Humeral Stress Fracture With Median Nerve Injury in a Baseball Player: A Case Report and Discussion

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Introduction

There are more than 6 million adolescents participating in baseball in the United States in organized leagues and nearly 13 million more playing in nonorganized leagues according to the Consumer Product Safety Commission (1). Because of the volume of participation in this sport, the number of overuse throwing arm injuries are a significant cause of time loss in adolescent baseball players (2,3). Risk factors for overuse throwing injuries include pitching mechanics, frequency, volume, shoulder rotational range of motion, hip range of motion, decreased posterior shoulder flexibility, rotator cuff weakness and imbalance, and poor neuromuscular control of scapular, core, and lower extremity musculature (4–12). These may result in a variety of upper extremity injuries, such as proximal humeral epiphysiolysis, rotator cuff injury, proximal biceps tendon injury, and ulnar collateral ligament injury (2,13–15).

Stress fractures of the humerus are much less common compared to those in the lower extremities, but also may result from overuse in the throwing athlete (13,16–20). In throwing athletes, humeral stress fractures have been described as spiral and transverse, with the latter occurring in the proximal and midportions of the humerus (21). Humeral stress fractures in a throwing athlete typically present with feelings of arm fatigue and aching after cessation of the act of throwing. However, it also is possible to present with an insidious onset of increasing arm pain if the fracture is incomplete or nondisplaced (17). If not treated, pain will become symptomatic during the act of throwing itself. Physical examination will likely include tenderness at the site of the stress fracture. Shoulder and elbow range of motion is typically unchanged but pain may be present at terminal flexion and extension (18,22).

Distal transverse humeral stress fractures in the throwing athlete are rarely reported in the literature. Humeral stress fractures have not been previously associated with median nerve impairments. Using PubMed, EMBASE, and Scopus, we identified no English language reports of a humeral stress fracture with median nerve impairments. With this report, we present the first known case of a distal humeral stress fracture in a skeletally immature overhead throwing athlete with a concomitant proximal median neuropathy.

Case

A 15-year-old boy, a right hand dominant catcher, presented with right elbow pain and weakness in the summer of 2015. The onset was insidious with the likely mechanism of injury due to throwing without participation in a preseason conditioning or throwing program. Initially, the patient was diagnosed at an outside location with a reported nondisplaced medial epicondyle avulsion fracture in September 2014. At the time of this initial injury, he stopped all throwing activities for a period of 6 months. He then returned to his high school baseball team in February of 2015, but did not engage in a throwing program with progressive volume and intensity. He subsequently developed recurrence of his injury and noted arm pain throughout the throwing cycle. This pain was located anterior, medial, and eventually laterally over the distal humeral and antecubital fossa region. The patient continued to throw intermittingly for a few months without any improvement in pain. He also began to experience occasional numbness and paresthesias in his right volar forearm in the spring of 2015. These symptoms improved at rest and worsened with throwing. He reattempted rest for a few weeks, used ice, and took acetaminophen and non-steroidal anti-inflammatory medications. Despite this, his pain and neurological symptoms continued to persist.

Upon examination in our clinic, he had complete active range of motion about his shoulder and elbow with tenderness to palpation over the antecubital fossa as well as just proximal to the medial and lateral epicondyles. He also was noted to have slight weakness with wrist flexion and radial deviation compared with his nondominant arm. Initial

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Figure 1: Radiograph of the right elbow.

anterior-posterior and lateral elbow radiographs were normal with the medial epicondyle physis still open. Due to his musculoskeletal weakness and neurological symptoms, electromyography (EMG) and nerve conduction studies (NCS) were performed and additional imaging was obtained. The NCS revealed decreased conduction velocity in the median motor nerve at the elbow; this was noted to be 47 $m \cdot s^{-1}$, which was low compared to an expected velocity of >50 $m \cdot s^{-1}$ and compared to 60 $m \cdot s^{-1}$ in the ulnar nerve at the elbow. The median motor nerve also demonstrated decreased conduction amplitudes of >50% The EMG studies were notable for findings consistent with denervation in median-innervated muscles distal to the elbow, including mild acute-on-chronic neurogenic changes in the pronator teres, abductor pollicis brevis, and flexor pollicis longus muscles. The electrodiagnostician diagnosed the patient with proximal median neuropathy consistent with pronator syndrome. Stress view radiographs which revealed possible non-displaced distal humeral metadiaphyseal fracture (Fig. 1) and a subsequent magnetic resonance imaging (MRI) revealed marrow edema concerning for a stress fracture of the distal metadiaphysis.

