Spinal Trauma Management Update

UNILATERAL FACET DISLOCATIONS AND FRACTURE-DISLOCATIONS OF THE CERVICAL SPINE: A REVIEW

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ABSTRACT

Unilateral facet dislocations or fracture-dislocations of the cervical spine constitute an important subgroup of cervical spine injuries. According to the literature, the diagnosis of this entity is often missed and the treatment is controversial. On the basis of our patient review, we conclude that operative intervention appears superior to nonoperative treatment of these injuries. Nonoperative management is often fraught with inability to obtain and maintain anatomic reduction and, in addition, late pain and instability frequently ensue. Alternatively, operative intervention provides the greatest probability for achieving and maintaining anatomic reduction and appears to eliminate chances of late symptoms.

The cervical spine supports the head, allows complex motion, and protects the neural elements. Injuries to this area can be quite devastating, resulting in significant morbidity and mortality. Dislocations and fracture-dislocations in adults in the region of C3 to C7 account for most cervical spine injuries. Unilateral facet dislocations or fracture-dislocations represent an important subgroup of cervical injuries.

There are many classifications of cervical spine injuries. According to the comprehensive mechanistic scheme of Allen et al., unilateral facet dislocations and fracture-dislocations result from a distraction-flexion force and have a spectrum of injury from posterior ligamentous complex failure with interspinous widening (distraction-flexion stage 1 [DFS1]) to bilateral facet dislocation with gross instability and greater than 100% vertebral body displacement (DFS4); unilateral facet injuries account for DFS2. It certainly would appear that for unilateral facet injuries to occur, some degree of rotational force has to accompany the distraction-flexion force.

Cervical spine injuries tend to occur in high-energy mishaps, and unilateral facet injuries are no exception. Several authors have found that motor vehicle accidents are the leading cause of unilateral facet dislocations and fracture-dislocations. It appears also that the lower cervical spine, specifically C5-6 and C6-7, is injured most frequently.2-4

DIAGNOSIS

Unilateral facet injuries are notorious for being diagnosed late. In Braakman and Vinken’s series, the lesion was diagnosed more than 2 weeks after the injury in 15 of the 35 patients. Likewise, Rorabeck et al. found a 40% incidence of late diagnosis (12.5 days). This delay in diagnosis is likely due to three factors.

The first factor is inadequate radiographic evaluation. Minimal radiographic evaluation should include a full cervical spine series, with care to ensure that all levels, especially C7 to T1, are seen. The top of T1 must be visualized, which may require a special technique such as a swimmer’s view. Because of the association of facet fractures, tomography or computed tomography may be helpful as well. Typical

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radiographic findings with unilateral facet dislocation include anterior subluxation of one vertebral body to the one below of less than half the anteroposterior (AP) dimension of the body, as seen in a lateral radiograph (Fig 1). On this lateral view, one may also see a "bow-tie sign" secondary to body and facet rotation, and overlap that gives the appearance of a bow tie. The AP view shows a spinous process displacement toward the side of dislocation. Oblique views usually show the facet dislocation, and may show an associated facet fracture.

The second factor in delayed diagnosis is associated injuries, which may lead the physician's concern away from the cervical spine.

The third factor is the lack or paucity of symptoms associated with unilateral facet dislocation or fracture-dislocation. Frequently, the patients have no neurologic deficit or have only an isolated radiculopathy that may be overlooked in a cursory examination. Of additional concern with cervical spine trauma is the possibility of multiple non-contiguous spinal injuries. Studies of this phenomenon found incidences in the range of 4% to 8%, therefore, close scrutiny is required in the radiographic evaluation to determine if a multiple-level injury has occurred. Evaluation of the thoracic and lumbar portions of the spine as well may be indicated clinically.

The stability of the cervical spine is maintained by many structures, including the various groups of intervertebral ligaments and disks, the surrounding musculature, and the anatomy of the joints themselves. Beatson thought that disruption of the interspinous ligament and facet capsule could allow unilateral facet dislocation with minimal damage to the annulus and posterior longitudinal ligament. White et al. did important experimental work to evaluate cervical stability. According to their work, sagittal translation greater than 3.5 mm or sagittal angulation of more than 11° denotes instability.

Certainly, clinical factors also can be used in estimating stability after unilateral facet injury. An associated facet fracture may decrease the bony stability obtained by reduction. The difficulty of reduction may indicate the degree of instability. Unilateral facet injuries that reduce easily may be due to minimal subluxation or only perching, or may be secondary to significant ligamentous disruption, resulting in increased instability. A final instability factor is neurologic injury. Greater displacement would result in the potential for greater neurologic damage. Thus, there may be instability in patients with a partial or complete cord lesion.

**TREATMENT**

The goals of treatment of unilateral facet dislocations and fracture-dislocations are primarily preservation of the functional and anatomic continuity of the spinal cord and nerve roots, restoration of spinal canal alignment to relieve neural compression, establishment of spinal stability to provide freedom from postinjury pain or delayed neurologic problems and, finally, quick restoration of the highest functional level consistent with the patient's neurologic condition. How best to achieve these goals is a controversy in the literature.

There are two phases in dealing with these injuries. The first is reduction of the subluxation. This is followed by immobilization during the healing period. Weighted cervical skeletal traction with pure axial loading or with mild cervical flexion is the method most commonly used at this time. Open reduction is reserved for instances in which closed reduction fails or in which early decompressive surgery is required because of neurologic deterioration. For postreduction immobilization, halo thoracic devices and internal fixation are the two choices.

