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Conservative Management for a Traumatic Cervical Spine Cycling Injury

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Abstract

Competitive cycling holds an inherent risk of traumatic injury often resulting in fracture. Questions regarding the probability of return to sport then arise. The purpose of this case report is to describe the treatment approach and likelihood of returning to cycling after traumatic fracture of the cervical spine and clavicle. This case report describes the use of an original combination of interventions for a C1 fracture with an associated open reduction internal fixation of a left clavicle fracture in a 39-year-old male cyclist. The patient lost control of his bike while descending a slippery slope and was propelled over the handlebars landing head first. The resultant cervical spine and clavicle fractures required twelve weeks in a cervical collar. Physical therapy interventions focused on regaining strength and functional mobility of the cervical spine and shoulder. Following treatment a minimal detectable change was seen for range of motion (>6%) of the cervical spine and shoulder, the Numerical Pain Rating Scale (3 point change), and the Disabilities of the Arm, Shoulder and Hand (29.2% change). The patient returned to his prior level of function at home and work. Medical clearance was received to return to training, with a hopeful prognosis of eventually returning to competition.

Keywords: physical therapy, atlas fracture, clavicle fracture, return to sport

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Introduction

Cycling injuries are on the incline; however, literature regarding the incidence and management is scarce (De Bernardo, et al., 2012). A high number of cycling injuries are related to traumatic events leading to fracture. Although clavicle fractures are common amongst cyclists, accounting for 28% of all injuries, cervical spine fractures are scarce (Nelson, et al., 2011). The rather high incidence of clavicle fractures reported during cycling is not surprising; as clavicle fractures are the second most common fracture in the human body (Mirzatolooei, 2011). The most common mechanism of clavicle fracture occurs when the body decelerates against a hard surface. This direct trauma often results in a comminuted clavicle fracture requiring surgical intervention.

A less typical fracture is that of the cervical spine. Cervical spine injuries are most commonly the result of axial loading (85%) with initial contact to the top of the head (Bailes, 2007). The cervical fracture of interest in this case report is that of the C1 (atlas) vertebra, also known as a Jefferson fracture. Atlas fractures account for 3-13% of all cervical spine injuries (Ivancic, 2012). It is rare that a person experiences a unilateral fracture of the atlas due its' rigid structure (Inaoka, et al., 2007). Prior to this case report, only twenty-eight published cases of unilateral atlas fractures were found. Only one case occurred at the junction of the lateral mass and posterior arch as seen in this case (Inaoka, et al., 2007). The rarity of the Jefferson Fracture results in a lack of standardized treatment (Inaoka, et al., 2007). Therefore, return to competitive cycling following traumatic cervical injuries is controversial. The purpose of this case report is to describe the physical therapy treatment approach and likelihood of returning to cycling after traumatic fracture of the cervical spine and clavicle.

Clinical Methodology

The patient in this case report is a 39 year old male. He is a competitive mountain biker and recreational road cyclist. The treating physical therapist obtained verbal consent for this case report . While mountain bike racing downhill the patient lost control of his bike and flew over the handlebars. The crash resulted in left clavicle and atlas vertebra fractures (Figure 1). The treating therapist had not been exposed to this rare combination of injuries and strong evidence for a treatment approach was not found in the literature; thus, an experimental combination of interventions based on clinical reasoning was employed. Prior to the initiation of therapy the patient wore a ridged cervical collar for six weeks. At the start of therapy he was transitioned to a soft clerical collar for an additional six weeks.

Upon initial evaluation the patient displayed a malaligned posture with his head laterally flexed to the left and rotated to the right. Range of motion measures of the shoulder were performed in a supine position using a Sammons-Preston (32cm) goniometer. Ligamentous stress testing and manual muscle testing

were not performed to prevent strain on the cervical spine. Myofascial tissue release and shoulder range of motion were performed in supine while the head and neck were well supported to protect the cervical spine. The patient completed self-report measures for the upper extremity and the cervical spine at this appointment, including the Disabilities of the Arm, Shoulder, and Hand (DASH) and the Numerical Pain Rating Scale (NPRS).

