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Auto-Decompression - Preserved Neurological Function in Bilateral Cervical Facet Dislocations

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Abstract

Introduction

Bilateral cervical facet dislocation (BCFD) is an uncommon injury with a high incidence of severe neurological impairment. We describe 4 cases of BCFD with preserved neurological function.

Cases

Case 1: A 78-year-old female who suffered two ground level falls (GLFs). Pre-operative American Spinal Injury Association (ASIA) Score was C5D. Imaging revealed a BCFD at C6/C7 and a C6 laminar fracture.

Case 2: A 63-year-old male suffered a fall down 14 steps. Pre-operative ASIA score was E. Imaging demonstrated a BCFD at C7/T1, and a C6 laminar fracture.

Case 3: A 46-year-old male collided with a tree while descending a hill on a bicycle. Pre-operative ASIA score was C6D. Imaging revealed a BCFD at C7/T1 and a C7 laminar fracture.

Case 4: A 67-year-old male suffered a GLF while exiting a stationary car. Pre-operative ASIA score on admission was E. Imaging revealed a BCFD at C6/C7 with bilateral laminar fractures at C5 and C6.

Outcome

All cases underwent 2-stage surgical fixation. All cases maintained or had an improved ASIA score post-operatively.

Conclusion

In all cases, the presence of concurrent laminar fractures resulted in an auto-decompression of the spinal canal, preserving neurological function

Keywords: Cervical spine, spinal trauma, bilateral cervical facet dislocation, auto-decompression, spinal cord injury, ground level fall

Introduction

Cervical spine fractures account for 19% of all spinal fractures.[1] Of these fractures, bilateral cervical facet dislocation (BCFD) is a uncommon injury accounting for 4% of all acute traumatic cervical spine injuries[2] leading to significant mechanical instability, such as anterolisthesis.[3] This injury pattern typically affects young men in the subaxial region, most commonly at the level of C6/C7.[2-5] BCFDs commonly occur secondary to a high energy force with a hyperflexion component, with or without rotation.[2-5] These injuries typically follow road traffic or diving accidents.[2-4] Unfortunately, these injuries are associated with a high incidence of severe neurological disability [2-5], with the degree of anterior displacement correlating with degree of paralysis.[6]

From August 2018 to June 2019, four consecutive cases of BCFD with minimal or no neurological deficits were treated at the National Spinal Injuries Unit (NSIU) in the Republic of Ireland. These four cases are illustrated below.

Case Reports

Case 1

A 78-year-old woman with Parkinson's disease suffered two unwitnessed ground level falls (GLFs) over 48 hours. The first fall occurred while the patient was turning in the kitchen, which caused her to fall back and hit her head on a countertop. The second fall occurred a day later, while hanging clothes on a washing line. She reported losing balance, falling forward onto outstretched hands and hitting her head on the ground. The second fall precipitated cervical and upper thoracic pain. On reporting her symptoms to relatives 2 days later, an ambulance was called and she was brought to her local emergency department. On arrival, she reported mobilising independently for the previous 2 days and had no loss of consciousness. Her Glasgow Coma Score (GCS) was 14 and she had no neurological deficits. Full spinal precautions were applied, before transfer to the NSIU was arranged for definitive management. Neurological assessment on arrival revealed an American Spinal Injury Association (ASIA) Score of C5D with reduced sensation in a left sided C6 and C7 distribution.

Initial plain film radiographs failed to reveal any spinal injury. Computed tomography (CT) (Figure 1) and magnetic resonance imaging (MRI) demonstrated a BCFD with an Allen and Ferguson Stage 4 dislocation at the level of C6/C7. There was an associated C6 laminar fracture.

