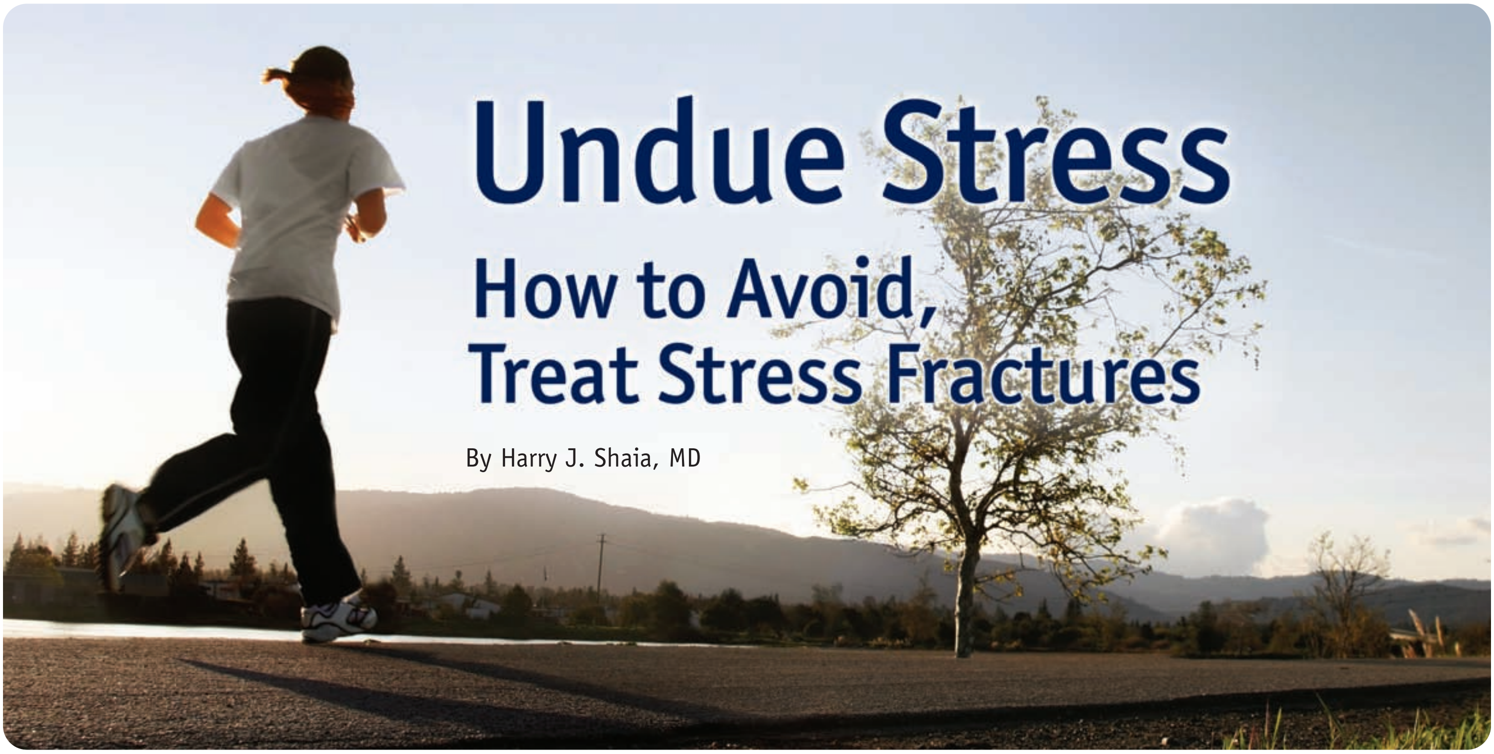


Undue Stress

How to Avoid, Treat Stress Fractures

By Harry J. Shaia, MD

A young woman who has been training for a marathon increased her mileage from 20 to 50 miles per week during the past month. She has noticed increased pain in her right foot for the last several weeks. Initially, she had pain only while she was running, but it slowly increased in severity and began to ache during everyday activities. Now, she has pain at night while trying to sleep.

A retired lawyer decided to get in shape. He started a walking program and soon decided to "step it up" by running three miles a day instead of walking. After a month, his left groin began to hurt as he ran. He ignored it, thinking "no pain, no gain." Eventually, the pain became more severe and frequent, and now he cannot walk even short distances without pain.