Given these results, the patient was instructed to stop all throwing activities and was made non–weight-bearing in the right upper extremity for four weeks. On follow-up, he continued to have pain and occasional tingling in his forearm, but admitted that he did not adhere to the treatment plan as he continued to mow lawns and perform yardwork. Because of his continued symptoms and noncompliance, a long-arm cast with the elbow at 90 degrees with neutral pronation/supination was applied for a period of 3 wk to ensure compliance. After casting, the patient had resolution of his pain and neurological symptoms. A repeat MRI to assess for resolving bony edema and healing revealed some persistent edema in the distal humerus (Fig. 2). While complete resolution of edema was not unexpected in this time frame, a consultation to an upper extremity orthopedic surgeon for a second opinion was made before allowing the patient to begin formal physical therapy. On examination, the patient was asymptomatic with full painless active and passive range of motion, and had a normal, symmetric, sensory, and motor examination. Due to our patient's clinical improvement, he was instructed to begin physical therapy and progress to a light throwing program. After completion of a return to throw program, he returned to full baseball activities the following high school season without complaints of pain or weakness with hitting or throwing. He has had no complaints or recurrent throwing arm pain in the past 2 years since treatment for this issue.

Discussion

To the best of our knowledge, this is the first published case of a distal humeral stress fracture in an adolescent thrower with concomitant proximal median neuropathy. Distal humeral stress reactions and fractures can occur in overhead skeletally mature athletes that play a variety of overhead sports, specifically baseball, football, softball, cricket, weight lifters, javelin, and tennis (16–18,23–25). Locations of stress fractures in the distal humerus have included the medial distal metaphysis (26) and the humeral shaft (25,27). In skeletally immature athletes, bony injury typically involves the physis of the proximal humerus (28) or medial epicondyle (6,10,27). When combining nerve-related injuries and bony stress injuries in throwers there is a known association with radial nerve palsy with humeral shaft fractures (29). Our patient is unique as he is a skeletally immature overhead thrower that has a stress fracture of the distal aspect of the humerus but 1) without physeal involvement, and 2) with a concomitant proximal median neuropathy.

There is literature that has discussed nerve injuries and entrapment in association with stress-related bony injuries; however, the literature involves the lower extremities and the common peroneal and saphenous nerves (30,31). A common symptom in these situations includes feelings of numbness around the bony stress injury and/or peripheral nerve injury distribution, similar to our patient (32).

With respect to the patient's nerve injury, one must review the typical course of the median nerve. The median nerve is anterior to the supracondylar region before descending into the cubital fossa and then passing between the two heads of pronator teres. Given the location of the stress fracture on MRI and its proximity to the median nerve in this area, we postulate that edema from the distal humerus may have caused the proximal median neuropathy. However, it is possible that the same neuromuscular, biomechanical, and overuse risk factors for the humeral stress fracture also may have predisposed the patient to injuring

Figure 2: MRI right elbow. Coronal T2 weighted image. Notice the edema pattern, indicative of a potential distal humeral metadiaphyseal stress injury.

the median nerve via traction across the elbow or between the two heads of the pronator teres (pronator syndrome) (33).

