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CASE REPORT

Stress Fracture of the Ulna in a Baseball Pitcher

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Stress fractures are common entities in intensively training athletes and are considered to be a result of the repeated application of low-grade stress to bone. Stress fractures are most common in the weight-bearing bones of the lower extremity and the spine, but are also found in the non–weight-bearing bones of the body.

Stress fractures of the ulna diaphysis were first reported in 1948, when Kitchin[1] described an ulna fatigue fracture in a laborer. Subsequently, ulna diaphyseal stress fractures have been described in underarm softball pitchers,[2] ten pin bowlers,[3] rowers,[4] golfers,[5] tennis players using double handed backhand,[6,7] weight lifters,[8] and Japanese fencers.[9] To our knowledge they have not previously been recognized in a baseball pitcher.

CASE REPORT

The patient, a 27-year-old male, right-handed, first grade baseball pitcher, reported an 18-week history of pain along the medial border of his right forearm. The pain occurred immediately after the release of the ball during his pitching action, predominantly when throwing his fast ball, which accounted for approximately 80% of his pitches. He was throwing approximately 120 pitches per week in a single session. The pain was initially mild and present for approximately 4 weeks before resolving spontaneously for 5 to 6 weeks. Eight weeks before presentation the pain recurred during the release of the ball, and progressed until it forced him to cease playing baseball 2 weeks before examination. Concurrent with this problem he had experienced a 3-year history of right shoulder pain when in the cocked (hyperextended, abducted, externally rotated) position. This he was managing with simple analgesia.

On initial examination, the patient was noted to have tenderness over the anteromedial border of the midshaft of the right ulna associated with a palpable irregularity. Pain could not be reproduced with passive or active movements of his elbow, wrist, or hand. Weight bearing through a dorsiflexed wrist reproduced his pain. Shoulder examination revealed poor scapulothoracic control, increased external rotation, decreased internal rotation, and global laxity. Radiographs revealed an area of callus formation and a clear fracture line in the midshaft of the ulna (Figure 1). Magnetic resonance imaging (MRI) showed a stress fracture with a small area of interosseus membrane edema adjacent (Figure 2).

Management consisted of resting from pitching and weight-bearing activities on his wrist until local tenderness had resolved, a graded resumption of throwing activities after shoulder rehabilitation consisting of scapulothoracic retraining with rotator cuff strengthening, and biomechanical analysis and correction of his pitching technique. Clinical healing occurred over a 6-week period.

DISCUSSION

The etiology of stress fractures of the ulna diaphysis has been described as either a traction injury of the origins of the hand flexors and extensors,[3,5] or related to torsional forces associated with excessive pronation and supination.[2]

Tanabe et al.[2] are the only authors that have provided objective data to support a proposed mechanism for the development of ulna stress fractures. Evaluating three cases of middiaphyseal ulna stress fracture in softball pitchers, they analyzed ulna shaft shape and relative composition using 8-mm computed tomography (CT) slices. They found that the cross-sectional shape of the ulna varied from approximately circular proximally and distally to approximately triangular centrally. The maximum rate of cross-sectional shape change was found between the proximal to middle and middle to distal diaphysis, respectively. As weak areas correspond to sites where cross-sectional areas change abruptly, these are points of stress concentration, which equate to common areas of fracture with weight-bearing activities.[8,10]

In contrast, after clinically analyzing a 44-year-old female golfer with a distal ulna stress fracture, Koskinen et al.[5] proposed that the most likely etiology was overuse of the hand flexor muscles in combination with excessive supination. In reviewing a stress fracture at the junction of the middle and distal third of the ulna diaphysis in a ten pin bowler, Escher[3] proposed that it was most likely due to flexor digitorum profundus traction. Similarly, Rettig[7] theorized that the differential stress between

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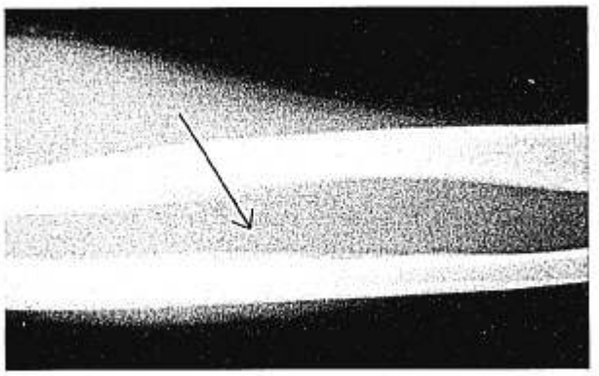

FIG. 1. Radiograph of midshaft ulna stress fracture (**arrow**).

flexor digitorum profundus and abductor pollucis longus, extensor pollucis brevis, extensor pollucis longus, and extensor indicis was etiologic.

However, with forearm pronation in underarm softball pitching, significant shear forces are applied to the long axis of the ulna. Tanabe et al.[2] found the middle third of the ulna to be significantly thinner in cross section than at either end in both cortical and cancellous bone. They proposed that the approximately triangular shaped bone, resulting in elevated shear stress relative to circular shaped bone (shear stress being inversely proportional to the square of the distance between the point of action of the torsional force and the neutral axis of the column), and the minimal cortical thickness in the middle third of the diaphysis resulted in the stress fractures in their patients, all of whom were softball pitchers. Our patient had a prolonged history of right shoulder problems, which probably resulted in a gradual but progressive alteration of his throwing action. With reduced glenohumeral internal rotation at completion of his pitching action, it is proposed that increased pronation and hence ulna torsional stress resulted. Additionally, altered kinematics may result in increased eccentric and concentric loading of hand flexors.

We believe that the mid diaphyseal stress fracture in this pitcher was most likely due to a combination of torsional forces and tractional forces, secondary to altered pitching biomechanics. With stress fractures of the ulna, the challenge is to identify and treat the etiologic factors. This case highlights the possibility that stress fractures of the ulna can occur in baseball pitchers, and that they resolve with rest from aggravating activities.

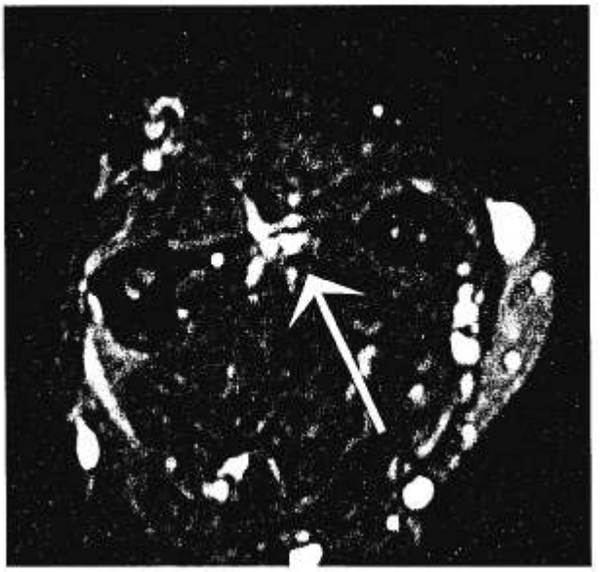

FIG. 2. Nuclear magnetic resonance image showing interosseus membrane edema (**arrow**).

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