Unstable Cervical Spine Fracture in a Surfer Presenting as Concussion With Associated Low Grade Neck Pain: A Case Report

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ABSTRACT

Objective: The purpose of this study is to describe the evaluation and management of a surfer who presented with concussion-like symptoms and was eventually diagnosed with an unstable cervical spine fracture.

Clinical Features: A young man presented to a chiropractic clinic 5 weeks after a surfing injury. He had mild lower cervical spine pain and complaints of cognitive disturbance. He was previously evaluated by his primary care provider who diagnosed cervical sprain and strain injuries. There was no prior imaging or follow-up concussion management.

Intervention and Outcome: After a history, exams were performed of the cervical spine, thoracic spine, shoulder, and head, including a modified Sport Concussion Assessment Tool, Third Edition, concussion evaluation. Cervical spine radiographs were taken, which demonstrated a right C6 pillar fracture grade 2 anterior spondylolisthesis. These findings were confirmed with a CT scan. The patient was referred to an orthopedic spine specialist for further consultation, which resulted in cervical fusion of the C6/7 motor unit.

Conclusion: The use of clinical guidelines for head and neck injury assisted in the appropriate management of this patient with cervical spine injury presenting with concussion symptoms. (J Chiropr Med 2019;18:48-55)

Key Indexing Terms: *Spinal Fractures; Spondylolisthesis; Chiropractic; Neck Pain*

INTRODUCTION

Concussion is a form of mild traumatic brain injury (mTBI) that has gained increased public awareness especially in sport. The consensus statement of the international conference in Zurich (2012) defined concussion as “a complex pathophysiological process affecting the brain, induced by traumatic biomechanical direct or indirect forces with rapid onset of short-lived symptoms and impairments, largely functional, with spontaneous resolution (in most cases) and normal neuroimaging studies.”¹ Concussive symptoms can appear to be mild, but if inappropriately managed, can lead to significant, long-term impairment in physical, cognitive, and psychological functioning.² Leading causes of concussion and other mTBI outside of sport include falls, motor vehicle collisions and assaults.³ Common symptoms include headache,

nausea, dizziness, visual disturbances, difficulty concentrating, emotional irritability, and sleep difficulties. Other than headache, however, pain symptoms are not associated with mTBI itself and are likely to be caused by injury to a separate region such as the cervical spine.⁴

The frequency of cervical spine injury associated with concussion is high in sports such as football and rugby.⁵ More than half of catastrophic injuries in sports are cervical spine injuries.⁶ Axial compression with the neck flexed, such as spear tackling in football, transmits the load to the bones and discs, potentially causing fracture, dislocation, and even spinal cord injury.⁷ Cervical spine injury is one of the most common problems encountered in chiropractic clinics.⁸ Acute neck pain is often associated with recent injury to the neck, head, or face.⁹ Other common sports injuries that can cause axial compression to the head include tackling sports such as rugby, diving injuries in swimming, and power maneuvers in wrestling. Surfing can also be dangerous because of the possibility of impacting with the seafloor, which is the most common form of spinal injury while surfboarding.¹⁰

The most common symptom associated with cervical spine injury is neck pain.¹¹ Neck pain is a common health problem for patients seeking care from chiropractic clinics.⁸ The degree of pain, however, is not directly correlated to the severity of injury, and undetected pathology such as fractures and dislocations can be missed owing to the lack of relative

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symptoms.¹² Proper workup including a complete history and exam is essential to appropriate management and to avoid exacerbation of an undetected pathology during treatment.¹³ The Hippocratic oath needs to be honored; it is important for the clinician to first do no harm. Although patients often present seeking relief from pain and discomfort, any and all serious diagnoses must first be ruled out before care is initiated.

The purpose of this case study is to report a patient who presented to a chiropractic clinic after initial evaluation by his primary care physician for a head injury. The individual presented without clinical signs of an unstable cervical spine fracture and spondylolisthesis.

CASE REPORT

A 26-year-old male patient presented to a chiropractic clinic 5 weeks after a surfing accident in which he impacted headfirst into the sand. Initial symptoms were severe neck pain, and the patient was unable to move the head without hand or arm assistance because of the pain. According to the patient, he was initially evaluated by his primary care physician who diagnosed him with cervical sprain and strain injuries and prescribed pain medications, which the patient refused by personal choice. Pain symptoms gradually improved over the first 4 days without intervention, but then plateaued over the next several weeks.

