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Anterior displacement correlates with neurological impairment in cervical facet dislocations

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Abstract We studied all patients with either unifacetal or bifacetal dislocations treated in our National Spinal Injuries Unit between January 1996 and December 2000. There were 25 cases, of which 13 were unifacetal and 12 bifacetal. Craniocervical traction was employed in 21 cases and closed reduction achieved in 11. Eighteen patients underwent surgical stabilisation. Traction weights of up to 36 kg were employed, but there was no relationship found between the level of dislocation and traction weight. Anterior translation was measured by a newly described method, and we found a statistically significant correlation between the neurological score on admission and the degree of anterior translation.

Résumé Nous avons étudié tous les malades avec une luxation uni ou bi-articulaire du rachis cervical traités dans notre Unité entre janvier 1996 et décembre 2000. Il y avait 25 cas, 13 uni-articulaires et 12 bi-articulaires. La traction craniocervicale a été employée dans 21 cas et la réduction fermée accomplie 11 fois. 18 malades ont eu une stabilisation chirurgicale. La traction jusqu'à 36 kg a été employée mais il n'y avait aucun rapport entre le niveau de luxation et l'importance de la traction. La translation antérieure a été mesurée par une méthode récemment décrite et nous avons trouvé une corrélation statistiquement significative entre le score neurologique à l'admission et le degré de cette translation.

Introduction

The management of facet dislocation in the cervical spine is varied. The main principles of treatment in the presence of neural compression are to reduce anatomic malalignment urgently, preserve neurologic function, prevent spinal deformity, and enhance neurologic recovery [21]. Traditionally, facet dislocation injuries have been treated with weighted craniocervical traction, which was first introduced by Crutchfield [6]. Manipulation under anaesthesia has been advocated by some authors [2, 3, 5, 10, 12, 15], and open reduction methods have been well described [20]. Doubt exists regarding the significance of pre-injury spinal canal diameter. Several authors have reported the protective effect of a larger canal from neurological injury [8] whilst others have found no relationship [14]. Methodology for assessing spinal canal diameter has been standardised following introduction of the ratio method by Torg [26].

It seems obvious that the greater the anterior translation that occurs in cervical facet dislocations the more severe the neurological impairment that should occur. There have been several studies on sagittal measurements of the cervical spine in traumatic injuries, but we found no previous studies correlating the anterior translation with a neurological score. In 1971, Burke and Berryman [3] stated "one of the puzzling features is the lack of correlation between vertebral displacement and severity of spinal cord trauma". With this statement in mind, we performed a review of our experience at a national spinal unit in treating cervical facet dislocations over a 5-year period. In addition to examining radiographic and clinical parameters, we assessed the use of weighted cervical traction over the same period.

Materials and methods

A retrospective audit of patient data for all patients admitted to the National Spinal Injuries Unit (NSIU) between January 1, 1996 and December 31, 2000 with facet dislocations, either unifacetal or

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Fig. 1 **a** Lateral cervical spine radiograph illustrating the method used for determining the ratio of translation (A/B) in a patient with bifacetal dislocation at the C5/6 level. **b** Antero-posterior cervical radiograph of the patient in **a**. Note the normal alignment of the spinous processes. **c** Lateral cervical spine radiograph of the patient in **a** and **b** following application of craniocervical traction with 25 lb. Perched facets are illustrated. **d** Lateral cervical spine radiograph of the patient in **a-c** showing reduced cervical dislocation. **e** Lateral cervical spine radiograph illustrating unifacetal cervical dislocation at the C5/6 level. **f** Antero-posterior cervical radiographs of the patient in **e**. Note the deviation of the C5 spinous process (arrow)

bifacetal, was performed. Patients were identified from a computerised database run by the NSIU of all patients treated for spinal injuries. Data was collected under the headings of age, sex, mechanism of injury, neurological deficit, pattern of dislocation, level

of injury, use of traction, method of reduction and follow-up results. Only patients with radiographic evidence of facet dislocation were included. The admission protocol to our unit mandates a full neurological examination and the completion of the American Spinal Injuries Association (ASIA) form. Axial-weighted craniocervical traction is applied in the presence of cervical spine malalignment as part of the treatment protocol. ASIA scores were recorded for all patients prior to admission, following any intervention and at regular follow-up. The amount of skeletal traction applied was recorded, as was the efficacy of achieving reduction. Any surgical intervention during acute treatment or in subsequent follow-up was noted.

Initial cervical spine radiographs were examined, and anterior translation measured on lateral views. This was expressed as a ratio A/B, where A is the amount of anterior displacement measured in millimetres from the anterior border of the undisplaced lower vertebrae to the anterior cortex of the translated vertebral body (Fig. 1). The mid-sagittal diameter (B) of the undisplaced verte-

bral body was measured in millimetres. This ratio accounted for any effect of magnification in non-standardised trauma lateral cervical radiographs.

