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Clinical Article

Immediate open anterior reduction and antero-posterior fixation/fusion for bilateral cervical locked facets

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Summary

Background. Bilateral cervical locked facets is a severe traumatic lesion, most frequently resulting in tetraplegia. The common treatment strategy has been an attempt of awake, closed reduction, adding general anesthesia, muscle relaxation and manual traction in difficult cases. In cases of failed closed reduction, open reduction has most commonly been performed by a posterior approach. Patients in the current series have been managed by immediate open anterior reduction and circumferential fixation/fusion. The technique is described and its potential advantages are discussed.

Method. Five consecutive patients with traumatic bilateral cervical locked facets are reported. The injury level was C4/5 in one and C5/6 in four patients. Four patients had initial tetraplegia, one patient was neurogically intact. All patients underwent immediate open anterior reduction by interbody distraction and gentle manual traction, followed by circumferential fixation/fusion. Mean follow-up was 15 months.

Findings. Immediate anterior open reduction was rapidly and reliably achieved in all five patients. No surgical complication occurred. All patients showed fusion at the three-month follow-up. All four tetraplegic patients regained at least one functional root level, but remained tetraplegic.

Conclusion. Immediate open anterior reduction of bilateral cervical locked facets and combined antero-posterior fixation/fusion was safe and reliable. This treatment strategy avoids time loss and patient discomfort from attempted closed reduction by traction, obviates the need for external immobilization, and results in an excellent fusion rate.

Keywords: Cervical spine; cervical locked facets; facet dislocation; spinal reduction; spinal fusion.

Introduction

Traumatic bilateral locked facets is a rare lesion of the cervical spine, most commonly caused by motor vehicle accidents and most frequently affecting the levels C6/7 and C5/6 [10, 11, 14, 17, 20]. Anatomically, the inferior articular processes of the upper vertebra are moved upward and forward over the superior articular facets of the subjacent vertebra due to a severe hyperflexion trauma, most frequently causing tetraplegia [10, 14, 17]. Plain radiographs of the cervical spine show at least 50% anterolisthesis of the upper vertebra [17], computed tomography (CT) best assesses concommitant bony fractures [20]. Re-alignment by closed traction, followed by anterior, posterior or combined fixation/fusion has been the most common treatment [10, 11, 14, 17, 20]. Open reduction has been performed only after failed closed reduction [11, 14, 17, 20]. In the current article, the preliminary experience with immediate open reduction through an anterior approach and combined anterior and posterior fixation/fusion is reported and the advantages of this method are discussed.

Materials and methods

Five consecutive patients, four men and one woman, have been admitted at our institution during the past 3 years with traumatic bilateral cervical locked facets. The mean age was 55 years [48–66]. Cervical luxation was caused by a car accident in three cases, by a bicycle accident in one case, and by a fall from height in one case. Plain antero-posterior radiographs and cervical CT with sagittal and coronary reconstruction was performed in all patients and demonstrated bilateral facet locks at C4/5 in one patient and at C5/6 in the other four patients (Fig. 1). An associated cervical fracture was found in one patient in the form of a one-sided lateral mass fracture of the upper vertebra. Four patients had complete spinal cord injury grade A according to the ASIA classification [12]. The last neurologically intact level was C4 in the patient with the C4/5 luxation as well as in two patients with C5/6 luxation, and C5 in one patient with C5/6 luxation. One patient was neurologically intact ASIA E. All patients except for the neurologically intact one had received intravenous solu-medrol according to the NASCIC II study protocol [2] within 4 hours of the accident. One patient

Fig. 1. Lateral plain radiograph, showing a bilateral facet lock at C 5/6 in a 48 y old victim of a car accident with initial tetraplegia below C4

had a concommitant closed head injury with only a mild contusion, which did not need surgical intervention, and rib fractures, and one patient had a clavicular fracture. In the other three patients no relevant accompanying lesion was present. Patients were hemodynamically stabilized *and surgery was started within 8 hours from the accident in all patients with a range of between 5 and 8 hours.*

Patients were evaluated by neurological examination and plain radiographs postoperatively, at 3 months, and at a final mean follow-up at 15 months [6–24].