When the patient presented for a second opinion 5 weeks later, his concerns were primarily achy, tension-type pain in the lower neck (the patient described a “sensation similar to hamstring tightness”) along with a separate sensation of head fog, but there was no headache or pain. The primary purpose of the visit was the patient’s request for postconcussion syndrome workup. The visual analog scale pain rating was scored as 4 of 10 (moderate). The patient scored 22.5 on the Functional Rating Index, a questionnaire rating the level of pain-related cervical disability.¹⁴ This score is suggestive of moderate pain-related disability. A Modified Pain Catastrophizing Scale was used to screen for anxiety and depression with negative findings.¹⁵ A review of systems, past family, and social history screenings were unremarkable with no significant issues relevant to the chief complaint.

The patient was well nourished and muscular, and had an active lifestyle of surfing and Krav Maga style martial arts, which he performed at least 5× a week. During the patient history, he questioned whether he could return to these activities with his symptoms. The patient had returned to work as a house cleaner since his surfing accident. This occupation required long hours of varying levels of strenuous activity including lifting, carrying, moving, and reaching; however, these did not aggravate his condition.

Physical Exam

At the time of exam, the patient did not display signs of acute distress. For the area of chief complaint, the patient

pointed to the central cervicothoracic junction and slightly inferior through the interscapular region. Visual postural assessment showed a generalized forward head carriage with rounded shoulders and hunched posture. Palpation revealed no specific soft tissue or bony tenderness throughout the cervical and thoracic spine. A slight prominence of the C7 and T1 spinous processes was noted. Mild spasm and hypertonicity of the bilateral mid- and lower cervical paraspinal musculature was present without tenderness to palpation.

Active ranges of motion examination were measured with a goniometer and demonstrated right cervical rotation limited by 25° (65° right vs 90° left) with stiffness but no pain. Passive right rotation was also limited by 25° with a stiff end feel. All other directions were within normal limits and nonpainful. Thoracic segmental motion was stiff, but active range of motion of the thoracic and lumbar spine was within normal limits and nonpainful.

Orthopedic examination including compression and distraction tests, spinal percussion, and vibration of the spinous processes was negative. Nerve tension signs including upper limb tension of the median and ulnar nerves and shoulder depressor tests were also negative. Neurological exam including cranial nerves, myotomes, dermatomes (upper and lower extremity), deep tendon reflexes (upper and lower extremity), and upper motor neuron lesion testing were all within normal limits. Manual muscle testing was 5 of 5 bilaterally and pain free throughout the upper and lower extremities. Dynamometer testing showed unaffected grip strength (averaging 78 lbs on the right and 73 lbs on the left). Concussion status was assessed using a modified Sport Concussion Assessment Tool, Third Edition (SCAT 3) exam. The SCAT 3 was the current version available at the time of patient intake, and the SCAT 5 has since been published and used. The results were:

- Number of symptoms: 6 of 22
- Severity of symptoms: 11 of 132
- Cognitive/standardized assessment of concussion: 27 of 30
- Neck examination: positive for midline pain and limited range of motion
- Balance examination (tandem gait): 15.2 seconds
- Coordination score (1 of 1)

The patient was diagnosed with postconcussion syndrome and cervical sprain and strain injuries. However, cervical spine fracture was also on the differential diagnosis list, and treatment for these injuries was deferred owing to the serious nature of the potential cervical fracture and so additional imaging was taken to rule this out.

Management and Outcome

A 4-view weight-bearing cervical spine radiograph series consisting of lateral, anteroposterior lower cervical,

and bilateral oblique views was obtained. The lateral cervical projection (Fig 1) demonstrated a grade 2 anterior spondylolisthesis of C6 over C7 with significant loss of disc height at that level. Cervical oblique projections (Fig 2) showed evidence of right C6 pillar fracture with resultant rightward rotation of the superior spinous processes and rotational offset of the right facets from C2 to C6.

The fracture was identified as an unstable fracture, and the patient was immediately placed in a hard cervical collar. He was promptly referred to an orthopedic spine surgeon for further evaluation, who then requested a STAT computerized axial tomography scan to confirm the fracture. Computed tomography imaging (Fig 3) revealed an unstable comminuted fracture of the right C6 lateral mass and lamina with 4-mm anterolisthesis of C6 on C7.

