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CASE REPORT

Combined approach for a locked unilateral facet fracture-dislocation of the cervicothoracic junction

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The authors present the case of a 36-year-old patient who sustained a unilateral fracture-dislocation C7-T1 involving all three columns, given the lesion of the C7-T1 disc on MRI. In view of the fractured facet, closed reduction without anaesthesia was not attempted. First, open reduction and instrumentation were performed from posteriorly. In a second operation, anterior fusion C7-T1 was added, using a tricortical bone graft and instrumentation. The authors felt that this three-column lesion at the cervicothoracic junction necessitated combined posterior-anterior stabilisation.

Keywords : locked fracture-dislocation ; cervicothoracic junction ; combined approach ; three-column lesion.

INTRODUCTION

Traumatic fracture-dislocation of the cervicothoracic junction is a rare injury. The reported incidence is 2.4 to 9% of all fracture-dislocations of the cervical spine (*3,9,19*). The lesion can range from unilateral facet subluxation to bilateral frank dislocation. The authors report the case of a locked unilateral cervicothoracic fracture-dislocation C7-T1 as a result of flexion-distraction with concomitant lateral bending and rotational forces.

The cervicothoracic junction is characterised by an abrupt transition between the lordotic flexible cervical spine and the more rigid kyphotic thoracic spine. The transition from cervical lordosis to thoracic kyphosis leads to a transfer of weight from the more posterior aspect cranially to the anterior aspect of the thoracic spinal column caudally, which results in increased stress at the junction. This transition imposes special requirements in terms of instrumentation when treatment of unstable conditions such as a fracture-dislocation at this level is required.

Cervicothoracic fracture-dislocations and specific instrumentation of this region have been rarely mentioned in the literature (*2,3,6,24*). Moreover, these studies are retrospective. Due to the rare incidence of these lesions, randomised clinical trials, prospective cohort studies, and case-control studies are not available.

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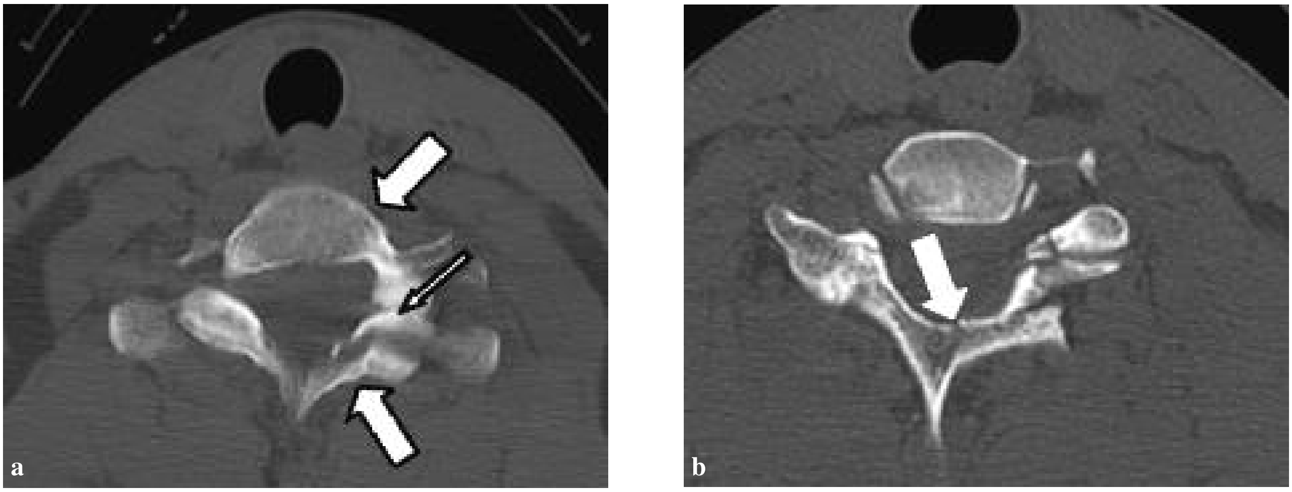

Fig. 1. — CT-scan demonstrating a left fracture-dislocation C7-T1 (small arrow).The two large arrows point to the vertebral body and to the lamina C7 (a). The fractures of the lamina (arrow) and of the facet joint are clearly visible (b).