Surgical technique

A standard anterior approach to the cervical spine was performed first. After adequate exposure, vertebral body posts were inserted into the luxated and its subjacent vertebra, in a slightly divergent position. Opening of the vertebral body post distractor facilitated complete disc removal and opening of the often torn posterior longitudinal ligament. Attention was paid to remove all disc fragments with a blunt nerve hook posterior to the vertebral bodies prior to the reduction maneuvre. Then under lateral fluoroscopy, the main surgeon progressively compressed the tips of the vertebral body posts and applied progressive interbody distraction with a blunt interbody distractor, thereby disengaging and distracting the locked facets (Fig. 2). At the same time, the assistant surgeon added gentle bi-mastoid manual traction and a little bit of flexion. Manual pressure on the luxated vertebra was then applied and it regained its physiological position. With the blunt nerve hook, the anterior

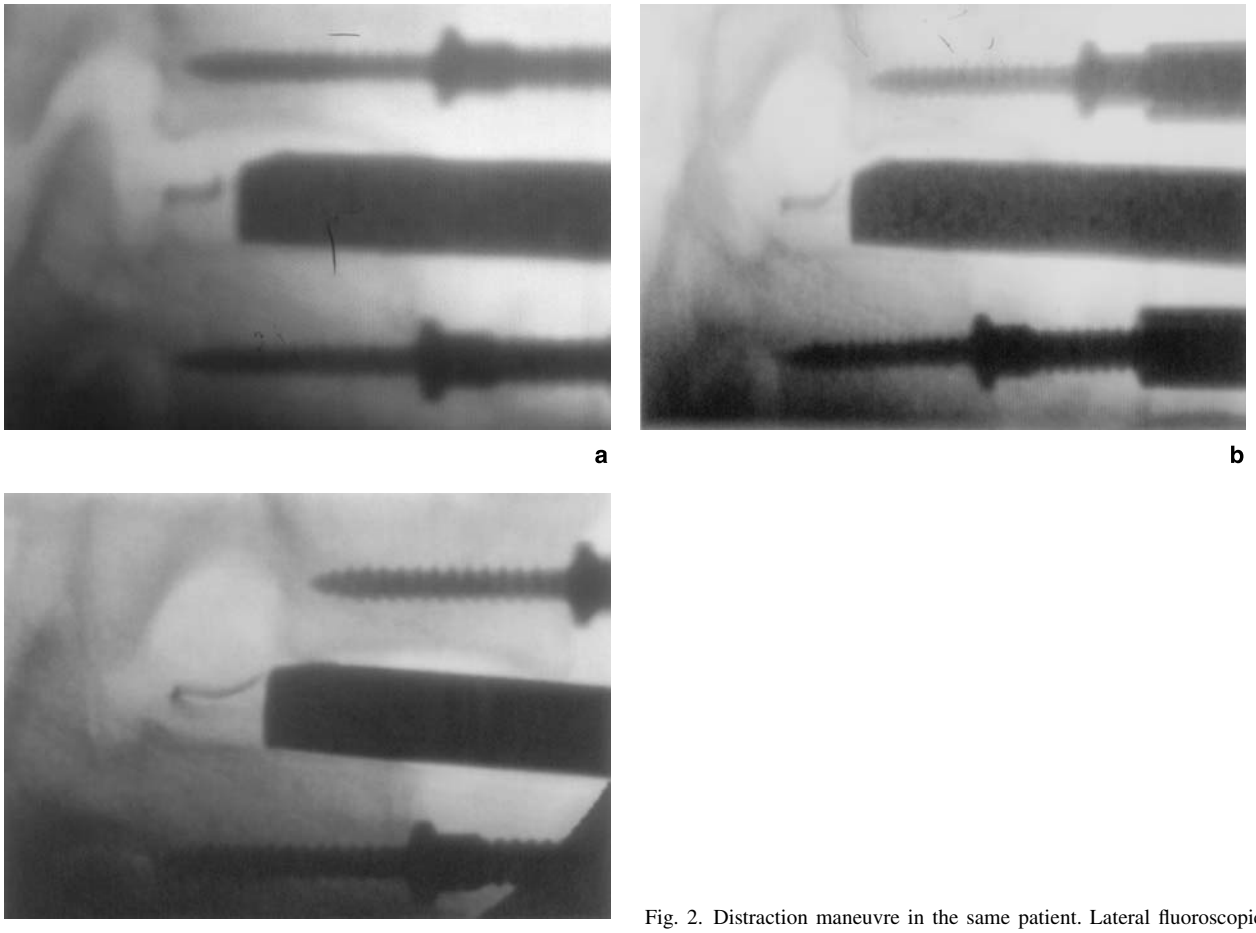

Fig. 2. Distraction maneuvre in the same patient. Lateral fluoroscopic images, documenting progressive distraction and reduction (a–c)

