

Clinical Study

Traumatic subaxial cervical facet subluxation and dislocation: epidemiology, radiographic analyses, and risk factors for spinal cord injury

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Abstract

BACKGROUND CONTEXT: Distractive flexion injuries (DFIs) of the subaxial cervical spine are major contributors to spinal cord injury (SCI). Prompt assessment and early intervention of DFIs associated with SCI are crucial to optimize patient outcome; however, neurologic examination of patients with subaxial cervical injury is often difficult, as patients commonly present with reduced levels of consciousness. Therefore, it is important to establish potential associations between injury epidemiology and radiographic features, and neurologic involvement.

PURPOSE: The aims of this study were to describe the epidemiology and radiographic features of DFIs presenting to a major Australian tertiary hospital and to identify those factors predictive of SCI. The agreement and repeatability of radiographic measures of DFI severity were also investigated.

STUDY DESIGN/SETTING: This is a combined retrospective case-control and reliability-agreement study.

FDA device/drug status: Not applicable.

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The disclosure key can be found on the Table of Contents and at www.TheSpineJournalOnline.com.

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PATIENT SAMPLE: Two hundred twenty-six patients (median age 40 years [interquartile range = 34]; 72.1% male) who presented with a DFI of the subaxial cervical spine between 2003 and 2013 were reviewed.

OUTCOME MEASURES: The epidemiology and radiographic features of DFI, and risk factors for SCI were identified. Inter- and intraobserver agreement of radiographic measurements was evaluated.

METHODS: Medical records, radiographs, and computed tomography and magnetic resonance imaging scans were examined, and the presence of SCI was evaluated. Radiographic images were analyzed by two consultant spinal surgeons, and the degree of vertebral translation, facet apposition, spinal canal occlusion, and spinal cord compression were documented. Multivariable logistic regression models identified epidemiology and radiographic features predictive of SCI. Intraclass correlation coefficients (ICCs) examined inter- and intraobserver agreement of radiographic measurements.

RESULTS: The majority of patients (56.2%) sustained a unilateral (51.2%) or a bilateral facet (48.8%) dislocation. The C6–C7 vertebral level was most commonly involved (38.5%). Younger adults were over-represented among motor-vehicle accidents, whereas falls contributed to a majority of DFIs sustained by older adults. Greater vertebral translation, together with lower facet apposition, distinguished facet dislocation from subluxation. Dislocation, bilateral facet injury, reduced Glasgow Coma Scale, spinal canal occlusion, and spinal cord compression were predictive of neurologic deficit. Radiographic measurements demonstrated at least a “moderate” agreement ($ICC > 0.4$), with most demonstrating an “almost perfect” reproducibility.

CONCLUSIONS: This large-scale cohort investigation of DFIs in the cervical spine describes radiographic features that distinguish facet dislocation from subluxation, and associates highly reproducible anatomical and clinical indices to the occurrence of concomitant SCI. © 2017 Elsevier Inc. All rights reserved.

Keywords: Cervical facet dislocation; Distractive flexion injury; Epidemiology; Radiographic analysis; Risk factor; Spinal cord injury

Introduction

Subaxial cervical spinal cord injury (SCI) is one of the most devastating injuries in medicine [1]. In Australia, 50% of traumatic SCIs reported in a 2008 cohort resulted in 136 cases of tetraplegia, amounting to annual personal care costs of approximately AUD\$14.6 million [2]. Patients with subaxial facet dislocations present with the most severe neurologic deficit [3], resulting in tetraplegia in up to 87% of cases [4–8]. Rapid reduction is crucial, particularly in patients with a bilateral facet dislocation and a significant neurologic deficit [3]. Despite potentially devastating consequences, the spectrum of traumatic subaxial cervical facet subluxation and dislocation, herein termed distractive flexion injuries (DFIs) as described by Allen et al. [9], is significantly understudied.

Allen et al. describe four radiological stages of DFI: Stage 1, flexion sprain; Stage 2, unilateral facet dislocation; Stage 3, bilateral facet dislocation with up to 50% translation; and, Stage 4, bilateral facet dislocation with up to 100% translation [9]. Complete neurologic injury occurs more frequently following a bilateral facet dislocation [9], but by no means is this certain. Newton et al. advocates reduction of cervical facet dislocation within 4 hours of injury to prevent permanent neurologic damage following low-velocity trauma [10]. Although there is no consensus on the optimal surgical management of low- or high-velocity trauma [1,11–19], in the case of SCI, prompt assessment and early intervention are crucial to optimize patient outcome [4,10,20,21].

The literature pertaining to DFI comprises only small-cohort studies reporting radiographic features [5,9,22–27] or

the clinical outcomes of surgical or medical interventional treatment methods [3,4,14,28–34]. Notably, there have been no large-scale cohort investigations of DFI, with or without concomitant neurologic deterioration, reported. In relation to clinical assessment, the neurologic examination of patients with subaxial cervical injury is often difficult, as patients commonly present with reduced levels of consciousness [35,36]. Therefore, it is important to establish potential associations between injury epidemiology and radiographic features, and neurologic involvement. Furthermore, although qualitative radiographic analysis of cervical vertebral alignment is routinely used to provide an indication of injury severity, it is not known which (if any) of the proposed quantitative radiographic measures of subaxial spine trauma [37] are predictive of neurologic deficit. The interobserver agreement and the intraobserver repeatability of quantitative radiographic measures have not been reported for DFI.

The primary aims of the present study were to describe the epidemiology and the radiographic features of DFI in patients presenting to a major Australian tertiary hospital over a decade, and to identify which of these variables are risk factors for SCI. A secondary aim was to investigate the agreement and the repeatability of several quantitative radiographic measurements of subaxial cervical trauma severity in the context of DFI.

Methods

Research Ethics Committee approval was granted for the present study (Reference No. HREC/14/RAH/154). All patients

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