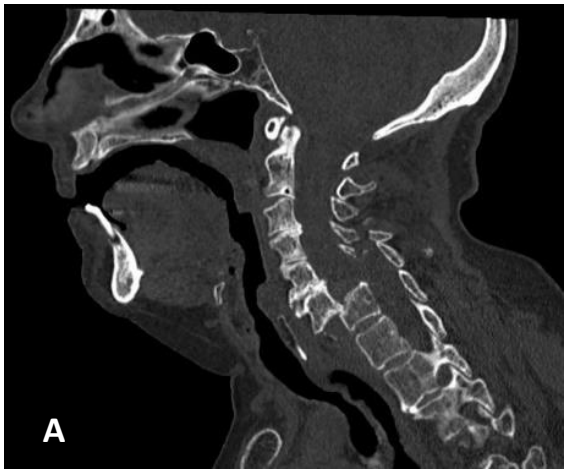

Figure 1: CT imaging for Case 1. A) Sagittal CT demonstrating a fracture-dislocation at C6/C7.

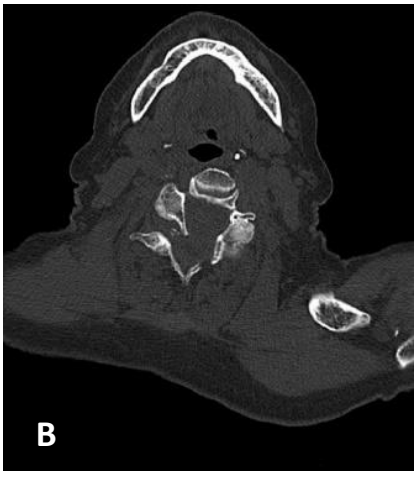

Figure 1: CT imaging for Case 1. B) Axial CT demonstrating overlapping posterior elements due to an associated laminar fracture, resulting in spinal canal enlargement at the site of potential cord compression.

Case 2

A 63-year-old man suffered an unwitnessed fall down approximately 14 steps secondary to alcohol intoxication. Following his fall he stood up independently, walked to his bed and fell asleep. On waking the following morning, he was unable to rise from bed secondary to severe neck pain. He was brought to his local emergency department by ambulance. On arrival he had a GCS of 15, lower cervical spine tenderness and a laceration to his forehead, but no neurological deficits. He was transferred to the NSIU for operative management. Pre- operative examination confirmed no neurological compromise (ASIA E).

Plain film radiographs on presentation yielded inadequate views of the cervical spine. A swimmer's view highlighted discontinuity in the anterior spinal line. Subsequent CT and MRI imaging demonstrated an Allen and Ferguson Stage 4 dislocation at C7/T1. There was significant disruption of the discoligamentous complex with tearing of the anterior and posterior longitudinal ligaments, disc substance, ligamentum flavum and facet joint capsule. There was a concurrent laminar fracture of C6 and spinous process fractures of C6 and C7. The spinal cord was shown to be acutely deviated, however, there was no spinal cord compression.

Case 3

A 46-year-old man lost control of his bicycle while descending a hill at high speed (~50 kph). He collided with a tree with the vertex of his head before falling from his bicycle. He was wearing a helmet and his bike sustained significant damage. He stood up independently and reported an immediate feeling of cervical instability, with neck and interscapular back pain. There was no reported loss of consciousness. He was brought by ambulance to a local emergency department. Initial clinical examinations demonstrated a GCS of 15 and no neurological deficits. He was transferred to our institution for operative management. His neurological injury was classified as C6 ASIA D secondary to decreased sensation in a left sided C7 and C8 distribution.

A CT scan, following non-diagnostic plan film radiographs in an outside institution, and subsequent MRI demonstrated an Allen and Ferguson Stage 3 dislocation at C7/T1, superior endplate fracture of T1 and spinous process fractures of C5-7. There was also a concurrent C7 laminar fracture with a traumatic dural tear, but no identifiable spinal cord injury.

Case 4

A 67-year-old male lost his balance while exiting a stationary car, secondary to alcohol intoxication. He fell forward and struck the frontal aspect of his head on an adjacent concrete windowsill. He denied any loss of consciousness. Following his fall, he continued to mobilise independently and work as a bus driver for a subsequent 17 days before presenting to his General Practitioner (GP) with a new onset of paresthesia in his left second digit. A collateral history from his daughter revealed that he had been mobilising and carrying out activities of daily living in a position of maintained cervical spine flexion. Following examination by his GP, he was transferred by ambulance to a local emergency department. Emergency department examinations revealed a GCS of 15 and no neurological deficits. He was transferred to the NSIU for definitive management. His pre-operative ASIA score was ASIA E.