These two patients developed stress fractures. The woman's stress fracture is in the fifth metatarsal (foot bone) along the outside of the foot, and the man's is in the hip just below the ball of the hip (femoral neck). While stress fractures are most common in athletes and military recruits, anyone who abruptly increases his or her activity level is at risk. The reported incidence of stress fractures is less than 1% in the general population but may be as high as 20% in runners.

While stress fractures can occur in almost any bone in the body, weight-bearing bones are at highest risk. Certain activities are classically associated with specific stress fractures. For example, runners are at increased risk for lower extremity stress fractures, and stress fractures of the ribs are sometimes seen in golfers and rowers. Gymnasts have an increased risk for spine and foot stress fractures, while athletes who throw have an increased risk of humeral (upper arm) stress fractures.

Biomechanics

When a person changes his or her activity (i.e., an increase in running), it creates different stresses throughout the skeleton. As bone experiences altered stresses, changes occur to better resist those stresses. This occurs through a harmony of bone resorption (osteoclast activity) and bone deposition (osteoblast activity). Through this process, microfractures created in the bone through repetitive stresses are remodeled into a stronger construct. This remodeling occurs over a period of many months.

An abrupt increase in the duration, intensity, or frequency of physical activity without adequate periods of rest may lead to pathological changes in bone. These pathological changes result from an imbalance between bone resorption and formation. During periods of intense exercise, bone formation lags behind bone resorption. The ultimate strength in bone is reduced, rendering it susceptible to microfractures. Under continued strenuous conditions, these microfractures may propagate and coalesce into stress fractures.

Risk Factors

The etiology of stress fractures is multifactorial. The rate of occurrence depends on the bone composition, vascular supply, surrounding muscle attachments, systemic factors, and type of athletic activity. Muscle fatigue may also contribute to increased loads transmitted to underlying bone. Muscle groups may also localize forces over a specific bony region, causing mechanical forces that exceed the capacity of the bone.

Systemic factors, including hormonal imbalances, nutritional deficiencies, sleep deprivation, collagen abnormalities, and metabolic bone disorders, may also increase the risk of stress fractures.

A high incidence of stress fractures is reported in female athletes. This may be related to the prevalence of the female triad — disordered eating, amenorrhea (lack of menstrual cycle), and osteoporosis. High-performance female athletes — particularly gymnasts, figure skaters, and runners — are at increased risk. Menstrual irregularities may occur in as many as 50% of female distance runners. The resultant estrogen deficiencies lead to decreased bone mineral density and an increased risk of stress fractures.

Male endurance athletes are also at risk for stress fractures. Abnormally low testosterone levels result in poor bone remodeling, allowing microfractures to coalesce into stress fractures.

Most Common Anatomic Sites

In a review of 370 athletes with stress fractures, the tibia (shinbone) was the most commonly involved bone (49.1%). The tarsal and metatarsal bones (foot) followed (25.3% and 8.8%, respectively). Other less common sites included the humerus, pars interarticularis (back), pelvis, femoral shaft (thighbone), calcaneus (heel), and sesamoids (small bones at the big toe).

History

Patients classically report slow onset of localized pain; it is initially activity related and increases in severity with increased activity. Eventually, the pain is present during less strenuous activities and, ultimately, during rest.

The start of new training programs and significant changes in training regimens (i.e., boot camp, addition of hill training, or a change to a harder training surface) are commonly reported in people with developing stress fractures. Patients who have had previous stress fractures are at increased risk for developing stress fractures at other sites.

Clinical Evaluation

Early diagnosis is essential for avoiding both complications and a prolonged delay of return to activity.

Bone tenderness versus soft tissue tenderness is often the most obvious finding on physical exam. In areas that are not easily palpable, gently moving the involved extremity through a range of motions may cause pain. If the bone affected is superficial, local swelling and erythema may be present. Clinical findings will vary to some degree, depending on the bone in question.

Making the Diagnosis

The diagnosis of a stress fracture is often based on the history and physical exam. Specific imaging studies may be helpful in confirming a diagnosis or in understanding the severity of the condition. However, findings may not present for several months. A bone scan has traditionally been used for diagnosis because of its excellent sensitivity.

Magnetic resonance imaging (MRI) is also helpful in confirmation of diagnosis.