The current literature is not entirely clear about the best way to deal with unilateral facet injuries. One body of literature suggests that nonoperative treatment is adequate. Beatson showed that dislocations could be left in an unreduced position with minimal or no symptoms. Braakman and Vinken found that there was a tendency toward spontaneous stabilization whether or not reduction was carried out. Cheshire found the late instability rate (7.3%) to be acceptable. Cotler et al. reported that closed reduction was safe and effective.

On the other hand, one can find evidence in the literature that contradicts all of the above. Rorabeck et al. found that pain developed late in dislocations left in a displaced position. In
addition, spontaneous fusion after injury occurred in only 20% of the patients in their series. These results indicated that spontaneous fusion was neither predictable nor able to prevent late pain. Donovan et al. [14] found progressive deformity to be a problem after flexion-distraction type injuries. O’Brien et al. [13] reported a late instability rate of 20% after closed treatment of these injuries. This late instability may be due to inadequate immobilization by the halo jacket apparatus and subsequent insufficient ligamentous healing. In biomechanical studies of the halo apparatus, Koch and Nickel [15] found retention of 31% of the normal AP motion in the cervical spine while the patient was in the apparatus. This motion was most pronounced in the middle and lower cervical spine.

Both Rorabeck et al. [14] and Bucholz and

Cheung [16] discovered that unilateral facet injuries were quite difficult to treat in a closed fashion. They found that axial halo traction was inadequate for obtaining closed reduction and had high failure rates.

**Mayo Clinic Experience**

Because of the contradictions in the literature, we reviewed the experience with unilateral facet injuries at our institution between 1975 and 1986. The 36 patients with such injuries identified had a mean age of nearly 33 years, and most were male. As in other series, the main mode of injury was motor vehicle accidents, and a significant number had a delay in diagnosis (one third
in our series; mean: 8 days). Most of our patients presented with an isolated radiculopathy or with no neurologic deficit. The most frequent levels of injury were C5-6 and C6-7, and about half the patients had associated facet fractures.

Thirty-four of the 36 patients were available for follow-up—24 in the nonoperative group and 10 who were treated surgically. The mean ages were comparable in both groups; the mean follow-up was nearly 9 years in the nonoperative group and 6½ years in the surgical group. Over the study period, nonoperative treatment was the norm in the early years and operative treatment became more frequent later. This change may reflect a trend toward aggressive surgical management of unilateral facet injuries at our institution.

Treatment methods in the nonoperative group were attempted reduction by weighted axial traction followed by external immobilization in 19, simple use of a cervical orthosis in 4, and no treatment in 1.

In the operative group, the indications for surgical treatment were persistence or progression of neurologic deficit and failure to achieve or to maintain reduction. Treatment involved open reduction through a posterior approach, foraminotomy if deemed advisable, and posterior fusion with interspinous or facet joint wiring, usually at one level and rarely at two levels (Figs 2-3). Interspinous wiring was our choice of fixation in the majority of patients. Facet wiring was used in addition to interspinous wiring late in our series and is now our standard fixation method because it provides insurance against resubluxation.

Halo traction was not very satisfactory as a means to obtain closed reduction. There was outright failure to achieve reduction in 25% of the cases, and in only a third of the cervical spines was anatomic reduction achieved. There was no correlation between failure to obtain anatomic reduction and presence of a facet fracture.

Manipulative closed reduction was attempted in only one patient. This closed reduction technique is not our standard practice. Satisfactory fusion was achieved in all patients treated operatively. About half the patients in the nonoperative group had spontaneous fusion. Anatomic reduction was achieved more frequently with operative intervention (60% operative reduction vs 25% closed anatomic reduction, \( P = .052, \chi^2 \) analysis). Patients in whom anatomic reduction was not achieved had residual subluxation or angular deformity or both.

Cervical translation at or adjacent to the injury level was observed on flexion-extension lateral radiographs more frequently in patients treated nonoperatively than in those treated operatively (38% vs 20%; not statistically significant). Cervical translation was associated with nonanatomic reduction—either operatively or nonoperatively. This result suggests that nonanatomic reduction predisposes to potential instability (\( P < .03, \chi^2 \) analysis). Peculiarly, this was observed more commonly at a level other than the level of the injury, a finding not reported before. This cervical translation, which appears late, might be related to altered biomechanics at the levels adjacent to the injury level in 10 patients in the nonoperative group who had significant complaints of pain and stiffness and in nine who had nonanatomic alignment, cervical translation, or both.

From a strictly clinical standpoint, the patients treated operatively did better and had significantly fewer complaints of pain and stiffness than did those treated nonoperatively (10% vs 42%; not statistically significant). In general, neurologic symptoms tended to resolve, but
resolution happened more frequently and more readily in patients treated operatively. Nonanatomic alignment and cervical translation appeared to predispose to more clinical complaints.

CONCLUSION

From our study we concluded that: 1) halo traction appears to be inadequate for obtaining and maintaining anatomic reduction in unilateral facet injuries; 2) nonanatomic reduction might predispose to dynamic cervical translation at follow up, and this could progress to frank instability (because the patients who have these injuries often are young, this possibility is of concern); 3) nonanatomic reduction and cervical translation are associated with late pain and stiffness; and 4) the best means for obtaining anatomic reduction and maintaining it is operative intervention.

Thus, our current attitude is to treat these injuries by early surgical reduction, wiring, and fusion. If a radicular deficit is associated, this therapeutic approach is combined with a foraminotomy over the appropriate nerve root.

REFERENCES