Management of unilateral cervical facet dislocations – a review of 49 cases

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Abstract

Study design: A retrospective study using prospectively collected data from 49 patients treated for unilateral cervical facet dislocations (UCFD) at the Groote Schuur Academic Hospital Acute Spinal Cord Injury Unit (GSH ASCI).

Objectives: To assess the outcome of unilateral cervical facet dislocations in this patient cohort with regards to stability, union, range of motion, neurology and related surgical complications. Pre-admission and in-hospital treatment is also reviewed.

Methods: The case files and X-rays of patients sustaining UCFD from July 2003 to July 2006 were reviewed. Clinical data was collected for all patients with adequate follow-up.

Background: The immediate and definitive management of unilateral facet dislocation remains controversial. The safety of rapid heavy weight closed reduction and the need for pre-reduction MRI studies continues to evoke debate among spinal surgeons. Different spinal cord injury units follow different protocols according to their personal experience and capabilities in their management of these potentially devastating injuries. The fact remains that the possibility for neurological injury exists however remote. Furthermore arguments can be made for both anterior and posterior fixation methods.

Results: Forty-nine patients, with average age of 37.5 years, admitted over a 3-year period into the GSH ASCI unit were reviewed. In this patient cohort results obtained with anterior cervical discectomy and fusion (ACDF) were favourable. A low surgical complication rate, hospital stay, and good structural and functional outcome were achieved. No neurological deterioration was seen in any patients.

Conclusion: In this unit early aggressive surgical management of UCFDs yield good results. Pre-reduction MRI is routinely obtained and ACDF is the preferred method of fixation in our unit. It allows for early mobilisation and commencement of rehabilitation. The average hospital stay is decreased and this results in cost-effective resource management.

Introduction

Cervical facet dislocations account for 6%-15% of cervical spine injuries and may be complicated by neurological compromise. There injuries are easily missed on initial assessment with potentially dire consequences.

Management protocols are diverse, ranging from closed reduction and non-operative immobilisation to open reduction and instrumented fusion. The chosen method is often based on locally available skills and resources.

The immediate and definitive management of unilateral facet dislocation remains controversial. The safety of rapid heavy weight closed reduction and the need for pre-reduction MRI studies continues to evoke debate, due to the remote possibility of iatrogenic neurological injury.

The study presents a case series of 49 patients with unilateral cervical facet dislocations (distraction flexion type 2 injuries) with reference to the early management and outcome.

Materials and methods

A database of all spinal injuries managed within the Acute Spinal Cord Injury (ASCI) unit is maintained. Prospective data is entered during the admission including epidemiological data, admission and discharge American Spinal Cord Injury Association (ASIA) neurological scores and surgical management. This database was interrogated for unifacet cervical dislocation (UCFD) cases and a retrospective review undertaken.
Only distraction flexion type 2 cases were collected and all cases with facet fractures excluded.

Forty-nine consecutively managed patients were identified from July 2003 to July 2006. The patient population consisted of 40 males and nine females with an average age of 37.5 (17.08-65.33 ± 11.25) years.

Case notes and X-rays were reviewed. The outcome with regards to stability, union, range of motion, neurology and related surgical complications was assessed. Pre-admission care and management was also reviewed. All patients came from the Western Cape referral area.

The majority of patients were initially treated at a peripheral hospital and then transferred to the ASCI unit as soon as a bed became available. Once admitted to the unit, patients were stabilised according to ACLS and ATLS principles. The following guidelines were followed in their initial management:

- In the Complete Spinal Cord Injury (SCI) patient or patients showing deterioration of neurology urgent closed reduction was attempted.
- In the Incomplete SCI patient, spinal cord immobilisation (low weight traction or rigid collar) was applied and MRI obtained urgently and these patients were taken to theatre for emergency anterior cervical decompression and instrumented fusion (ACDF).

The preferred method of stabilisation was anterior plating with an interbody autogenous iliac crest bone graft. The patient was positioned supine with Cones callipers in situ to assist intra-operative reduction. A standard Smith Robinson approach was used. Following complete discectomy, manual traction was applied via the callipers in slight flexion and the dislocation was reduced under vision using digital pressure on the cephalad vertebral body. Frequently a levering manoeuvre using a MacDonald or Cobb in the interbody space on the side of the dislocation was utilised to assist reduction (Cloward/reverse-Cloward manoeuvre). A palpable ‘clunk’ often accompanied reduction. This was confirmed clinically by the return of the lisheded body to the same level as the inferior body and radiographically with lateral fluoroscopy. When unsure, oblique views were utilised. With inferior dislocations (e.g. C6/7) in patients with large shoulders, visualisation could be a problem. Manual traction of the upper limbs did assist in some, but in some clinical assessment and the ‘best’ image picture used. Postoperative X-ray was then used for the final decision of reduction.