The orthopedic spine surgeon recommended cervical fusion surgery, which was performed 10 days after our initial visit (Figs 4 and 5). Postoperative rehabilitation was managed by his physical therapist. As of 1 year postoperation, the patient had been cleared to return to all activities, including work, surfing, and Krav Maga. His only limitation was to avoid activities that require body weight bearing on the head and neck (ie, headstands, bridges). All symptoms, including neck pain and brain fog, were resolved. The patient provided consent to publish this case report.

DISCUSSION

An appropriate cervical spine examination is an essential component of care for individuals who present with histories of substantive head trauma. The spinal examination is part of both the initial survey during emergency care and during follow-up assessment such as concussion evaluation. The cervical spine examination is highlighted in the SCAT assessment highlights and includes range of motion, tenderness (palpation) findings, and upper and lower limb sensation and strength testing. Physical examination, including cervical musculoskeletal evaluation, is an essential part of any acceptable evidence-based concussion evaluation and must be performed alongside the mental status evaluation.¹⁶ Many injuries to the cervical spine can cause clinical manifestations and symptoms that are similar to those of concussion, and so it is important to include proper cervical spine examination not only to rule out serious pathology such as cervical spine fracture or spinal cord injury, but also to distinguish if symptoms are cervicogenic rather than intracranial in nature.^{17,18}

The clinicians in this case used the SCAT 3 in a modified format and were not performing an on-field or sideline assessment. Normally, the first 2 portions of the SCAT 3 include a Glasgow Coma scale and Maddocks Score questionnaire—which are not necessary for a patient walking

Fig 1. Lateral cervical radiograph showing a grade 2 anterior spondylolisthesis of C6 over C7 with loss of disc height at that level.

Fig 2. Cervical oblique radiograph showing evidence of right C6 pillar fracture with resultant rightward rotation of the superior spinous processes and rotational offset of the right facets from C2 to C6.

into and conversing in an office setting. As it is intended, the SCAT 3 is a standardized tool to help evaluate athletes for concussion, and it is understood that this is performed after a complete initial survey of the entire body has been completed to rule out any necessary emergency or first aid care.¹⁹ Only after all apparent head, neck, spine, and body trauma have been evaluated and determined to not require emergency transport or immediate treatment are concussion assessment tools used as a part of the return-to-play guidelines.

Surveys of clinicians who evaluate and manage concussions, including pediatricians, emergency medicine physicians, and neurologists, show that most either do not follow any published concussion guidelines or did not receive or remember any formal training on sports-related concussion.²⁰ Health care providers who are not properly trained in the evaluation and management of concussion are placing athletes and patients in increased danger. This includes the failure to diagnose initial pathology and the risk for additional and potentially more serious injury from failure to remove from play.

Spinal fracture was undiagnosed during the initial evaluation and management of this case. A high index of suspicion must be maintained after a history of trauma. It is the authors' opinion that images would have been warranted owing to the severe level of pain and the Rust's Sign (grasping of the head with both hands to

support the weight of the head on the cervical spine). However, medical records were not available for review to verify the patient's presentation at the time of evaluation. The clinician can only perform due diligence with his or her own full workup, regardless of any previous evaluation. The mechanism of injury in this patient was a headfirst impact into the sand, which mimics the type of high-risk axial compression similar to spear tackling in football.⁹ The patient presented to our office several weeks after his acute bout with pain, with significantly improved symptoms and a high level of confidence in his primary care physician ruling out any severe pathology. It was not until the patient's improvement plateaued that he considered obtaining a second opinion. Interestingly, the patient presented with more concern for his head-fog symptoms, which he attributed to a self-diagnosed postconcussion syndrome, rather than his neck injury. The timing was crucial because he was planning on returning to Krav Maga martial arts where he would have been in danger of a devastating complication. Despite the lack of symptomatology, radiographs were taken to rule out fracture or dislocation. In this case, an unstable cervical spine fracture and spondylolisthesis was revealed in a patient without clinical signs of serious injury.

Several clinical prediction tools have been created that are designed to improve outcomes in head and neck injury,

Fig 3. Computed tomography image showing an unstable comminuted fracture of the right C6 lateral mass and lamina with 4-mm anterolisthesis of C6 on C7.

such as the Canadian C-Spine Rule and the National Emergency X-Radiography Utilization Study (NEXUS) criteria.^{21,22} These are established to help clinicians avoid unnecessary exposure to low-risk patients of cervical spine and head injury.

