Bilateral Cuneiform Stress Fractures in a Collegiate Coxswain

A Case Review

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ABSTRACT
Cuneiform stress fractures are rare sports injuries caused by repetitive weight bearing. A careful history and physical examination are essential in establishing a diagnosis. We describe a stress fracture of the medial and lateral cuneiforms in a crew athlete with an uncommon presentation.

Foot and ankle injuries are among the most common in weight-bearing athletes. Most of these injuries are due to overuse, including tendinopathies, plantar fasciosis, and stress fractures. Rapid onset of activity or increased exercise intensity is often the precipitating factor in these cases. As our case demonstrates, lower extremity stress injuries may also be present in nonweight-bearing athletes under special circumstances. The patient has agreed to have her clinical data used as a teaching case report.

CASE REVIEW
A 21-year-old female coxswain on a division I collegiate men’s crew team presented for evaluation of bilateral midfoot pain. She had begun jump roping for cardiovascular exercise 2 weeks prior to the visit. She performed an intense daily workout of 1 hour of jump roping continuously for 1.5 weeks. In the days following, she experienced decreased mobility in her feet and pain along the dorsum of the midfoot, greater on the right.

On presentation, examination revealed tenderness over the right first through third cuneiforms. The patient had a positive hop and tuning fork test with pain over this area. Examination of her left foot revealed tenderness over the medial cuneiform, a positive hop test, and mildly positive tuning fork test. Radiographs of both feet were normal. On the basis of the patient’s history and physical examination, a tentative diagnosis of stress fracture was made. She was placed in a right low tide walker and advised to begin icing both feet. Magnetic resonance imaging (MRI) demonstrated T2-weighted images with bone marrow edema of the medial and lateral cuneiforms (Figures 1 and 2). The presence of a linear signal on T1-weighted images in the medial and lateral cuneiforms was consistent with a nondisplaced stress fracture. At the 1-week follow-up, she continued to have some tenderness to palpation bilaterally. She was put into a right nonweight-bearing short leg cast. She was started on calcium twice daily and had blood work and a bone density scan to rule out secondary causes of osteopenia. These were both within normal limits.

At 3 weeks, she denied right foot pain while in the nonweight-bearing cast; however, she did complain of residual left midfoot pain. On examination, there was tenderness over the left medial cuneiform. She had mild pain with hop test and a positive tuning fork test. She was conservatively treated with ice because she already had a cast on the right foot.

The cast was removed after 5 weeks of immobilization. At that point, the patient had some tenderness to palpation over the right medial cuneiform, but no tenderness to palpation over the lateral cuneiform. There was...
mild tenderness over the left medial cuneiform as well, although it was improving. She had a negative hop test and tuning fork test bilaterally. The patient was started on nonweight-bearing exercise for 1 week. She was then advanced to weight-bearing exercise at 10- to 15-minute intervals, followed by icing both feet. Exercise intensity and distance was titrated up at 25% per week; however, jumping rope was prohibited.

Approximately 6 weeks after the initial injury, the patient returned for follow-up and had some residual tenderness over the right cuneiform. Her left foot also revealed some tenderness around the medial cuneiform. At that time, she was walking approximately 6 miles per day. She continued stretching and strengthening, followed by icing in the athletic training room. She was referred to a sports podiatrist for orthotics. Four months after her injury, the patient was pain free and back to her previous level of activity.

**DISCUSSION**

Foot and ankle injuries are extremely common in weight-bearing athletes. A significant percentage of these injuries are stress related due to overuse or repetitive movements. The case described in this article is one of the first to show a stress-related injury from jump roping in an athlete who is otherwise nonweight bearing. There is little literature discussing cuneiform stress fractures, as they are not as common as navicular and metatarsal stress fractures. Warren et al\(^1\) discussed a medial cuneiform stress fracture in a pole vaulter. This injury was potentially caused by the force placed on the midfoot during sprinting and push-off. In our case, the athlete had isolated and repetitive load on the tarsal bones of the midfoot during jump take-off and landing.

This resulted in a stress fracture, which demonstrated patchy marrow edema on the MRI.

Diagnosis of a stress fracture is largely based on clinical suspicion, including the history and physical examination. The increased frequency and intensity of a new activity are key diagnostic factors in stress-related injuries. Often athletes involved in jumping sports (eg, volleyball and basketball) are at a higher risk of developing midfoot stress fractures.\(^2\) The athlete complains of localized pain, which often worsens with activity.\(^3\) On examination, there is usually pain to palpation as well as with hopping tests.\(^4\) Imaging is another useful diagnosis method. Three-view plain radiographs are the initial imaging of choice.\(^5\) Abnormalities may be seen as early as 2 to 8 weeks after the onset of symptoms; however, sensitivity may be low.\(^6\) A bone scan is another option; however, fracture lines cannot be visualized.\(^6\) Magnetic resonance imaging is more specific for diagnosing stress fractures. It can reveal bone marrow edema, periosteal inflammation, and fracture lines.\(^6\) The MRI of our patient showed diffuse marrow edema of the tarsal bones and discrete fracture lines of the medial and lateral cuneiforms.

Treatment options for stress fractures vary between conservative management and surgical intervention. Uncomplicated and nondisplaced midfoot stress fractures can be treated conservatively. This consists of a 4- to 6-week period of nonweight-bearing cast immobilization, icing, and rest from the inciting activity. Displaced fractures or cases of delayed union may re-
quire internal fixation.\textsuperscript{5,6} Potter et al\textsuperscript{7} studied surgical outcomes versus conservative management in navicular stress fractures. They found no overall difference in healing time; however, their sample size was small and the morbidity related to surgery has to be considered. A semirigid orthotic can add extra support while the patient makes a gradual return to full weight-bearing status.\textsuperscript{6,8} Return to activity depends largely on the patient’s symptoms. To prevent reinjury, a more gradual incremental increase in activity of approximately 10\% is recommended.\textsuperscript{8}

The diagnosis and treatment of stress fractures is similar among all athletes, regardless of gender. In contrast, when caring for a female athlete, other factors are important, including nutritional habits, hormonal balance, and anatomy. When conducting a history and a physical examination, it is important to consider the factors of the female athlete triad. The triad consists of energy imbalance, menstrual irregularity, and low bone density.\textsuperscript{9} A careful history including eating habits, menstrual function, and previous fractures should be obtained on presentation. Laboratory testing and a bone density scan can also be helpful in determining secondary causes of low bone density. Osteoporosis and nutritional imbalance lead to decreased bone strength and may increase the risk of stress fractures.\textsuperscript{3,10} Low estrogen levels may also lead to decreased bone mass.\textsuperscript{10} Administration of an oral contraceptive may help raise basal estrogen levels and prevent decreased bone mass, but conclusive evidence is lacking.\textsuperscript{10} Calcium and vitamin D are important nutritional supplements for patients with inadequate dietary intake.\textsuperscript{12} Identification and treatment of the stress fracture etiology is as important as treating the stress fracture itself.

**CONCLUSION**

This case demonstrates the occurrence of a rare stress fracture under an uncommon exercise regimen in a non-weight-bearing athlete. Although stress fractures are common injuries in athletes, a high clinical suspicion is required for there to be an accurate and timely diagnosis. Treatment and return-to-play issues rest largely on the location and the severity of the injury. Ongoing research is needed in comparing conservative versus surgical management regarding overall morbidity and return to play. It is also important to get a full nutritional and menstrual history from female athletes to correct any underlying predisposing factors.

**REFERENCES**