The authors focus on the diagnostic work-up and on the surgical treatment options. In view of the rare incidence and of the potential catastrophic consequences of such an injury the present knowledge in terms of treatment and of imaging procedures is discussed. When looking at the literature, there is no unequivocal strategy for the use of instrumentation in the treatment of unstable conditions of the cervicothoracic junction (*22*).

CASE REPORT

A 36-year-old man was transferred to the Emergency Department after a bicycle accident. He collided with a car and fell down wearing a helmet. He sustained a flexion-rotation injury of the cervical spine. The ambulance team applied a stiff collar. On admission he was fully alert, but complained of diffuse pain and stiffness of the neck.

On clinical examination, localised tenderness of the neck and spasm of the neck muscles were observed. There was slight numbness in the left C8 dermatome, but no weakness. Other injuries were ruled out.

The diagnostic work-up included plain radiographs, including a swimmer's view ; they showed no pathology, as the cervicothoracic junction was concealed by the shoulders. Additionally, multislice spiral CT-imaging with multiplanar reformatting in sagittal, coronal and para-axial planes was performed (fig 1). This revealed a left fracture-dislocation C7-T1 and a fracture of the left hemilamina T1, without signs of nerve root compression. A pre-reduction MRI (fig 2) comprising various combinations of sagittal and axial T1-weighted spin echo and T2-weighted spin echo sequences demonstrated a disrupted but not herniated disc C7-T1 and an epidural haematoma (4.5×7 mm) without pathologic enhancement of the spinal cord. No pathology of the vertebral artery was observed. An axial MRI section at the level C7 (fig 3) showed a haematoma in close proximity to, but without compression of, the left C7 nerve root.

An MRI-compatible halo-vest was applied under local anaesthesia, as an emergency procedure. Two days later open posterior reduction of the dislocation, including resection of the fractured facet joint, was performed. A versatile rod-screw system (fig 4) (Neon®, Ulrich Medical, Ulm, Germany) was used for instrumentation with lateral mass screws at C7 and pedicle screws at T1. This provided immediate internal stability. In a second operation, a discectomy C7-T1 was performed using an oblique incision parallel to the anterior border of the right sternocleidomastoideus muscle, while the shoulders were pulled caudally by applying traction at the wrists. A

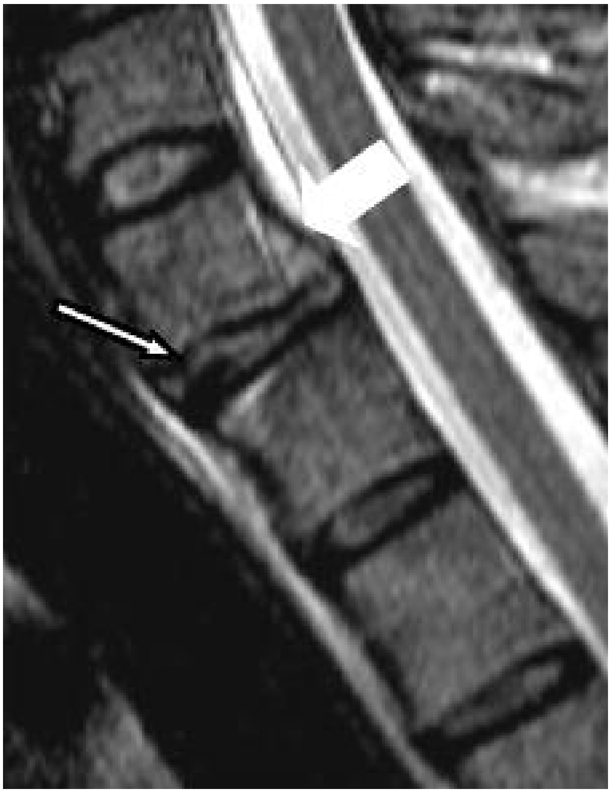

Fig. 2. — Sagittal MRI (midline section) demonstrating disruption of the C7-T1 disc (small arrow). A haematoma can be identified behind the vertebral body, with minor narrowing of the subarachnoid space (large arrow).

monosegmental fusion was performed with an autologous tricortical bone graft taken from the iliac crest, and with an anterior plate which provided a fixed angle construct (Atlantis™ plate, Medtronic Sofamor Danek, Memphis, USA).

The postoperative course was uneventful. The numbness in the left C8 dermatome lessened, and disappeared almost completely by the time the patient was discharged from hospital. He returned to his previous occupation within three weeks after the injury.