Canadian C-Spine Rules are the following: high risk factors are age >65, fall >1 m, axial loading injury, high-speed motor vehicle crash/rollover/ejection, motorized

recreational vehicle or bike collision, and presence of paresthesias. Low risk factors are simple rear-end motor vehicle crash, sitting position in the emergency department, ambulatory, delayed onset of neck pain, and no midline cervical tenderness.

The NEXUS criteria are if the following 5 are met, there is no risk of cervical spine fracture and imaging is not necessary: (1) absence of posterior midline tenderness, (2) absence of focal

Fig 4. Lateral cervical radiograph after cervical fusion surgery.

Fig 5. Anterior cervical radiograph after cervical fusion surgery.

neurologic deficit, (3) normal level of alertness, (4) no evidence of intoxication, and (5) absence of painful distracting injury.

These guidelines are best used in settings with high volumes of trauma patients, such as hospital emergency rooms and urgent care clinics.^{23,24} The basis for establishing such criteria is to minimize unnecessary radiography while aiming to reduce costs and radiation dose exposures.^{25,26} However, it is important for the clinician to balance the bounds of prudence, making decisions that ultimately protect the patient in all ways. As important as it is to limit patient radiation exposure and reduce medical costs, special imaging is an important tool that should never be withheld if there is a question of serious pathology. In this case, the authors believe the Canadian C-Spine Rules and NEXUS rules may justify taking, rather than avoiding, cervical radiographs. The presence of focal midline tenderness and painful distracting injury and axial loading injury are high risk factors for probability of injury.

Clinical judgment and experience play an important role in patient management. There is no specific orthopedic exam that can solely determine the presence of spinal fracture with acceptable sensitivity and specificity, but the presence of multiple findings with historical correlation can together raise a red flag of suspicion. It is therefore up to the clinician to assemble the clinical picture as a whole. In this case, the history outweighed any particular evidence-based exam. Both the history of injury and history of symptoms at the time of initial workup by the patient's primary care physician were an important consideration, especially with the altered presentation owing to the period between consultations. Proper management begins with an accurate diagnosis. The discovery of cervical spine fracture could not have been possible without radiographic imaging, and

the decision to take those radiographs was made to ensure thorough evaluation.

The recent increased attention on concussion has helped the general public become better educated about an important component of head injuries. However, the practitioner must be diligent and follow best practices to thoroughly screen any other comorbidities, including the cervical spine, when examining patients with a suspected head injury. Health care providers cannot be distracted by a patient's self-diagnosis or assume that other practitioners have ruled out serious pathology.

Without complete and careful assessment, health care providers can fail to properly diagnose high-risk patients. In addition, any practitioner performing manual treatment, such as therapists and doctors of chiropractic, would have risked severe adverse effects to the patient. This case demonstrates the need to always proceed with caution before initiating treatment. Any manual therapy or manipulation could have resulted in iatrogenic injury. Doctors of chiropractic are often seen by patients seeking symptomatic relief, sometimes expecting immediate results. Because of the high frequency of patients presenting with low-level pain, practitioners may assume benign causation of symptoms and fall subject to routine treatment and management. This is complicated further by repeat patients who establish a comfort and familiarity with the practitioner, and thus anticipate similar treatment for what may be a much more complex problem. The clinician must avoid this poor habit and use proper diligence in the workup of every patient injury. Despite the lack of symptomology, the patient was at high risk during his sporting activity. Immediate intervention was necessary to prevent potentially devastating injury.

Limitations

During the exam, it was an oversight by the authors to fail to consider and assess for vestibular injury, such as vertigo. Dizziness or vertigo was not described by the patient, but the “brain fog” could have been a way of describing vertigo. Orthopedic exams including the Dix-Hallpike or Nysten-Barany test could have been used to rule this out but were not done.

CONCLUSION

A complete history and full examination are essential to proper workup and diagnosis. This case demonstrates a patient with a head injury who presented without clinical signs of an unstable cervical spine fracture and spondylolisthesis.

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No funding sources or conflicts of interest were reported for this study.

CONTRIBUTORSHIP INFORMATION

Concept development (provided idea for the research): G.H.G., K.Q.H.

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Critical review (revised manuscript for intellectual content, this does not relate to spelling and grammar checking): G.H.G., K.Q.H.

Practical Application

- Clinical guidelines for head and neck injury assist with the appropriate management of patients with cervical spine injury.

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