Subsequent visits over the next 13 weeks focused on postural correction, gentle stretching and strengthening of the neck and shoulder, and return to daily living without restriction. Clinical measures, including cervical and shoulder active range of motion and strength using manual muscle testing as outlined by Beerman Reese (2009), were used to monitor patient progress.

Through the first eight weeks of physical therapy strengthening of the upper extremity was advanced through progression of sets, repetitions, resistance, and difficulty of exercise without stressing the cervical spine. Isometric strengthening of the shoulder was initiated during the second visit. A great deal of verbal, tactile, and visual cueing was used to correct the malaligned posture of the cervical spine over the first six weeks. Self-correction and awareness with the use of a mirror was added the patient's home exercise program. As activation of the upper extremity normalized, closed kinetic chain exercises were added including quadruped rocking and a sub-maximal serratus push-up plus. Cervical spine active range of motion was initiated at week 8. Strength testing was deferred due to physician restrictions. At week 11 cervical passive range of motion was initiated and assessed via a standard Sammons-Preston (32cm) goniometer. Therapy progressed rapidly following initiation of active cervical motion. The intensity of his home exercise program increased significantly to include pulling and pushing tasks, overhead lifting, diagonal/rotational band training, and cervical endurance exercises. Compliance with a comprehensive home exercise program, a thorough understanding of continued activity restrictions, and satisfactory performance in physical therapy lead to patient discharge. Pain rating, range of motion, strength, and self –report measures (Disabilities of the Arm, Shoulder and Hand and the Neck Disability Index) were completed prior to discharge. Verbal consent from the patient was obtained to report this rehabilitation as a case report.

Results

Following this experimental combination of interventions the patient showed clinically substantial improvements in pain (Numerical Pain Rating Scale), range of motion (Table 1), strength, and self-reported disability measures for the upper extremity (Disabilities of the Arm, Shoulder and Hand) (Table 3). A three point change was observed using the Numerical Pain Rating System. The patient reported no cervical or shoulder pain for the last six visits. A substantial change was seen for range of motion (>6%) of the cervical spine and shoulder (Table 1). Despite the substantial change, normative cervical and shoulder active range of motion (Table 2) was not achieved (Youdas, et al., 1992, Valro, et al., 2012). The patient achieved full strength of the shoulder and cervical spine (5/5 strength using MMT) with the exception of cervical flexion (4/5). The patient scored a 12.50% (a 29.2 % change) rating of disability based on the self-reported Disabilities of the Arm, Shoulder and Hand functional outcome measure (Table 3). At the time of

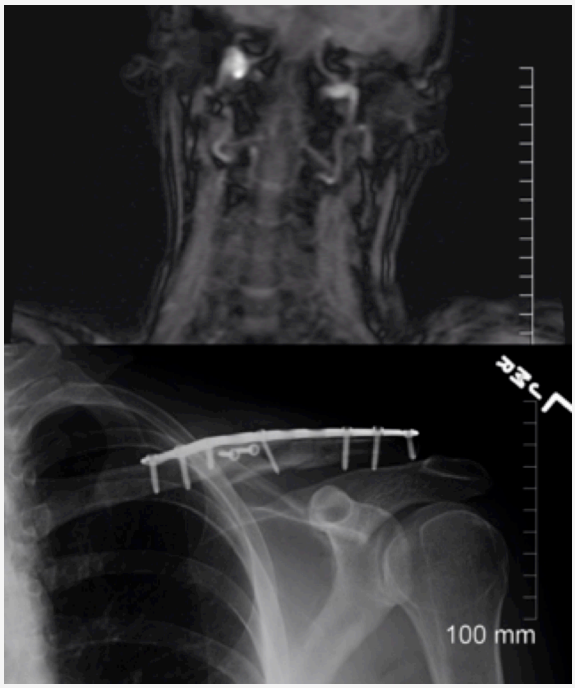

Figure 1. (above) Top: Computed tomography revealing a mildly displaced unilateral left lateral mass fracture of the atlas Bottom: Plain film of surgically repaired left highly comminuted clavicle.