Results

Of the 25 patients during the study period, 23 were men and two women. Average age was 40 (17–75) years. Mechanism of injury was a fall or a motor vehicle accident in the majority of cases. There were 13 unifacetal and 12 bifacetal dislocations. Dislocation levels are shown in Table 1, with C5/6 being the most common level. Most patients with unifacetal dislocation escaped neurological injury. However, three patients in this group had motor deficits, of which one (with a C5/6 dislocation) had a profound impairment with an ASIA motor score of 13/100 on admission. By contrast, patients with bifacetal dislocation had severe motor impairments with an average ASIA motor score of 22/100, with nine having complete deficits. No patient with bifacetal dislocation in this study escaped neurological injury.

Craniocervical traction via MRI-compatible Gardner-Wells Tongs (GWT) was employed in all but four cases, and weights were recorded in 15. Maximum weight used was 36 kg; reduction was achieved in 11 cases. Traction resulted in an increase in neurological impairment in one patient that resolved with reduction of axial weight. There were no other complications associated with the use of traction or GWT. Presentation was delayed in five cases from 5 days up to 4 months post-injury. Of these five cases, traction was employed for those dislocations less than 2 weeks old; however none were reducible by traction. Surgery was undertaken in 18 cases – 12 were treated by posterior fusion alone and six had anterior surgery. There was one two-stage procedure and one three-stage procedure.

The amount of anterior displacement on the lateral radiograph was measured and presented as a ratio over the mid-vertebral diameter of the level below the dislocation. There was a linear relationship (R^2 0.4478, p =0.0033) between the amount of displacement and neurological impairment, as measured by the ASIA score on admission (Fig. 2).

The amount of traction used varied from 4.5–36 kg. There was no statistically significant relationship between weight and level found in this series. The amount of anterior translation in cases of unilateral dislocation as

Fig. 2 American Spinal Injuries Association (ASIA) score versus degree of vertebral displacement

measured by the ratio method ranged from 0.2 to 0.4 and in bilateral cases ranged from 0.3 to 0.8.

Discussion

In 1940, Crutchfield introduced the use of weighted craniocervical traction to reduce subluxations of the cervical spine. Since then, it has been customary to apply skeletal traction via skull tongs according to 'Cruthfield's Rule'. This implies the application of traction based on an estimate of 10 lb for head weight and an additional 5 lb for each cervical vertebral level involved in the dislocation, starting with the atlas [16]. Several authors have advocated the use of heavy weights to achieve reduction [4, 13, 25] which otherwise may not have been effected by adherence to Cruthfield's Rule. There is, however, potential for spinal cord impingement from an unrecognised prolapsed intervertebral disc following vertebral realignment [19]. The incidence of acute disc herniation at the level of injury in patients with flexion-distraction injuries is reportedly between 54% to 80% [22]. It has been argued that pre-reduction MR imaging be obtained prior to any attempt at closed reduction in cases of facet dislocation [9, 11, 22]. However, its availability may delay reduction, and should a prolapsed disc be identified, reduction may be further delayed pending appropriate surgery [28]. In the absence of neurological deficits, timing of any realignment procedure is less urgent.

Manipulation under anaesthesia (MUA) has been advocated by several authors [2, 3, 5, 10, 12], particularly due to the muscle relaxant effects achieved. Others have condemned this practice [7, 24], as there is a potential risk of further cord injury in an unmonitored spinal cord. It has not been our practice to perform MUA for this reason. In addition to pharmacological treatment to patients with cervical spinal cord injury [18], we advocate weighted craniocervical traction to realign cervical spine dislocations.

Unifacetal dislocations in our series were always displaced less than 50% of the diameter of the unaffected vertebra as seen on a lateral cervical radiograph. Beatson [1] found that half or greater antero-posterior vertebral

Table 1 Dislocation levels

Cervical level	Number of patients
C2/3	1
C3/4	1
C4/5	5
C5/6	11
C6/7	5
C7/Th1	2

body displacement forwards on the lateral film always indicated bilateral dislocation. In our series, bilateral cases had translation ratios from 0.3–0.8. Neurological impairment is inevitably more severe with bilateral facet dislocations but can be significant in cases of uniaxial dislocation. One patient in this category in the present series had a profound deficit. O'Brien [17] found complete quadriplegia in 20% of his patients with uniaxial dislocation.

The use of a ratio to eliminate magnification between different lateral radiographs is not new. The use of a ratio to describe the sagittal diameter of the spinal canal to the sagittal diameter of the mid-vertebra was reported by Torg [26]. This allows for standardisation of values regardless of the target distance of the radiograph. Other parameters that have been applied to lateral cervical radiographs include the disc height ratio [23] and the vertebral body overlap ratio [27]. However, to date, we have found no reports correlating neurological impairment with the degree of vertebral alignment. Our data shows there is a relationship, which is linear.

In summary, we reviewed a cohort of patients with cervical facet dislocations and described a new ratio method for measuring vertebral translation. We found a statistically significant correlation between neurological impairment on admission, as measured by the motor component of the ASIA score, and anterior translation, as measured by our ratio method.

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