It has been postulated that risk factors for humeral throwing fractures include age older than 30 years, prolonged period of layoff from throwing, lack of regular exercise and training, and prodromal throwing arm pain (21,34). In our case, our patient meets all of the above factors except age. Additionally, poor training, lack of an appropriate warm-up, recent growth spurts, and inadequate muscular development can contribute to muscular incoordination and imbalance and lead to injury (17,21,34,35). In a growing individual with open physes, poor biomechanics can result in injury. Biomechanical data have shown that overhead athletes, who throw with greater linear velocity, can generate greater torques and shoulder and elbow angular velocity (36). Thus, placing the arm in extreme valgus with rapid elbow flexion during the throwing motion can add to the torsional stress on the humerus (21,37,38). These biomechanical characteristics may predispose the throwing athlete to a bone stress injury.

Prior radiological research has described different categories of stress-related injuries in the elbow in overhead athletes. They are categorized as follows: diffuse, humeral shaft, medial tension, lateral compression, and extension (21). Gore et al. (39) stated that resultant bony injury can result in bony hypertrophy, loose bodies, traction spur formation, osteochondral and humeral shaft fractures in the adult, and epiphyseal and apophyseal hypermaturity or avulsion in the youngster. In our case, our patient would be considered as diffuse but does not fit within the resultant bony injury categories.

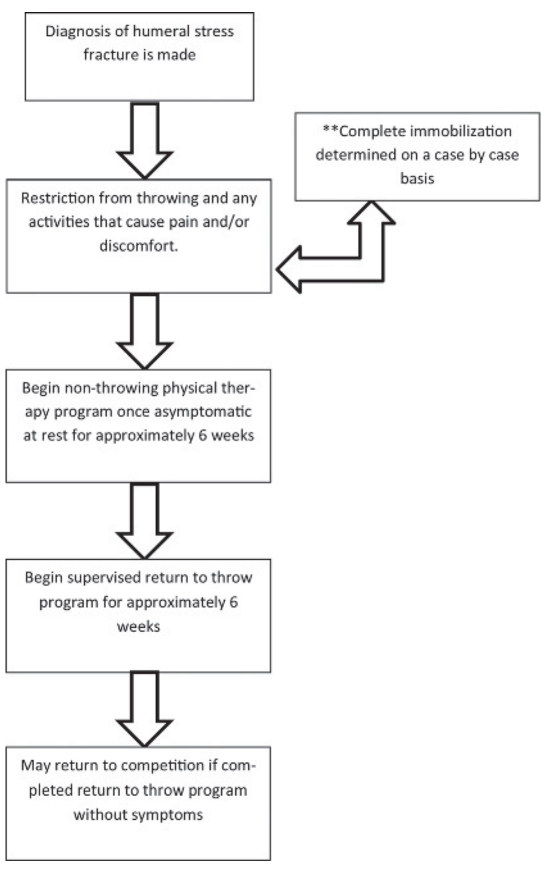

Figure 3: Treatment algorithm for diagnosed humeral stress fractures in overhead throwers.

Treatment approaches in the literature for stress fractures in the distal humerus have revealed that conservative management is an appropriate first step for athletes to prevent further injury (21). However, once the patient is asymptomatic at rest, it is crucial that an athlete performs sports specific rehabilitation before returning to sport (Fig. 3). When treating an overhead thrower, it is important to recommend participation in a return to throwing program before competition to prevent a recurrence of injuries (40). Due to the high forces imparted on the humerus, a slowly progressive throwing program starting approximately 3 months before the start of return to baseball competition is recommended but exact timing is variable based on the position of the athlete and the severity of injury sustained (21). Principles in a postinjury return to throw program include restoration of motion, strength, static and dynamic stability, and neuromuscular control all the while in a controlled manner minimizing the risk of reinjury (41). While there are a variety of throwing programs in the literature, we would direct readers to the most recent throwing program published by Chang and colleagues and adopted from Reinhold and colleagues (18,41).

Conclusions

Overuse throwing injuries are common, particularly in baseball. There are a myriad of factors that may result in these injuries. Any members of the sports medicine team that care for throwing athletes should be aware of the potential for a humeral bony stress injury and possible resulting concomitant peripheral nerve injury. Early diagnosis and subsequent management of this type of injury can lead to a successful outcome and return to play without further significant injury.

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