epidural space and neuroforamina were again checked for residual disc or ligament fragments, *reaching up and down from the disc to about 50% of the vertebral body height*. Anterior fixation/fusion was performed with an iliac crest autograft and a monosegmental anterior cervical plate.

Then the patient was turned into the prone position and a posterior fixation with lateral mass screws and rods was performed; fusion consisted of excising the articular cartilage and filling the articular gap with local bone from the laminae. No external immobilisation was applied.

Results

All 5 patients could be rapidly and safely reduced by the described anterior open technique. Anterior and posterior fixation/fusion was performed without technical difficulties. In the one case with an inferior lateral mass fracture, sufficient screw purchase was achieved in the uninjured cranial part of the lateral mass. No surgical or neurological complication was observed in this series. Complete postoperative re-alignment was achieved in all cases and maintained throughout the follow-up. Fusion occurred after 3 months in all patients, assessed by lateral radiographs as isodense bone bridging across the endplates (Fig. 3) and absence of motion on lateral flexion/extension views. No hardware failure was observed. At the 3 month follow-up and thereafter, none of the patients complained of relevant neck pain.

Functional motor and sensory recovery of the nerve roots exiting the foramina at the luxation level was observed in all tetraplegic patients in the postoperative period; both patients with C5/6 luxation and tetraplegia below C4 also regained the C5 level, and one patient regained perianal sensation and anal reflexes, but not bladder or bowel control. The neurologically intact patient remained so postoperatively.

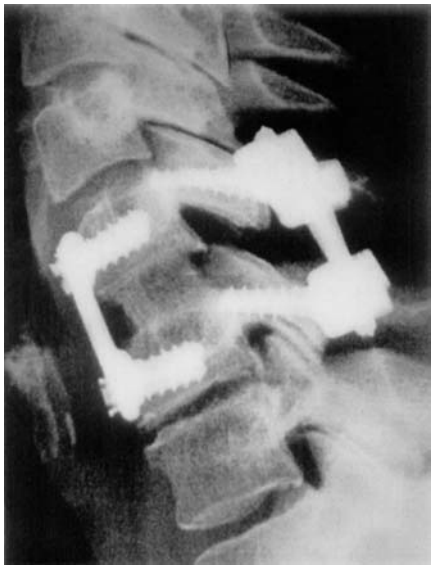

Fig. 3. 3-month follow-up plain lateral radiograph, showing maintained complete reduction and circumferential fixation with bony intervertebral fusion, with a tolerable slight overdistraction of the intervertebral space

Discussion

Bilateral cervical locked facets is a severe traumatic hyperflexion lesion with complete anterior and posterior discoligamentous instability [10, 14, 17]. Rupture or distension of the supraspinous, interspinous and yellow ligaments, the facet capsules, the posterior longitudinal ligament, annulus fibrosus and nucleus pulposus, and the anterior longitudinal ligament occurs [11, 14]. Adjacent fractures of the vertebral body, facet, lamina, pedicle, transverse or spinous process have been found in 38.5–60% [14, 20].

Lateral plain radiographs show an important anterolisthesis of the upper vertebra of usually at least one half of the vertebral body depth [17], 1 mm thin sectionned CT with sagittal reconstruction reveals the exact position of the facets, associated fractures and a possible traumatic disc herniation [20]. Magnetic resonance imaging (MRI) can best assess a possible traumatic disc herniation; the potential benefit from MRI information has been inconclusively weighed against the additional loss of time until starting closed reduction or surgery [4, 5, 7–9, 13, 15, 19]. In the current series, the retrocorporeal space was explored with a blunt nerve hook, reaching about 50% of the vertebral body height cranially and caudally from the disc; therefore preoperative MRI was not judged necessary in this technique. In this series, a traumatic disc herniation was found at the level of the disc in one patient, and in another patient one was luxated cranially about 30% of the vertebral body height.