Table 1. Cervical range of motion.

2nd Visit	8th Visit	% Change
Flexion 57°	Flexion 52°	-8.77%
Extension 28°	Extension 50°	78.57%
R Rotation 35°	R Rotation 73°	108.57%
L Rotation 28°	L Rotation 72°	157.14%
R Side bend 29°	R Side bend 22°	-31.81%
L Side bend 31°	L Side bend 25°	-19.35%

Figure 2. (above) Timeline progression of cervical and shoulder rehabilitation.

Table 2. Cervical and shoulder active range of motion normative data as described by Youdas (1992) and Vairo (2012).

Cervical	Shoulder
Flexion 47.3°	Flexion 165.2°
Extension 68°	Internal Rotation 54.5°
Lateral Bend 41.2°-42.9°	External Rotation 98.6°
Rotation 65.4°-67.1°	

Table 3. Disabilities of the Arm, Shoulder and Hand.

Initial	Discharge	Change Percentage
42.7%	12.5%	29.2%

discharge the patient returned to stationary cycling and participation in training rides. Per physician recommendations he had not returned to road cycling or competitive mountain biking.

Discussion

A novel sequence of interventions focused on the shoulder and cervical spine was utilized to improve the patient's function following this rare combination of injuries. Initially, interventions were performed in a supine position to normalize function of the shoulder due to upper cervical spine (C1-C2) muscular attachments. Muscular attachments of the lower cervical spine were also of concern, as it is difficult to isolate to one vertebral level. Movement in any segment of the cervical spine could be detrimental to the immobilization of the atlas due to nature of coupled movements (Malstrom, et al., 2006). The supine position is presumed to be safest for postoperative rehabilitation of the upper extremity due to low levels of electromyographic activity (McCann, et al., 1993).

Range of motion and strength were the patient's primary concern throughout rehabilitation, as his return to competitive cycling was directly correlated with these measures. The patient reached acceptable values for cervical range of motion when compared to Youdas (1992) with the exception of lateral bend (Table 2). This deficit was not expected to interfere with his return to sport. Flexion strength was a limiting factor in his return to sport due to the cervical endurance necessary in both mountain and road cycling. It is important to note that this strength data should be used cautiously due to the inability to obtain baseline measures and poor sensitivity and validity of manual muscle testing for the cervical spine (Dvir, et al., 2008). Training rides were significantly reduced based on the patient's symptoms and poor cervical endurance.

Return to sport following traumatic injury to the cervical spine is highly controversial. Approximately 50% of physicians use established guidelines when making return to sport decisions (Morganti, et al., 2001). Return to sport criterion established by Torg classifies patients into one of three categories based on initial injury: no contraindication, relative contraindication, or absolute contraindication (Torg, et al., 1991). A C1 unilateral lateral mass fracture would be classified as an absolute contraindication. Once the patient progresses to be neurologically intact, asymptomatic, pain free, and demonstrates full strength and cervical range of motion return to sport is considered to be a relative contraindication (Torg, 2009). The treating physical therapist felt that return to sport was likely due to the patient's high level of motivation, compliance with home exercise program and restrictions, and acceptable objective measures. Final clearance was dependent on the patient's completion of a return to cycling protocol.

In summary, the patient successfully completed physical therapy and implemented an independent home exercise and cycling training program. Following discharge from physical therapy the patient received an additional six months of racing restrictions from his physician.

Practical applications

The addition of this case report to the literature provides an outline of an original combination of interventions used for rehabilitation of an unusual atlas fracture with an associated clavicle fracture. The use of a strategic exercise program focusing on protection of the cervical spine yielded a successful return to prior level of function with the anticipation of a return to competitive mountain bike racing. The supine position was utilized in rehabilitation in order to decrease the strain on the cervical spine. Rehabilitation exercises were progressed cautiously due to the severity of injury. Return to sport decisions per a medical physician were based on the patient's ability to meet all return to sport criteria established by Torg.

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