

## [ Primary Care ]

# Ulnar Shaft Stress Fracture in a High School Softball Pitcher

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This article presents a case of a 17-year-old softball pitcher with insidious onset of right forearm pain. On presentation, the patient had tenderness on palpation of the midshaft of the ulna, pain with resisted pronation, and pain with fulcrum-type stressing of the forearm. A bone scan revealed increased uptake in the right ulna, and a subsequent magnetic resonance imaging revealed bone marrow edema and numerous small ulnar stress fractures. She was treated with bone stimulation and complete rest and is in the process of returning to pitching.

**Keywords:** ulna; stress fracture; midshaft; softball

With the popularity of women's softball, both the level of competitiveness and the level of training have increased in recent years. Whereas stress fractures of the lower extremities are commonly seen, stress fractures of the upper extremities are a rare occurrence. This case of an ulnar shaft stress fracture in a softball pitcher is the first described in the United States. Sports medicine physicians should consider ulnar shaft stress fracture in the differential diagnosis of a throwing athlete with forearm pain.

## CASE HISTORY

A 17-year-old girl reported right forearm pain starting during her sophomore season of high school softball. At onset, the pain was minor and not reliably reproducible with throwing. In the late summer of her sophomore year, near the end of club season, her pain worsened along the ulnar aspect of her forearm and became consistently associated with overhead throwing and pitching. She especially noticed pain with her curveball and fastball. These 2 pitches finished with the hand and wrist in full pronation and were the pitches that she threw 70% to 80% of the time. Her other 4 pitches ended in full supination and were not used as often. She saw an orthopaedist, and at the time plain radiographs of the forearm yielded normal results. She was instructed to participate in physical therapy and to rest from pitching for approximately 12 weeks. During this time, however, she continued to bat, lift weights, and throw overhand.

She started pitching at 11 years of age. She started throwing more advanced pitches such as curveballs and changeups at age 13 or 14. Throughout the course of her softball career, she had no significant injuries. For the past 3 to 4 years, the patient participated in spring and summer leagues (approximately 5 to 6 months a year) and practiced pitching with a pitching coach 12 months of the year. She frequently pitched as many as 130 pitches per outing or practice session; she pitched multiple games per weekend; and she often pitched on consecutive days.

Approximately 14 weeks after her initial occurrence of pain, she was unable to return to pitching pain-free. She reported compliance with previous recommendations of no pitching for 12 weeks and then returned to pitching. Her pain returned shortly after she reinitiated pitching. A video analysis of her delivery did not identify any errors in her technique. Approximately 12 weeks after her initial onset of pain, a bone scan was done (see Figure 1), which showed increased uptake in the right ulna, and a subsequent magnetic resonance imaging revealed bone marrow edema over a 12.5-cm region of the ulnar diaphysis and multiple small ulnar stress fractures (see Figure 2).

Physical examination findings included tenderness along the midshaft of the ulna on the dorsal and especially the volar aspect, pain with fulcrum-type stress of the ulna, and pain with resisted pronation. There was no swelling, deformity, or bruising.

Laboratory evaluation revealed a normal complete blood count and vitamin D level. Nutritional evaluation revealed a

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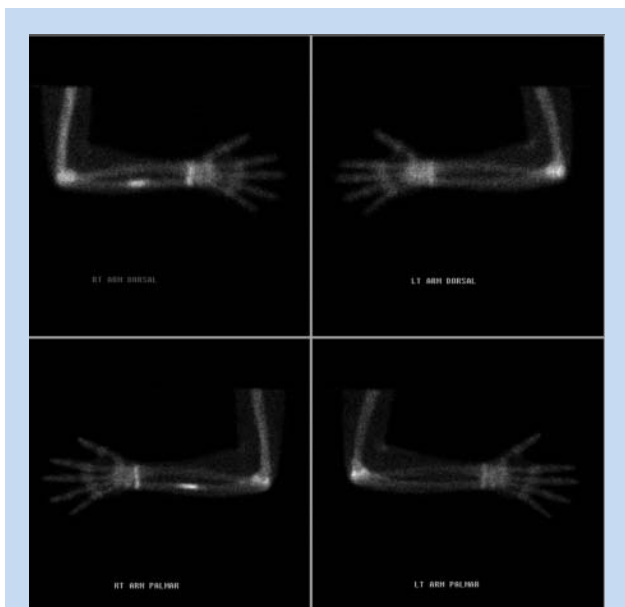


Figure 1. Ulnar stress fracture bone scan.



Figure 2. Ulnar stress fracture MRI.

diet with an appropriate balance of nutrients at each meal; however, she did have an overall deficit in her caloric intake related to the demand of her sport, and the timing of her meals was suboptimal. Her periods were regular, and she had no recent changes in her weight. Her body mass index was 21.

