



## Clinical Case of the Month

### Anterior dislocation and extruded disc of the lower cervical spine

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#### Introduction

In anterior fracture dislocations of the lower cervical spine (C 3/4 to C 7/T1), constriction of the spinal canal between the dislocated vertebral arch and the posterior upper edge of the adjacent caudal vertebral body causes injuries of the spinal cord. The spinal cord is crushed at the moment of injury, and the severity of paralysis varies depending on the severity of compression. Since the spinal cord remains under continuous compression caused by constriction of the spinal canal and the unstable facet joints, early reduction of the dislocation and stabilization to prevent further injuries of the spinal cord are the usual treatment.

In dislocation with unilateral or bilateral facet locking and fracture dislocation with facet fractures, the posterior elements are frequently ruptured. In most cases, the supraspinous ligaments and interspinous ligaments, ligamentum flavum and facet joint capsule are ruptured, and sometimes there may be a fracture of the lamina and pars interarticularis. When intervertebral subluxation is accompanied by rupture of the discs and the posterior longitudinal ligaments, the disc tissues may be extruded further into the spinal canal following reduction, possibly causing compression of the spinal cord. Magnetic resonance imaging (MRI), in most cases, has enabled diagnosis of extrusion of the disc prior to reduction. However, it may be difficult before reduction to know whether the extruded disc turns back or remains in the spinal canal.

#### Case presentation

A 49-year-old woman fell down from a height, and was brought to our hospital 25 h after the injury. Neurological examination revealed incomplete quad-

riplegia (Frankel grade C). T1-weighted MRI demonstrated anterior dislocation at the C6–C7 level and abnormal tissues with the signal intensity similar to that of the disc in the spinal canal (Figure 1).

Which management would you recommend for this patient?

#### First opinion

*K Shiba, MD*

On the day of admission, she had posterior reduction and Rogers' wiring and fusion, followed by anterior discectomy and iliac strut graft with removal of a herniated disc. At the time of surgery, dislocation of the bilateral facets was noted. Postoperatively, her neck was supported by soft collar and she was mobilized on the second postoperative day. Twenty-nine days after the operation, compression of the spinal cord was not found by MRI. The paralysis had improved to Frankel grade D. However, in this case with a herniated disc, anterior discectomy and arthrodesis would be favored as the initial therapy prior to operative posterior reduction. If reduction cannot be achieved after anterior decompression then subsequent posterior open reduction and fusion is indicated.

Safe reduction and fixation are most important in the treatment of dislocation, and there is much discussion about surgical treatment, including the instrumentation method and operation by the anterior, posterior or anterior–posterior approach. If disc extrusion is suspected by MRI before reduction of the dislocated facets, decompression through an anterior approach should be carried out before closed reduction or operative posterior reduction.<sup>1</sup> If MRI before reduction demonstrates no sign of soft tissue extrusion, posterior reduction and fusion is indicated. However, extrusion of the disc should always be taken into consideration, and if it is suspected, investigation

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**Figure 1** T1-weighted MRI in a 49-year-old woman showing C6–C7 bilateral locked facets and C6–C7 disc extrusion prior to reduction of the locked facets

by MRI should be performed as early as possible after posterior open reduction. If disc compression factors are identified by MRI, decompression through an anterior approach should be immediately carried out.<sup>2</sup>

In patients who have received successful manual reduction, the presence or absence of a herniated disc may be diagnosed by MRI, but we consider there to be a limit in the accuracy in diagnosis by MRI before reduction. Before reduction of the dislocated facets, MRI often reveals not only anterior translation of the cephalad vertebra but also the presence of an area with a signal intensity similar to that of the disc tissues behind the dislocated vertebrae. However, it may be difficult to judge whether the signal indicates the disc or congestion of the epidural venous plexus. Even if it shows extrusion of the disc tissues into the spinal canal, it is impossible to judge whether the extruded disc is reduced, or left behind, or displaced further by a closed or posterior open reduction. It is, therefore, necessary to establish the diagnostic criteria for disc extrusion, which is likely to cause compression of the spinal cord, by accumulating case studies in which the MRI performed prior to reduction is correlated with the operative findings during anterior decompression following reduction.