Plain film radiographs failed to reveal any significant spinal injury. Focused CT and MRI demonstrated a high grade anterolisthesis at C6/C7 with concurrent bilateral laminar fractures at C5 and C6. MRI delineated an acutely deviated course of the spinal cord through the zone of injury, with no evidence of cord oedema. Additional injuries included a burst fracture of the vertebral body of C7, anterior wedge compression fractures at T1 and superior endplate fractures at T2-3. Ligamentous injuries included posterior longitudinal ligament and ligamentum flavum disruption at C6-7.

Results

All cases underwent closed cervical traction and reduction on admission to the NSIU (Figure 2). This was followed by definitive surgical fixation using an anterior and posterior approach (Figure 3). Case 1 and Case 3 had an improved

post-operative ASIA score. ASIA scores for Case 2 and Case 4 did not deteriorate post-operatively. Results are summarised in Table 1.

Figure 2. Lateral plain film cervical spine radiographs for Case 1 with closed cervical traction in situ. Traction magnitude increases from left to right, with progressive reduction of the dislocation.

Figure 3. Post- operative plain film radiographs for Case 1 following C6-T1 ACDF and C4-T2 PCDF.

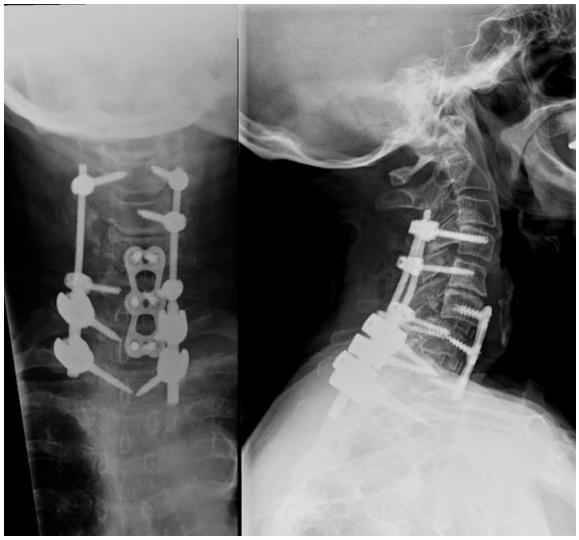

Table 1. Case Series Summary

Case	Sex	Age	Mechanism	Level of BCFD	Pre-op ASIA	Operation (1^{st}/2^{nd} Stage)	Post-op ASIA
1	F	78	GLF	C6/C7	C5 D	C6-T1 ACDF/ C4-T2 PCDF	E
2	M	63	High Energy Trauma	C7/T1	E	C6-T1 ACDF/ C5-T2 PCDF	E
3	M	46	High Energy Trauma	C7/T1	C6 D	C4-T3 PCDF/ C7/T1 ACDF	C8 D
4	M	67	GLF	C6/C7	E	C7 Corpectomy, C6-T1 Anterior Fusion/ C5-T2 Posterior Fixation	E

Abbreviations: BCFD, Bilateral Cervical Facet Dislocation; GLF, Ground Level Fall; ACDF, Anterior Cervical Discectomy and Fusion; PCDF, Posterior Cervical Decompression and Fusion.

Discussion

The cervical spine is the most vulnerable portion of the spine to be injured during trauma, with the cervical spinal cord accounting for 75% of cases of traumatic spinal cord injury (SCI).[7] BCFD typically results in major spinal cord injury due to significant encroachment of the spinal canal. This occurs as the inferior articular facet of the superior vertebrae displaces over the superior facet of the subadjacent vertebrae causing dynamic spinal canal narrowing and resultant cord compression.[8] Previous studies describing BCFD, with or without fractures, have demonstrated that between 52-87% have complete neurological impairment below the affected level.[2, 4, 5, 9] Previously, a limited number of single patient case reports have described BCFDs of the cervical spine with minimal or no neurological deficits.[10-13] In each of these reports there was concurrent posterior element fractures, which was postulated to functionally enlarge the spinal canal preventing SCI. In all four cases presented here, the spinal cord was significantly displaced due to anterolisthesis of the segments at the level of the fracture-dislocation. Despite this displacement, fracture of the posterior elements allowed the spinal canal to be auto-decompressed without any significant SCI.