Could It Be Something Else?

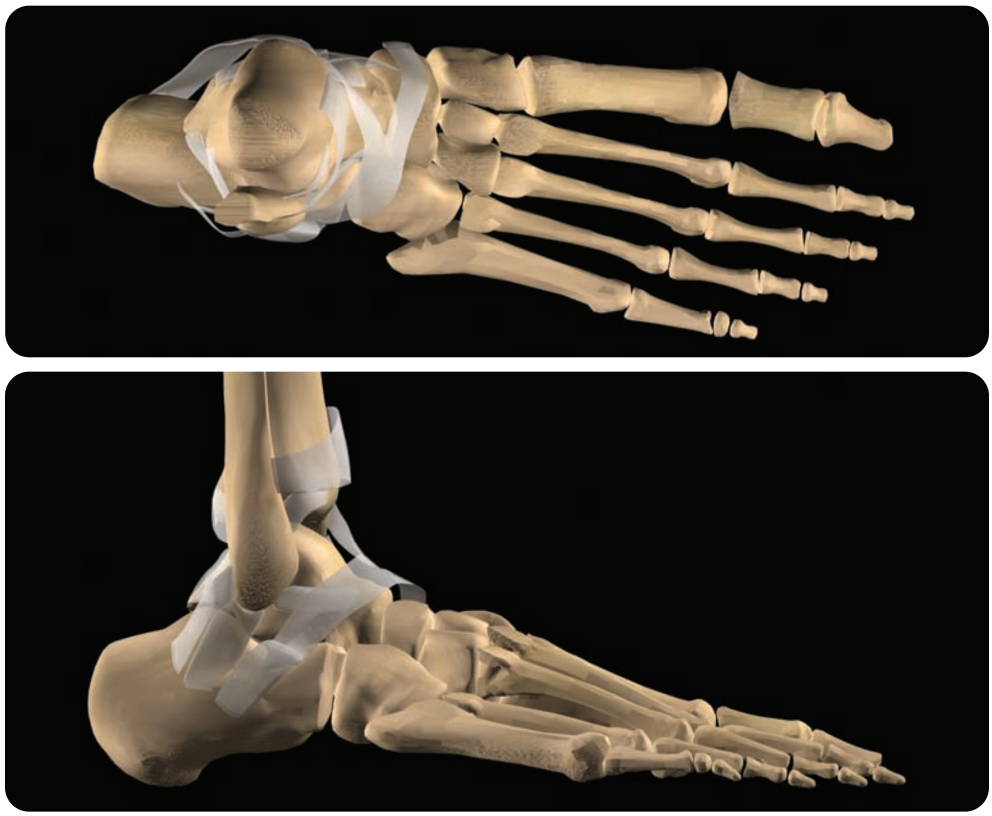
Many orthopaedic disorders can present with a similar history and constellation of symptoms. Muscle strains, joint sprains, nerve entrapment syndromes, and compartment syndrome have many of the same presenting features. Stress reactions in bone are a “prestress fracture” state and represent a weakened bone, which should be protected to prevent further injury.

Treatment Options

Early intervention includes treating any underlying causes, controlling pain, and resting the affected area.

Underlying causes such as the female triad and poor training techniques must be addressed to allow for both the healing of the existing stress fracture and the prevention of future injuries. Patients should eat a healthy diet, which includes an adequate supply of calcium (1200 to 1500 mg) and vitamin D (400 to 800 IU). Patients who have eating disorders should seek appropriate counseling. A careful assessment of training frequency, exercises, shoe wear, and training surfaces can help identify potential problems with a given workout routine.

Ice and anti-inflammatory medications are the mainstay for pain control. Pain should quickly subside with activity modification. Weight-bearing status should be addressed according to the bone involved.



(top) Dorsal view of the ankle joint bones showing the calcaneus, cuneiforms, metatarsals, and phalanges; **(bottom)** Lateral view of the ankle joint bones showing the calcaneus, cuneiforms, metatarsals, and phalanges

With early diagnosis and the appropriate intervention, most stress fractures heal and the patient can return to a healthy exercise routine.

Harry J. Shaia, MD, received his Bachelor of Science from the University of Notre Dame and his medical degree from the Medical College of Virginia. He completed his orthopaedic residency at the University of Massachusetts Medical Center.