DISCUSSION

Routine lateral radiographs frequently fail to show the cervicothoracic junction. In particular, this can be a problem in patients with well-developed

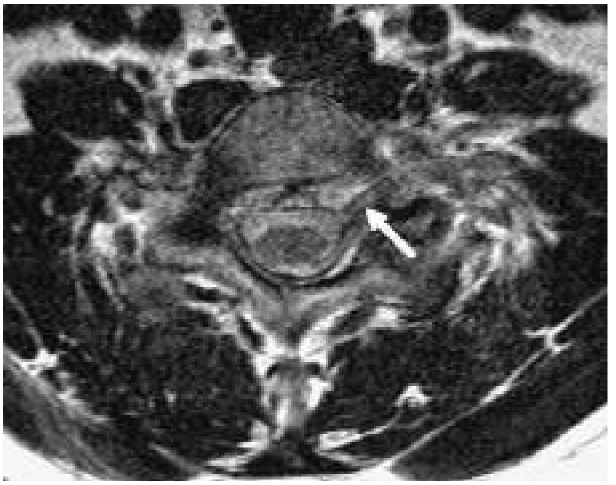

Fig. 3. — Axial MRI at level C7. A haematoma can be seen in close proximity to, but without compression of the left C7 nerve root (arrow).

shoulders so that even a swimmer's view cannot sufficiently reveal pathology (*25*). Therefore a CT-scan is mandatory in patients with a suspected injury of the cervical spine, and with insufficient plain radiographs (*9*). Modern CT technology provides excellent high resolution images in all planes (axial, coronal, sagittal), which allow direct visualisation of the relevant structures.

Injuries of the lower cervical spine typically combine bony and ligamentous injuries (*23*). Dislocations and fracture-dislocations are more common in the lower part of the vertebral column, because of the more horizontal orientation of the facet joints. Unilateral dislocations are less common than bilateral dislocations, and less frequently associated with neurological injuries, but can be more difficult to reduce with traction (*28*).

Early reduction of the locked facet is recommended, even in those patients without neurological deficit (*4,28*). Although the ideal timing of reduction is unknown, many investigators favour reduction as rapidly as possible after injury in order to maximise the potential for neurological recovery (*20*). There are different methods for performing closed reduction. Reduction under general anaesthesia has the drawback that is does not allow to follow the neurological condition. Therefore, an awake and cooperative patient, whose neurological status can be

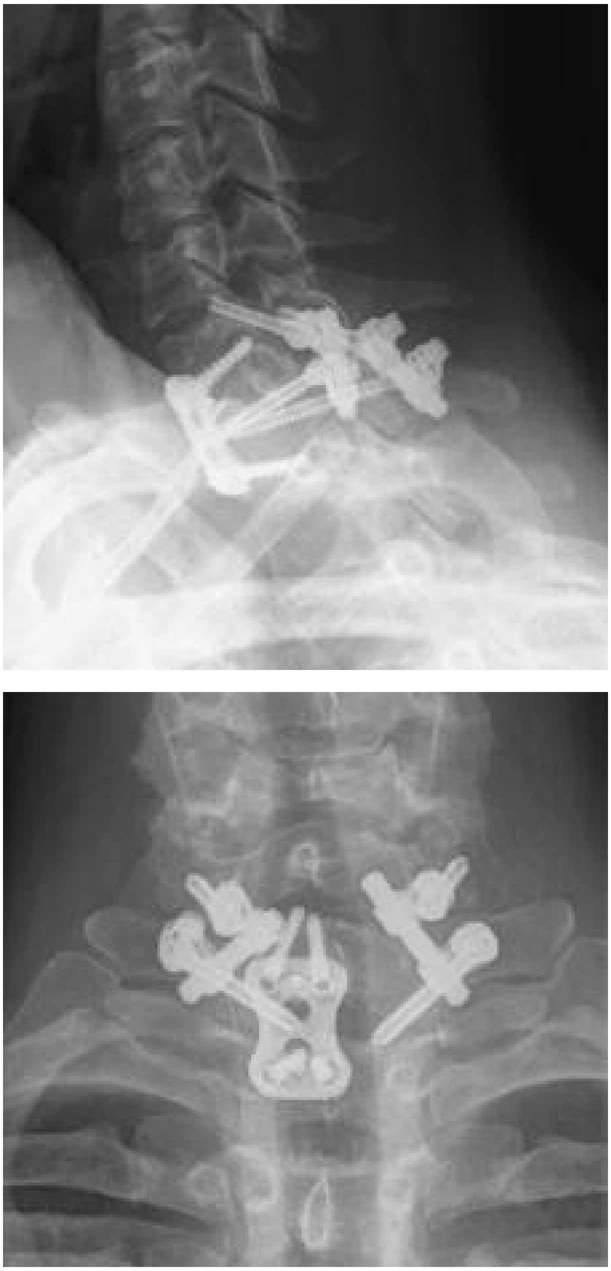

Fig. 4. — Postoperative situation after reduction, posterior-anterior instrumentation and insertion of a tricortical bone graft into the disc space C7-T1.