A wedge-shaped tri-cortical iliac crest graft was harvested and placed into the inter-vertebral space under slight distraction. Fluoroscopy was used to confirm the reduction and placement of the graft and instrumentation. The patient was immobilised in a Philadelphia collar and the cones callipers removed.

Patients were followed up to at least union. As is typical of trauma patients, many defaulted following removal of the collar once union was achieved. Bony fusion was assessed on standard lateral and flexion-extension views.

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**Figure 1: Level of injury**

No movement on superimposed flexion-extension views, cross-trabeculation of the graft-endplates and absence of peri-screws lucency were accepted as signs of fusion.

**Results**

The most common level of injury was C5/6 followed by C4/5 and C6/7 (Figure 1).

Motor vehicle accidents were the commonest cause (Figure 2).

The average delay before reaching our unit was 5.2 (0-72 ± 11.8) days. The delay was due to misdiagnosis in nine patients (18%).

Management in peripheral hospitals, prior to admission to our unit, consisted of successful closed reduction (protocol unspecified) (n=15), failed reduction with callipers and traction (n=5), and simple immobilisation (no attempted reduction) in a hard or Philadelphia collar (n=29).

On presentation to our unit the study population consisted of 15 reduced and 34 unreduced UCFDs. Management in the GSH ASCI unit consisted of immediate closed reduction in four cases followed by urgent ACDF. In the remaining 30 unreduced UCFDs reduction was attempted intra-operatively. Successful intra-operative reduction could be obtained in 28 cases (93.3%). The two failures were both late presenters.
Anterior followed by posterior, same-day surgery was done in one case that only presented after 72 days. Anterior reduction failed in this case and necessitated posterior reduction. The other case with residual facet subluxation also presented late (40 days).

The total number of patients to receive ACDF was 43. In 41 cases (95.3%) complete reduction could be obtained. The two with residual facet subluxation following ACDF were those delayed in presentation by 40 and 72 days respectively.

Of those reduced pre-theatre, 15 patients were reduced in the peripheral hospital and four cases reduced on admission to the ASCI unit. ACDF was done for 14 of these cases. Three posterior instrumented fusions were done by surgeons according to their personal preference. These patients had complete SCI. The remaining two patients were treated non-operatively with traction due to associated non-contiguous spine injuries preventing early mobilisation.

The average surgery time (incision to closure) was 119 (45-210 ± 40.1) minutes and the average estimated blood loss was 93.1 ml (0-200 ± 55.8).

The most common surgery-related complication was transient dysphagia (n=3), one of which was caused by iatrogenic oesophagus rupture that was repaired at the time of surgery. There were two cases of dysarthria, one wound haematoma, and one graft site pain. One wrong level surgery (posterior) was recorded.

Three patients died in the initial hospitalisation phase. One was a poly-traumatised patient who died due to his severe concomitant injuries. The second died from overwhelming septicaemia following a grade III open tibia fracture. The last patient, an HIV-positive C3 Complete SCI, died after longstanding multi-drug-resistant pneumonia and ventilator dependency.

An additional three patients died before 6 months follow-up. All their data was however available for analysis. The most common in-hospital complication was pneumonia (n=15). This was attributed to the lack of effective early chest physiotherapy in referring hospitals, leading to a high incidence of atelectasis in patients awaiting transfer. Four cases of ileus were noted and two incidences of unrelated septicaemia were recorded. One patient suffered a peptic ulcer perforation.

The average duration of stay in the ASCI unit was 19.4 days (3-73 ± 14.63). This may appear prolonged but there is a big step-down in medical care at the rehabilitation facility, and patients need to be completely stable before transfer.

Two-nine patients were discharged home, with the other 20 transferred to the Western Cape Rehabilitation Centre.

Complete follow-up could be obtained in 48 of the study population ranging from 8 weeks to 3 years (average 37.8-114.8 ± 28 weeks). One patient defaulted after 8 weeks.

Neurological deficit on presentation was present in 33 patients (67.3%). While 39.4% of these patients showed no neurological improvement, others displayed remarkable recovery during the hospitalisation phase, gaining an average of 15.8 (0-83 ± 21.27) ASIA motor points. Overall, the average ASIA Pinprick score improved from 77.1 (5-112 ± 42.7) to 85.5 (5-112 ± 39.5). The ASIA Light touch score improved from 77.4 (6-112 ± 38.7) to 86.8 (6-112 ± 38.7) and the motor score improved from 59.4 (0-100 ± 41.6) to 68.3 (0-100 ± 39.3). No neurological deterioration was noted in this study. In general most patients continued to improve after discharge.