Weingardt and Rogers[9] specifically addressed the hypothesis that posterior element fractures at the level of a BCFD could auto-decompress the spinal canal, circumventing spinal cord injury. In their cohort no significant correlation was demonstrated between neurological outcomes and associated posterior element fractures during BCFD. However, the cases examined in their retrospective study predated the widespread use of MRI. Additionally, CT was available for less than half of the cases included. Future research should address the correlation between posterior element fractures identified using modern imaging protocols and neurological outcomes in BCFD.

All of our patients underwent cervical spine radiographs during their initial assessment. In each case, these failed to reveal any significant pathology due to inadequate visualisation related to overlying soft tissue shadowing. BCFDs were only revealed on subsequent CT imaging. The poor diagnostic accuracy of radiographs and their poor correlation with CT imaging in the setting of cervical spine trauma is previously well documented.[14-16] Given the catastrophic consequences of missing a cervical spine injury, clinicians should maintain a high index of suspicion of cervical spine insult despite the absence of neurological deficits and identifiable injury on radiographs, in the setting of trauma.

All patients had an uneventful post-operative recovery. Additionally, each of the two patients who had an incomplete spinal cord injury demonstrated an improved post-operative ASIA score. The management of cervical fracture-dislocations at our institution follows a standardised approach, with cervical traction and closed reduction over 24 hours. This is followed by definitive surgical fixation via a two- stage procedure using an anterior and posterior approach. The use of early cervical traction in cervical fracture-dislocations to reduce the injury and decompress the spinal cord, prior to definitive surgical fixation has been demonstrated to be a safe and effective method to achieve closed reduction and improve neurological outcomes[17]. Additionally, a recent systematic review demonstrated that earlier surgical fixation may reduce the incidence of post-operative complications and improve neurological recovery following traumatic spinal fractures[18].

Finally, it is well established that BCFDs most commonly occur secondary to high energy trauma among young males.[2-4]However, the incidence of cervical fractures following ground level falls (GLFs) among the geriatric population is significantly increasing[19]. When specifically examining BCFDs among geriatric patients, Lieberman and Webb[20] demonstrated that 66% of their cohort sustained these injuries following falls in the home. Interestingly, both geriatric patients in this case series (Case 1 and 4) sustained their injuries following a GLF. Despite this innocuous injury mechanism, geriatric patients who sustain cervical spine fractures following GLFs demonstrate relatively high 30-day mortality (13-28%) and readmission rates (31-50%) and have a high rate of dependent discharge (53-55%)[21]. Furthermore, care of the geriatric trauma patient is associated with significantly higher costs[22]. These poorer outcomes and associated costs have significant resource implications, particularly regarding management and preventative strategies. Previously, Matsushima et al.[23] has demonstrated improved outcomes among trauma centres treating a higher volume of geriatric trauma patients. Furthermore, fall prevention interventions can significantly reduce the incidence of GLFs in older adults[24], which may circumvent their associated morbidity and mortality.

In conclusion, these cases illustrate that BCFDs can have a varied mechanism of injury, present within a heterogeneous patient cohort and disclose themselves emergently after relatively benign emergency department presentations. In all cases, the presence of concurrent laminar fractures resulted in an auto-decompression of the spinal canal. Such fracture characteristics and spinal canal enlargement at the zone of injury created space posteriorly for the spinal cord to manoeuvre, preserving neurological function. These findings demonstrate the need to maintain a high index of suspicion for unstable cervical spine injuries following trauma despite the absence of significant neurological deficits.

Declaration of Conflicts of Interest:
The authors have no conflict of interest to declare.

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