monitored during the reduction, is preferred. However, data from the literature indicate that closed reduction of cervicothoracic dislocations will almost certainly fail, even under general anaesthesia (9). Moreover, in our patient a fracture of the dislocated and locked facet joint was an obstacle to closed reduction, which was confirmed preoperatively ; excision of the facet joint was necessary.

The presence of significant disc herniation is regarded as a relative indication for initial anterior decompression before closed or open reduction from posteriorly (*3,15,20*). Hadley (*12*) checked the literature and found 7 cases of neurological deterioration, caused by a disc herniation after posterior reduction : 4 after closed reduction or attempted closed reduction, and 3 after open reduction. This explains why many surgeons want an MRI, as it is extremely useful in diagnosing a disc herniation. However, pre-reduction MRI will demonstrate disc herniation in up to 50% of the patients with facet subluxation, so that the clinical importance of this finding is questionable as to neurological deterioration (*27*). Moreover, Vaccaro *et al* (*27*) reported no neurologic injuries after successful awake closed reduction in 11 patients, including two with known disc herniation prior to reduction ; but their series was rather small. In the case presented here, we, however, considered preoperative MRI as mandatory since the first operative approach was a posterior one ; MRI only showed a disc disruption, but no disc herniation.

We did not attempt a closed reduction, because of the fractured facet. Posterior open reduction of unreducible dislocations is considered to be an effective method of reduction by allowing direct disengagement of the inferior facet from the superior facet (*28*), at least if there is no major disc herniation (*11*).

Several biomechanical and clinical studies have raised concern regarding the adequacy of anterior plating for stabilising posterior element injuries of the cervical spine (*7,13,17,18*). Indeed, *in vitro* anterior plating has been found to be inferior to posterior fixation, particularly in resisting flexion-distraction moments (*5*). Do Koh *et al* (*7*) also found *in vitro* that anterior plating alone in the presence of complete posterior ligament destruction is substantially less stiff than posterior stabilisation (*7*). A recent biomechanical study of the cervicothoracic junction, performed on human cadaveric specimens, demonstrated the need for a combined posterior-anterior fixation of three-column injuries, whereas posterior fixation alone was sufficient in two-column injuries (*14*). Also in an other biomechanical study, combined anterior-posterior fixation provided stabilisation exceeding that of an intact segment in case of destruction of both anterior and posterior elements (*21*). However, it must be emphasised that clinical studies do not provide data suggesting that combined anterior-posterior instrumentation is mandatory for adequate treatment of instable cervicothoracic injuries. Therefore, transfer of biomechanical *in vitro* data to the *in vivo* situation must be done cautiously. In the present case, all three columns were involved. In addition, the facet fracture indicated an unstable situation (*21*). Therefore, and because of the injury's location at the cervicothoracic junction, the most stable fixation technique was chosen : combined anterior-posterior instrumentation.

Lateral mass screws were used at the level C7. Indeed, transpedicular screws are associated with an increased risk of injury to the major neurovascular structures, including the spinal cord, nerve roots, and the vertebral artery, especially at the cervical level (*1*). In addition, at the C7 level the shoulder girdles may obstruct a clear intra-operative radiographic view of the pedicles, making the procedure even more difficult. In contrast, pedicle screws were used at the T1 level. Compared with the cervical spine, the transverse processes of the thoracic spine are considerably weaker. Consequently, lateral mass screws are less favourable at this level. Since the diameter of the pedicles increases to a mean width of 7.8 mm at T1, pedicle screws are preferable (*26*).

CONCLUSION

If a lesion of the cervicothoracic junction is suspected, Computerised Tomography and often Magnetic Resonance Imaging are required for appropriate visualisation. Open reduction of a locked facet dislocation can reduce the risk of neurological complications. Although there is no unequivocal treatment strategy available, a three-column injury of the cervicothoracic junction may require a combined posterior-anterior approach and posterior-anterior instrumentation for maximum stability.

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