## Second opinion

*WS EL-Masry, FRCS*

Although a cervical spine X-ray of this patient is not available to me, her MRI scan suggests that she has bilateral dislocation of C6–C7, probably due to the disruption of all her ligaments.

Since she presented within less than 48 h from injury, in my opinion she should undergo closed reduction with incremental weight, without anaesthesia so that she can be monitored and examined neurologically with each increment of weight. This is particularly important in view of the presence of retropulsed disc between the sixth and seventh cervical vertebra.

If reduction is achieved without neurological deterioration, I would maintain this reduction with skull calipers and 6 lbs traction in the neutral position or slight extension of the cervical spine for a period of 3–4 weeks. Following this period she should undergo anterior surgical decompression of the retropulsed disc and surgical stabilization with a Casper plate or its equivalent. With this regime I am almost certain this lady will improve to Frankel D or E. Although early surgical decompression is feasible, this line of management is likely to put this lady's physiologically unstable cord<sup>3</sup> at a slightly higher risk. The risk can further increase with early mobilization. Early mobilization can lead to postural hypotension or hypoxia, related to a drop in vital capacity.<sup>4,5</sup>

Should any early sign of neurological deterioration occur during the initial reduction of the cervical spine; closed reduction should be abandoned. Steroids should be administered and anterior surgical decompression and stabilization carried out. I would keep the patient in bed for about 4 weeks following the procedure while managing her associated multi-system impairment. I would still avoid early mobilization even though her cervical spinal column is biomechanically surgically stabilized.

The patient can also be treated conservatively if the surgical expertise is not available. With conservative management she is also likely to improve neurologically equally as well whether or not the dislocation is reduced. Conservative management is however likely to require an unacceptable prolonged period of bedrest followed by bracing. This may not be justifiable should the surgical and parasurgical expertise be available on site.

External stabilization with a halo should be avoided as it has a bad reputation with distraction flexion injuries which this lady seems to have sustained.

## Third opinion

*AC Moraes, MD*

In a patient with a cervical fracture there are three aspects to be considered: decompression of the neural elements, realignment, and stabilization of the spinal

column. Decompression of the neural elements should be done as soon as medical conditions of the patient are stable. There is no statistical evidence that delayed surgery in a *medically* stable patient can improve neurological outcome. In addition early decompression may reduce the secondary ischaemic changes in the spinal cord. The incidence of medical complication can be reduced over 50%, and postsurgical neurological deterioration is considerably less, if we compare early *versus* late surgery.<sup>6,7</sup>

In a patient with Frankel grade C (motor function preserved below the neurological level and muscular grade less than 3) all efforts should be made to improve at least the muscular grade to promote a better FIM (Functional Independence Measure). As the patient was admitted to the hospital 25 h after the trauma, the methylprednisolone protocol should not be used.

In this particular case the MRI demonstrates:

- (a) A large disc herniation with anterior compromise of the spinal cord in C6–C7 [suggesting disruption of the annulus and posterior longitudinal ligament (median column)].
- (b) Widening of the distance between spinous processes C6–C7 with kyphotic deformity suggesting ligamentous damage (posterior column). These lesions heal poorly and mostly require surgical therapy.
- (c) There was anterior translation of C6 on C7 greater than 35% and probably luxation or fracture of the facets joints (anterior and posterior column).

All these elements denote injury to all three columns and consequently we have a highly unstable flexion-dislocation fracture. First of all axial traction should be applied in order to establish the alignment and this should be done under serial neurological examination to avoid overdistraction and worsen the neurological status. If reduction is successful only the anterior approach with microdiscectomy or if necessary vertebrectomy, and interbody fusion with graft and plate is needed. If unsuccessful there is evidence that circumferential stabilization through combined anterior and posterior approach is required for optimal results.<sup>8,9</sup>

- (a) Anterior discectomy under microscopic magnification should be performed as soon as possible to decompress the spinal cord.
- (b) Then the patient should be turned prone and an open reduction undertaken through a posterior approach with stabilization by lateral mass plates.
- (c) Subsequently she should be turned supine once more and an anterior interbody fusion at C6–C7 level undertaken with graft and plate.

