of the patellar reflex.

Fig. 1A–D Classification of limbus vertebral fractures. **A** Type I, an arcuate fragment without osseous defect. **B** Type II, an avulsion fracture that includes a rim of bone. **C** Type III, a localized fracture. The osseous defect anterior to the fragment is larger than the fragment. **D** Type IV, a fracture that extends both beyond the margins of the disc and the full length of the vertebral body between the end plates. (**A**, **B**, **C** adapted from Takata et al. [11], **D** adapted from Epstein et al. [6])

Discussion

Pathophysiology

The pathogenesis of this fracture remains controversial. Strenuous sports activity and acute trauma have been reported to be important mechanisms for this injury [3, 11]. On the other hand several cases with no history of trauma have been described [6, 9, 10], and in some cases the fracture was preceded only by lifting [1, 9].

Some consider that avulsion of the posterior vertebral apophyseal ring may be a posterior variant of marginal cartilaginous nodes. Others suggest that the relative weakness of the anterior and posterior osteocartilaginous junction and penetration of the collagen fibers of the annulus fibrosus through the cartilage of the limbus explain how disc herniation can tear the apophyseal ring [1, 9]. If this is correct, the location of the fracture would be determined more by the location of this “weak point” than by the position of the spine in flexion or extension, as previously reported [3, 9, 11].

Fig. 2 Lateral plain radiograph of the lumbar spine showed a bony fragment projecting from the lower rim of L4

Fig. 3 **A** Axial CT showed the fragment impinging on the spinal canal. **B** CT sagittal reconstruction confirmed the presence of a bony defect from the posteroinferior rim of L4

Fig. 4 Treatment included a wide laminectomy and excision of the fragment, followed by osteosynthesis with Cotrel-Dubousset instrumentation

It should be noted that among the different publications about limbus fractures, there have been no biomechanical studies to explain or reproduce this type of lesion.

In our case the trauma sustained by the patient was very violent and was obviously due to hyperflexion.

Classification

Several classifications of adult thoracolumbar spine fractures have been proposed. The classification by Denis, based on the three-column theory, has achieved wide acceptance [4]. More recently, Magerl et al. proposed a new classification based on the pathomorphological characteristics of the injury [8].

However, in clinical practice, these classifications cannot be used to explain or to treat vertebral limbus fractures. Such fractures are best described by the Takata and Epstein classifications [6, 11]. Using this system, our case was classified as type II.

Age and type

Until recently, it was thought that these lesions were more or less confined to teenagers, or at least those under 25 years, which is the maximum age for fusion of the apophyseal ring to the vertebral body.

In the study by Takata et al. [11], all of the type-I fractures occurred in children who were less than 13 years old (eight cases); type-II fractures occurred in somewhat older children (five cases). The age at onset of symptoms in patients who had a type-III fracture ranged from 15 to 36 years (ten cases).

Of the cases reported by Epstein et al. [6], one patient who had a type-I fracture was 37 years old, two patients with type-II fractures were 12 and 16 years old, respectively, and the remaining seven patients, aged between 18 and 41 years, had type-III and type-IV fractures (three and four patients respectively).

Thus, type-III and type-IV fractures seem to be more common after the age of 18 years.

Location of the fracture

According to Clark, in approximately 60% of cases, fractures affected the posteroinferior rim of the L4 vertebral body (as in our case), while 30% involved L5 and 10% L3 [3]. L5 was affected most often in the cases reported by Savini et al. (five cases out of nine) [9]. S1 and the cervical spine have also been reported as locations of these lesions [6, 11].

Diagnosis

Clinical signs may be absent, with no symptoms that could be attributed to the fracture [7, 11]. Most patients have no clinical history of any serious spinal trauma at all. Some patients complain of back and/or leg pain or sciatica, while others can only carry out positive Lasegue maneuvers without any associated neurological dysfunction [2, 5, 6].

Plain film radiographs of the lumbar spine show no abnormalities in many cases [11, 12]. Radiological signs of Scheuermann's disease were present in 50% of the cases reported by Soper [10] and in 38% of those reported by Dietemann et al. [5].

CT reveals a bony ridge protruding into the spinal canal, a degree of spinal narrowing, and the presence of an accompanying disc prolapse [5, 6, 10, 11, 13]. Diagnosis and classification according to Takata and Epstein is based only on CT signs.

MRI findings are less specific than CT signs. The avulsed ring (type I) is demonstrated as a small arcuate low signal intensity fragment displaced posteriorly from the cranial or caudal rim of the vertebral body. Thus, CT is preferable and should not be replaced by MRI, because of the lower resolution of osseous tissue by this technique [1, 10].

Treatment

In patients suffering symptoms of root irritation and/or spinal cord compression, an operative intervention is necessary. Posterior decompression should be supplemented, if possible, by resection of the fragment [6]. If a wide bilateral laminectomy is performed, osteosynthesis and posterolateral arthrodesis may be necessary to avoid secondary instability.

Conclusion

Familiarity with fractures of the vertebral limbus is essential, especially in emergency situations after acute trauma. With fewer than 100 cases reported in the literature, this type of fracture is rarely diagnosed.

Originally believed to occur only in adolescents and young adults, the latest reports show that such fractures can occur in adults over the age of 25. In these cases, type III and type IV fractures seem to be more common and are accompanied by a high risk of neurological damage.

Classifications of adult spinal fractures should therefore include vertebral limbus fractures as transient forms or partial fractures. A further study of these fractures would give better insight into the etiology and the physiopathologic mechanisms involved.

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