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Stress Fracture of the Radius Diaphysis in a Skeletally Immature Wrestler

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Abstract

Stress fractures in the forearm are rare events. Failing to detect a nondisplaced stress fracture could lead to further injury or fracture displacement. We present a case of a 15-year-old male wrestler without overt risk factors who presented with a transverse stress fracture in the middle-third of the radial diaphysis. The clinician should consider this diagnosis when examining athletes with otherwise unexplained forearm pain.

Keywords

Diaphysis; Fracture; Insufficiency fracture; Radius; Stress fracture

Introduction

It is important to recognize and treat nondisplaced stress fractures of any bone to prevent subsequent injury and potential displacement of the fracture. A high index of suspicion is required to diagnose these fractures, since they are often subtle or undetectable on plain radiographs. Stress fractures of the lower extremities, especially of the metatarsals or navicular, are well described and readily recognized. Stress fractures of the upper extremity are less common than stress fractures in the lower extremity but have been reported in clavicle, humerus, olecranon, ulnar shaft, scaphoid, phalanges, and distal radius.^[1] We report a stress fracture of the middle-third of the radial diaphysis in a 15-year-old skeletally immature male wrestler.

Case Report

A 15-year-old wrestler (bone age of 14 years) presented to our office with a 3 day history of right forearm pain. He was healthy, with a normal age-adjusted BMI (19.2: 157 cm, 48 kg) and no prior stress fracture or complete fracture. Although in the 5th percentile for height and 15th percentile for weight, he had not developed facial hair or voice changes, suggesting that his short stature was secondary to a late pubertal growth spurt rather than to malnutrition or to an endocrine abnormality. He had not been treated with human growth hormone. He denied any recent changes in his training regimen or any history of extreme

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weight loss behaviors. He was a multi-sport athlete who wrestled at his natural weight. He did not smoke or use any supplements, including illegal performance enhancers.

The forearm pain started while at wrestling practice, although he denied any specific injury. He was able to competitively wrestle the next day, but experienced pain in the forearm throughout matches. He also reported feelings of apprehension, feeling as if “something bad might happen” when the forearm was stressed or twisted. Despite this discomfort, he completed all of his matches. He had no pain at rest.

On physical examination, he experienced pain with direct palpation of the middle third of the dorsal-radial forearm as well as mild pain with resisted active pronation and supination. Plain radiographs demonstrated open physes and no obvious fractures, but upon close review, there was a subtle, nonspecific, transverse sclerotic line in the middle third of the radial diaphysis (Figure 1). Prior to subsequent magnetic resonance imaging (MRI) this radiograph was interpreted as normal by the treating surgeon and musculoskeletal radiologist. The patient planned to compete in a wrestling tournament the following day, but since the subtle transverse line corresponded to the patient’s area of maximal tenderness, further imaging was obtained prior to clearing him for competition. MRI confirmed a stress fracture with extensive bony edema and periosteal reaction centered at the sclerotic line in the mid-radius (Figure 2).

The patient was treated with activity restriction consisting of cessation of all sporting activities and avoidance of any weight bearing on that extremity. He was asymptomatic at rest, so no immobilization was provided. After 6 weeks of strict rest, the patient was nontender and had painless forearm rotation. He was also able to perform push-ups without pain. Repeat MRI documented resolution of the bony edema (Figure 3). He gradually increased his activities over the next few weeks and returned to competitive wrestling without difficulty. The patient completed the wrestling season without complication and remained symptom free at 9 months follow up.

Discussion

Stress fractures of the distal radius have been previously reported in gymnasts, military recruits, a pool player, a tennis player, and a cyclist.^[4-6] The most proximal stress fractures of the radius that have been reported were bilateral distal radius diaphyseal fractures in a 24-year-old female gymnast.^[1] That patient presented with 3 months of left forearm pain after an acute increase in her training regimen. Plain radiographs were unremarkable, but a bone scintigraphy revealed increased uptake in the distal radial diaphysis near both wrists. A stress fracture of the distal diaphysis has also been reported in a 12-year-old boy who reported several months of repeatedly performing “wheelies” on his bicycle.^[2] Plain radiographs were diagnostic with an obvious fracture and periosteal reaction. He was treated in a long arm cast for 4 weeks, with complete resolution of symptoms. All other reports involved stress fractures of the distal radius and not the radial diaphysis.

With the exception of the 12-year-old bicycle rider, the prior reports of radius stress fractures have all been in skeletally mature patients. Stress fractures in the lower extremity are becoming more common in the pediatric population as children are becoming increasingly involved in athletic activity. One recent study reported that up to 8% of patients with stress fractures who were seen in a sports medicine clinic occurred in patients between 10-14 years old. Another 43% occurred in patients who were between the ages of 15 and 19 years old.^[7] It follows that the incidence of stress fractures in the upper extremity may increase as well.

MRI has become the reference standard for diagnosis of stress fractures that are not visible on plain radiographs. MRI has a documented 88% sensitivity, compared to 42% for computed tomography (CT) and 74% for bone scintigraphy, and 100% specificity for detecting stress fractures.^[8] MRI is also preferred for follow-up management to verify fracture healing.^[9] In addition, MRI is advantageous in the pediatric setting to limit cumulative radiation exposure, especially when repeat imaging is anticipated. In this case, an MRI was performed because of initial under-reading of the plain radiographs. With low suspicion of stress fracture, the meaning of the subtle transverse line seen on the plain radiographs was not clear. Assuming an identical subsequent case, the authors would now treat similar radiographic appearance as diagnostic of stress fracture without ordering the MRI.

Further review of this patient's MRI demonstrates that the fracture is located immediately distal to the central band of the interosseous membrane (Figure 4). The central band is the most dominant and consistent component of the interosseous membrane.^[3] It is also the stiffest stabilizing structure of the forearm with the forearm in pronation, supination, and neutral positions.^[10] Wrestlers are repeatedly exposed to substantial axial loading and torsion forces across the forearm both in practice and competition. We postulate that in this athlete, these forces may have been concentrated at the fracture location secondary to force transmission across the central band of the interosseous membrane, which may have produced a stress riser. Further study is warranted to determine the ability of the central band to transmit force to the radial diaphysis.

Stress fracture of the mid-diaphysis of the radius should be suspected in athletes of any age with otherwise unexplained forearm pain. Any patient presenting with a stress fracture should be screened for inappropriate training regimens, eating disorders, amenorrhea in females, and illegal substance use. One should also consider evaluation for vitamin D deficiency or other endocrine abnormalities. The patient presented in this report did not have a formal endocrine evaluation following this injury, his only known stress fracture. In patients like the one reported, it would be tempting to attribute the vague pain to a nonspecific muscle strain or contusion in an athlete participating in a contact sport, but diligence is warranted.

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Figure 1.
Anteroposterior radiograph of injured forearm. Sclerotic line marked with arrow.

Figure 2. MRI image demonstrating stress fracture (arrow) and reactive edema extending along radial diaphysis.

Figure 3.
MRI demonstrating origin of central band of interosseous membrane (arrow) immediately proximal to fracture location.

Figure 4. MRI following resolution of symptoms demonstrating resolution of bony edema and appearance of periosteal bone formation.