Neurologically, patients with traumatic bilateral locked cervical facets presented with complete tetraplegia in 65%–87%, with incomplete spinal cord injury in 13–25%, and without spinal cord injury in 0–10% [17, 20].

Management of bilateral locked cervical facets is controversial. There are few articles focusing only on this pathology [10, 11, 14, 17, 20]. No evidence exists about benefit from rapid realignment/decompression and fixation, but this might be due to the rarity of focused investigations and the complete absence of prospective comparative studies. However, most authors agree that rapid realignment/decompression should give the patient the best chance for neurological recovery from spinal cord and/or nerve root compression [3, 11, 14, 17, 18, 20] or at least prevent progressive secondary spinal cord injury [10].

The most common form of treatment has been an attempt of awake closed reduction with skull tongs immediately after establishing the diagnosis, adding general anesthesia, muscle relaxation and manual traction in difficult cases, reserving open reduction for failed closed reduction. After successful reduction, surgical fixation/fusion is commonly performed by an anterior, posterior, or combined approach [1, 10, 11, 14, 17, 20].

However, closed reduction has several drawbacks. First of all, closed reduction fails in a substantial percentage of patients: using traction weights up to 2/3 of the patient's body weight and including all cases, where general anesthesia, muscle relaxation and manual traction was added, a total of only 91/121 patients or 75% of closed reductions were successful [10, 11, 14, 17, 20]. Failed closed reduction has been attributed to concomittant facet fractures, abandoning the procedure due to progressive neurological deficit during traction, and concomittant higher level non-contiguous cervical fracture [17]. Second, a traumatic disc herniation has been found in 10–80% of bilateral locked facets [4, 5, 15]. Even though statistically not assessed, closed reduction of a bilateral facet dislocation associated with disc rupture has been described to result in increased spinal cord compression and worsening neurological deficit [4, 16]. And finally, closed reduction obviously exposes the trauma patient to supplementary immobilization and pain.

Open reduction after failed closed reduction has most frequently been performed by a posterior approach [6, 11, 17, 20], less commonly by an anterior approach [11], with equal successful reduction and fusion rates of nearly 100%. However, a posterior open reduction bears the risk of decompensating a traumatic disc herniation; this seems to be a rare complication, but has been reported [5]. Ordonez reports the only series of direct anterior open reduction of facet dislocations without attempting closed reduction, including four bilateral dislocations [13]. His procedure is very similar to the one in the current report and was successful in all of his four bilateral dislocations. However, he did not use the adjunct of external manual traction, which was found very helpful in the current series by diminishing local bending and distracting forces with the vertebral body posts and interbody distractor. In his series, he did not use posterior fixation/fusion.

In the current series, immediate open anterior reduction without prior traction was rapidly and reliably performed. Good manual control was felt during the described reposition manoeuvre, avoiding abrupt spinal cord manipulation as well as overdistraction. However, it is important to underline that no relevant fractures were present at the injured levels in this series, which could make the reduction manoeuvre much more difficult. Ordonez reports the only other series of direct anterior open reduction of facet dislocations, which was successful in all of his four bilateral dislocations [13]; together with the current series, a total of 9/9 successful direct anterior open reductions is reported in the literature. Of course, more experience may change the success rate, and an important comminutive facet fracture with soft tissue interposition might be an obstacle to open anterior reduction. Careful preoperative facet fracture analysis on CT should be carried out, and the patient and medical team should be aware of the potential impossibility of achieving anterior reduction and of the necessity of performing an open posterior reduction instead.

No neurological worsening occurred and all patients improved at least one functional root level in the postoperative period. Preoperative MRI was not performed and was found to be unnecessary, since open reduction by the anterior approach gave excellent surgical control over the anterior epidural space. The combined anteroposterior fixation led to solid fusion at 3 months and obviated the need for external immobilisation.