Only two complications were noted at post-discharge follow-up. One screw violated the disc space and in the other, the plate stood proud inferiorly. Both these patients were asymptomatic and had a solid bony fusion. No further action was taken. No instrumentation failure or loosening was noted.

Bony fusion was confirmed in all but one patient (98%). The last patient defaulted after 8 weeks and no clinical problem was detected.

Range of motion were charted in 31 cases and recorded as follows: ‘very good’ results represented >75% flexion, extension and rotation; in ‘good’ outcomes >75% flexion and extension, and 50% rotation could be obtained; ‘poor’ results yielded less than 50% motion in all planes (Figure 3).

**Figure 3: Range of motion**
The posterior longitudinal (PLL), anterior longitudinal (ALL) and posterior inter-spinous ligaments (PIL) may also be involved depending on the severity of the injury. Disruption of these structures significantly contributes to the instability. Crawford, in cadaveric experiments, found that although UCFDs in the locked unreduced state were stable, they are inherently unstable in the reduced position. This is the basis of early surgical intervention.

Associated neurological injury can range from none to tetraplegia. This is usually caused at the time of the primary injury but may occur by persistent cord compression due to malalignment, soft tissue swelling, fracture fragments, or disc herniation. Cord oedema, hypoxia, and ischaemia within a constitutionally narrowed vertebral canal can also contribute further to secondary spinal cord damage.

Several other patient factors such as age, sex, level of injury, general medical status, the presence of other trauma, method of treatment (conservative or surgical) and steroid or NSAID use may also influence the final neurological outcome. Anatomical anomalies such as a congenitally narrowed canal or ossification of the PLL can also put the cord at risk even if there is not complete dislocation of the vertebra.

Anderson et al. reported on 45 patients with cervical facet dislocations (17 UCFD) and noted that in this complex clinical setting, defining definitive outcome measures is very difficult. They observed that an increase in age yields a significantly lower improvement in ASIA motor score if compared with younger patients.

The initial motor score was highly predictive of the final motor score (p<0.01). The time to reduction was not a significant predictor of recovery in their patient population. There have however been several reports to the contrary.

Disc herniation at the time of dislocation or after reduction remains one of the suspected causes for neurological deterioration. The significance of MRI features is difficult to interpret due to the abnormal dislocated anatomy, which explains the wide reported incidence of disc herniation of 18-100%. Vaccaro et al. defined a disc herniation in the dislocated spine as a protrusion of material with a signal consistent with nucleus pulposis, posterior to the vertical line drawn along the posterior cortex of the caudal vertebra of the affected segment. The degree of disc herniation could not be correlated with neurological deficit. Post-reduction disc herniation varies between 9-77. No clinical association between the disc herniation and neurological outcome has been shown.

Plain radiographic imaging (X-rays) remains the first line investigation and often all that is available in the primary care setting. Woodring and Lee reviewed 216 patients with cervical injuries and found 23% of these patients cervical spine X-rays were falsely reported as normal. Half had unstable cervical injuries. Braakman and Vinken also reported a staggering 48% misdiagnosed UCFD in their series. In our series of 49 UCFD, 18% accounted for injuries misdiagnosed at primary care level.
With this high ‘miss rate’ for correctly identifying UCFD on plain X-ray, care must be taken not to view the radiographs without clinical correlation. Any symptoms of neck, shoulder or arm pain/paraesthesia should be viewed with a high index of suspicion and repeat, careful review of the X-rays. The features are usually present, simply overlooked.

The lateral X-ray must be scrutinised for the disruption in the posterior body line and the characteristic ‘bow tie’ sign, the facets delineated. Divergence of the spinous processes on the lateral X-ray can also alert the clinician to possible fracture or dislocation. A difference in the height of the disc space at different levels should also be viewed with suspicion (Figure 4). Loss of spinous process alignment on the AP must be looked for. Oblique views may also be of assistance. All findings must be clinically correlated with each patient (Figure 5).

Computer tomography (CT) has become a standard of care and can be used effectively in demonstrating fractures and dislocations in UCFDs. The ‘reverse hamburger bun’ and ‘naked facet’ have been well described by Daffner et al and CT reconstructions make visualising the pathology in 3D easy (Figures 6-9).