## TREATMENT

Her initial treatment consisted of complete throwing rest, not just avoidance of pitching, as well as avoidance of weight training and batting. During this 6-week period, she improved her nutrition by eating meals or snacks every 3 to 4 hours, plus a snack 30 minutes to 1 hour before her workouts and within 30 minutes of completing exercise. A bone stimulator was employed to speed fracture healing. Bracing of the affected limb was briefly considered, but the athlete had not yet tried complete rest; therefore, bracing was deemed unnecessary at the time. Furthermore, surgery was not considered, because the fracture site was not considered to be at high risk for nonunion, as opposed to the olecranon tip; again, the degree of rest was thought to have been inadequate and deserved a trial before invasive treatment. After 6 weeks, she was completely pain-free. A computed tomography (CT) scan at this time showed a cortical lucency involving the posterior aspect of the mid-ulna, as well as cortical thickening. Physical therapy continued, focusing on rotator cuff strengthening, scapular stabilization, and core strengthening. A repeat CT scan, approximately 12 weeks after the most recent scan, revealed no cortical lucency and decreased cortical thickening. A throwing program—starting with short toss and progressing to long toss, easy pitching, harder pitching, and, finally, pitches with pronation—was completed without pain, and the player was able to return to competitive pitching approximately 10 months after initial presentation. Recommendations were made on taking rest days between pitching outings, not pitching multiple games per weekend, and not practicing pitching on game days.

## REVIEW OF THE LITERATURE

A literature review dating from 1989 to 2009 using the Ovid Medline database resulted in only 1 case report of ulnar stress fractures in 3 fast-pitch softball pitchers in Japan.<sup>14</sup> The search was for English-language articles including the terms *stress fracture*, *ulna*, *ulna fractures*, *throwing*, and *pitching*.

A number of proposed mechanisms may lead to ulnar shaft stress fractures. Pronation is postulated as a cause for stress fracture at the middle third of the ulna, owing to its relatively small cross-sectional area, its triangular shape (versus circular at the proximal and distal third), and its thin cortex in this region of the bone in softball pitchers,<sup>14</sup> table tennis players,<sup>11</sup> tennis players who hit a 2-handed backhand,<sup>15</sup> and bowlers who apply spin to their ball.<sup>6</sup> This is the most likely causative mechanism in this case because the pitcher threw pitches ending in full pronation approximately 75% of the time. Another possible mechanism for an ulnar stress fracture includes a combined axial and torsional force, as that in a breakdancer performing a spin with his or her entire weight on one hand.<sup>4</sup> A third potential mechanism is the repeated overuse or stress of the flexor digitorum muscle mass, as in weight lifting with the elbow flexed and the wrist in pronation or supination<sup>3</sup>; or with repeated strong grasping with flexion

at the elbow, as in the case of an elite bobsled brakeperson<sup>12</sup>; or with perpendicular force applied to the ulna with the hand in full grip, as in the case of an elite polo player.<sup>5</sup> These last two mechanisms are less likely in this case, given that softball pitching does not expose the player to axial loads or heavy perpendicularly applied loads.

The relationship between (1) game pitch counts and season pitch counts and (2) elbow and shoulder pain has been well established in Little League baseball. Furthermore, pitch type—specifically, the curveball and slider—have been shown to be correlated to increased shoulder and elbow pain compared to that of pitchers who throw only fastballs and changeups.<sup>9</sup>

Additionally, there have been numerous instances of stress fractures in the proximal ulna in baseball pitchers.<sup>1,10,13</sup> These have occurred in the region of the olecranon and the proximal medial aspect of the ulna but not at the shaft of the ulna, as in our patient. As opposed to a torsional mechanism of injury owing to pronation, as in softball pitching, ulnar stress fractures in baseball pitchers are more likely due to hyperextension and valgus forces at the elbow.<sup>1</sup> Although most of these injuries were treated successfully with conservative measures such as rest and bracing, a few had to be surgically repaired because of nonunion.<sup>8</sup> In the cases of ulnar stress fractures of the midshaft, the lesion usually appears to be a small cortical defect or periosteal reaction. This is in contrast to olecranon fractures, which may involve the tip of the olecranon and are more susceptible to nonunion.<sup>8</sup>

Finally, the relationship between female athlete triad and increased incidence of stress fractures is well established. The prevalence of stress fractures in young women may be as high as 20%.<sup>2</sup> Whereas most stress fractures occur in the lower extremities, it is reasonable to surmise that the decreased bone density caused by female athlete triad affects the upper extremities as well, making them more prone to stress fractures. This has been demonstrated in retrospective studies of collegiate athletes, showing higher rates of stress fracture in female tennis and volleyball players, as compared to male participants in these sports.<sup>7</sup>

## CONCLUSION

Fast-pitch softball continues to gain popularity in women's athletics. With the development of professional fast-pitch leagues and the increased profile of collegiate softball, the level of competition has increased in recent years. This has led to an increase in competitive club leagues, making it possible for softballers to play for up to 6 consecutive months. This may in turn lead to more overuse injuries, as have been seen in youth baseball. At this time, there are no pitch count regulations

for softball. If the incidence of overuse injuries in fast-pitch softball players begins to increase, it may be necessary to implement such a policy. Fast-pitch softball pitchers may also benefit from breaks of up to 3 months from pitching, as has been suggested for young baseball pitchers. Furthermore, many female athletes are more prone to developing stress fractures owing to inadequate nutrition. Although this athlete did not meet the strict criteria for the female athlete triad, she was found to have inadequate caloric intake for her training demands. The combination of overuse, a forearm pronation motion, and suboptimal nutrition likely contributed to the development of a stress fracture. Finally, when evaluating these athletes, one needs to consider upper extremity stress fracture in the differential diagnosis as a possible cause of forearm pain. The workup and treatment should be multidisciplinary, and it should focus on not only healing the acute bone injury but addressing underlying training, throwing, and nutritional practices of the athlete that may have contributed to the development of the injury.

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