From reviewing the literature and based on the preliminary experience with the above described technique, the current author concludes that immediate direct open anterior reduction and circumferential fixation/fusion of bilateral locked cervical facets could potentially be the first treatment choice in operable patients for the following reasons:

1. Rapid spinal realignment and spinal cord as well as exiting nerve root decompression can most reliably be achieved by immediate open reduction. Closed reduction on the other hand can be time consuming, has limited success, has been associated with neurological worsening due to overdistraction or decompensation of a traumatic disc herniation, and exposes the awake patient to considerable pain.
2. Anterior open reduction seems to be rapid, safe and reliable; discectomy and surgical exploration of the anterior epidural space probably eliminates the risk of aggravating a traumatic disc herniation during or after reduction.
3. Combined anterior and posterior fixation/fusion yields immediate stability and excellent fusion rates, obviating the need for external immobilisation.

Drawbacks of the current study are its limited number of patients and the lack of a control group. Creating such

a control group seems difficult, but gaining further experience with the described technique helps to corroborate its potential advantages or to detect possible drawbacks. On the other hand, a uniform technique has been applied by a single surgeon.

This study did not show and should by no means suggest that neurological recovery is more promising by the described technique than by the traditional awake closed reduction. And of course, immediate direct open reduction and circumferential fixation/fusion of bilateral locked cervical facets depends on the surgeon's availability and the patient's operability. In inoperable patients, closed reduction by traction remains the only therapeutic choice.

Conclusions

Immediate open anterior reduction and combined antero-posterior fixation/fusion for bilateral cervical locked facets has been successfully performed in five patients. This technique seems to have important potential advantages: immediate, safe and reliable spinal re-alignment and spinal cord and nerve root decompression; no time loss and patient discomfort from attempted closed reduction by traction; immediate postoperative stability without need for external immobilization; excellent fusion rate.

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Comments

The treatment of bilateral cervical locked facets continues to be controversial. In this paper, the author advocates immediate surgical intervention proceeding with an anterior procedure for decompression and reduction followed by posterior fixation. The author states that this treatment saves time and avoids patient discomfort from attempted closed reduction by traction.

This reviewer still favors closed reduction initially because it often can be performed quicker than open reduction. Once the patient is reduced, surgical intervention is warranted because these fracture-subluxations are extremely unstable. After reduction, the approach is dictated by the preoperative MRI. The presence of a bulging or ruptured disc indicates the need for an anterior approach. If no compression is anterior, the surgeon can choose between the anterior or posterior approach. This reviewer favors the anterior approach because the plate-screw system tends to fixate two columns. If reduction cannot be achieved within 8 to 12 hours, an open reduction is indicated. If the preoperative MRI shows an anterior herniated cervical disc, an anterior procedure is indicated followed by plating and fusion. Usually reduction can be performed from an anterior approach. If, however, reduction cannot be performed via an anterior approach, then the wound is closed anteriorly, a posterior reduction is performed, fusion is performed, and

then again an anterior fusion and plating is performed. If no anterior cervical disc herniation is present, a posterior approach is usually indicated for both reduction and fusion. It would be unusual to proceed with a 360-degree fusion in the routine patient.

The author, nevertheless makes a strong argument for his treatment strategy.

Volker K. H. Sonntag
Phoenix, Arizona

Dr. Payer presents an anterior technique for reducing dislocated cervical spine facet joints. He advocates an anterior technique which also permits removal of the intervertebral disc at the same procedure. As I understand it all of these five procedures were carried out within eight hours of the trauma.

The standard method of reduction using traction and if necessary proceeding to open reduction is relatively safe and successful. However, there is always an undercurrent of slight concern that any traumatic disc prolapse might be exacerbated and that secondary cord damage will ensue. It remains unclear whether there is valid concern over a pseudo-disc prolapse as opposed to an authentic traumatic herniated disc. To some extent however Dr. Payer's technique gets round this by removing the disc initially and relocating the facet joints anteriorly.

This is a technique which really only has a place in specialised spine units in order to validate its success and to identify those cases where there is fracturing of the facets that may resist this form of reduction.

I seem to recall about 25 years ago when reading through an orthopaedic text book seeing an illustration of a dislocated cervical vertebra being levered back into position via an anterior approach. Very little is truly novel.

R. A. Johnston
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