MRI allows the visualisation of ligamentous, disc, cord and bony injury (Figures 9,10). The use of pre-reduction MRI is still a matter of dispute and mostly relates to the incidence and clinical relevance of disc injury after UCFD, as well as the availability of the imaging modality.

The time delay before reduction or decompression is the subject of debate, with the speed of closed reduction versus the risks of secondary cord injury. Traditionally closed reduction has been performed with proponents for rapid heavy weights and slow lower weights. The rationale behind these closed reduction protocols remains the early reconstitution of the normal vertebral canal, thereby preventing further neurological injury. Authors advocating this approach feel that closed reduction in the awake, co-operative patient is safe and yields improved neurological outcome. No class one studies to support this have been forthcoming. The force needed for reduction of a UCFD has been shown to be significant. Cotler et al showed a 100% reduction rate in nine UCFD using up to 63 kg during AHWR. Jacobs needed an average of 34 kg (23-50 kg) to reduce the six UCFDs in his series, and attributed the higher failure rate in series by O’Brian, Hadley and Torg to the use of inadequate weight.

In the case of UCFD the canal diameter is not usually severely compromised as in the case of a bifacet dislocation. This may obviate the need for immediate reduction. Closed reduction carries risk as reported by Mahale et al. Nine cases of late onset neurology followed attempted closed reduction (6-48 hrs). This was attributed to cord oedema within the confined space of the canal. Of this group, five patients suffered immediate paralysis during an attempt at reduction, most probably due to acute compression and injury to the cord.
Further investigations done to determine the exact cause of the cord injury confirmed the presence of disc herniation in two patients. The remaining seven patients in their study deteriorated after surgical intervention. Robertson and Ryan also reported on three cases of late onset neurological deterioration ranging up to 72 hours after intervention. In all these cases extruded disc material was the cause of the cord compression.

Fehlings et al conducted an extensive review of the literature dating from 1966 to 2001. They concluded that:
- There are no standards (Class 1 evidence) regarding the role and timing of decompression in acute SCI.
- Class 2 evidence exists proving that surgery can be safely undertaken in patients with acute SCI.
- Class 3 data supports the urgent reduction for patients with bilateral cervical facet dislocations and urgent decompression for patients with deteriorating neurological status.

Fehlings et al also reviewed 585 cases of attempted closed reduction and documented an 8.1% incidence of neurological deterioration during these attempts.

ACDF has gained much popularity in recent years. The ease of patient positioning, straightforward surgical approach and low morbidity associated with this procedure makes it an attractive option for treatment of UCFDs.\[34-38]\n
It also has the advantage of addressing any disc elements that may be compressing the cord, thus reducing the risk of post-reduction disc herniation.

Failed open anterior reduction is rare and usually occurs in patients with delayed surgery of more than 10-14 days. In our series 100% of acute UCFDs could be reduced intraoperatively. Our failures were in late presenters.

Anterior cervical discectomy and fusion has been reported as a satisfactory form of treatment in a number of studies.\[39-42]\n
The use of allograft and autograft as an intervertebral spacer has also yielded similar good results.\[43,44]\n
Although biomechanical studies have shown the superiority of posterior fixation over anterior fixation, the anterior fixation still yields a construct of stability superior to that of the normal spine.\[45]\n
We have found this an extremely useful technique allowing the intra-operative reduction of the unifacet dislocation under controlled conditions with the application of minimal force to the affected level. It also obviates the risk of post-reduction disc sequestration and possible neurological deterioration.

Comparative studies evaluating anterior and posterior surgery have been undertaken. Capen et al\[46]\n
noted a higher incidence of kyphosis in the anterior treated patients but modern locking plate fixation was not used in his study. Brodke et al\[47]\n
concluded in his randomised study of 43 patients that no statistical difference in fusion rate, kyphosis, neck pain, hardware failure, or neurological outcome could be shown. In a randomised study by Keynan et al\[5] the posterior surgery group had a significantly higher incidence of infection. The anterior group had a higher incidence of dysphagia.

The ease of patient positioning, straightforward surgical approach and low morbidity associated with ACDF makes it an attractive option for treatment of UCFDs.
Combination anterior and posterior surgery is seldom indicated in the acute scenario, but may be useful in the case of failed anterior open reduction in the late presenter.

Conclusion

There are many options in the early management of cervical unifacet dislocations and the choice is often based on local medical resources. We have found early aggressive surgical intervention by means of anterior discectomy, open reduction and instrumented fusion to provide a high incidence of safe reduction and subsequent union.

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References