#### Fourth opinion

C Park, MD

In cases of incomplete spinal cord injury, very early decompression by reduction of the dislocation and

removal of material compressing the spinal cord is very important. Although this patient came to the hospital 25 h after being injured, I would recommend that closed reduction with Gardner-Wells tong traction should be attempted in the emergency room and that the patient then be moved to the operating room in traction to minimize further injury. An anterior approach to remove disc material from the spinal cord and interbody fusion between C6–C7 with autogenous bone graft would be recommended. Because the vertebral bodies of C6 and C7 were not fractured, the grafted bone between C6 and C7 may have been stable, in which case the anterior plate and screw would not be recommended. If the grafted bone is not stable, then plate and screw fixation would be recommended. The patient would require a Philadelphia collar for postoperative immobilization. Rehabilitation would be started after surgery.

#### Fifth opinion

RL Waters, MD

The patient has sustained a bilateral facet dislocation evidenced by 50% anterior displacement of C6 on C7. This injury is highly unstable since the annulus, longitudinal ligaments and facet capsules are disrupted (unless there are associated facet fractures).

The majority of individuals with bilateral cervical facet dislocations sustain complete spinal cord injuries.<sup>10</sup> Since this injury is incomplete, it is important to perform rapid reduction and stabilization as soon as possible to decompress the cord and prevent secondary cord injury. Since this patient is only 25 h post injury, closed reduction is readily obtained applying longitudinal cranial traction in graduated incremental loads. My preference is to perform this procedure under fluoroscopic control with the patient awake under iv sedation titrated to relax muscle spasm. The awake patient serves as his own spinal cord monitor. Following reduction there are several options for immobilization. The patient can be placed in a halo-vest for several months. Although the halo-vest is non-invasive, disadvantages are the possibility of spontaneous redislocation or long-term instability.

In a series of patients evaluated for stability at long-term follow-up, a high percentage of patients sustaining bilateral facet dislocations treated by closed reduction and halo-vest immobilization had excessive intervertebral motion.<sup>11</sup> This was in contrast to other types of injuries such as unilateral facet dislocations and fractures of vertebral body which tended to spontaneously develop an auto-fusion that created an osseous bridge across the injured intervertebral segment. For these reasons, posterior fusion is the treatment of choice for most patients since it also obviates the need to wear a halo-vest facilitating the rehabilitation process when severe neurologic deficit is present.

## Sixth opinion

CH Tator, MD

My interpretation of this MRI is that there is almost certainly a herniated and sequestered intervertebral disc in the spinal canal at C6–C7 and that a significant amount of disc material has compressed the spinal cord. There is also significant cephalad migration of disc material behind the body of C6. We have not been told whether there is a dislocation of facets or whether there are any posterior fractures of the facet joints or laminae, and certainly one would want to obtain complete radiographic delineation of the injury preoperatively.

In our Unit, we prefer to obtain MR and CT scans prior to traction in order to detect space occupying lesions such as in this case. We would place a halo on the patient and institute 5 lbs traction after the imaging for immobilization on the spine and not for correction. We would not attempt reduction by traction in this case because of the known risk of deterioration during traction in the presence of a large space occupying lesion in the spinal canal such as a ruptured disc. This patient has an incomplete injury, and therefore it is important to decompress the cord quickly. Thus, we would perform surgery shortly after arrival in the hospital, even though 25 h have elapsed. We would not administer methylprednisolone because of the time interval that has elapsed. The anaesthetic induction would be by means of an awake endotracheal intubation, and the operation would be done on a turning table such as a Jackson OR table in the event that a posterior approach was also required. Initially, an attempt would be made to perform an anterior decompression, reduction and fusion. Posts would be placed in the body of C6–C7 and a distraction apparatus used to open the disc space sufficiently to allow removal of the disc totally at C6–C7 and a small amount of bone would be removed from the adjacent vertebral bodies to allow complete decompression and to facilitate fusion. Some levering of the vertebral bodies and some traction may be required in order to facilitate reduction following decompression in the event that the facets are locked and fractured. Autologous iliac crest bone graft would

be used and an anterior plating system would be applied (at this time we prefer the Codman system because of its better versatility than other systems). Unless the CT scan showed major fracturing posteriorly, we would probably not use a halo-vest postoperatively for continuing immobilization, but would use a firm plastic collar. In the absence of major fractures posteriorly, we would not add a posterior fusion. If there was any concern about stability we would use the halo-vest.

There is a reasonable chance that this patient would show neurological improvement postoperatively, even though the decompression was performed late.

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