Overuse Bone Trauma and Stress Fractures

Annick Demeyere and Filip M. Vanhoenacker

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Box 7.1. Plain films
● Always the initial first imaging modality
● First signs of stress fractures in cortical bone are gray cortex sign, cortical striations and periosteal new bone formation
● Early signs in cancellous bone are subtle and include blurring and faint sclerotic radiopaque areas

Box 7.2. Bone scintigraphy
● Very sensitive but lacks specificity
● Particularly useful for demonstration of multiple stress fractures, and distinguishing bipartite bones from stress fractures
● Too sensitive for stress reactions and subclinical bone remodeling
● Not useful for follow-up the healing

Box 7.3. CT scan
● Less sensitive
● Specific indication are complex anatomical sites, longitudinal stress fractures and differential diagnosis with tumoral lesions

Box 7.4. MR imaging
● Comparable sensitivity and higher specificity than scintigraphy distinguishing bone involvement from soft-tissue injuries
● More accurate in grading the stage of stress fractures and predicting the time of recovery
● No radiation exposure, non-invasive

A. Demeyere, MD
Department of Radiology, Imelda Hospital, Imeldalaan 9, 2820 Bonheiden, Belgium

F. M. Vanhoenacker, MD, PhD
Department of Radiology, University Hospital Antwerp, Wilrijkstraat 10, 2650 Edegem, Belgium
**7.1 Introduction**

Stress related bone injuries are common in athletes and account for up to 10% of cases in sports medicine practice. Stress fractures have been classified into two types: fatigue and insufficiency. The fatigue fracture is caused by an abnormal stress to a normally elastic bone. Fatigue fractures are thought to occur in different sites depending on the age, sex and activity of the athlete. Insufficiency fractures arise from the application of a normal stress on a bone that is mineral deficient or abnormally inelastic. Insufficiency fractures are most prevalent in nutrient-deficient (osteomalacia) and older populations in whom osteoporosis and rheumatoid arthritis are more common (Romani et al. 2002; Anderson and Greenspan 1996). The focus of this chapter is sports-related injuries and so this latter will not be further discussed.

Stress fractures are common injuries frequently seen in athletes and military recruits. Although the reported incidence of stress fractures in the general athletic population is less than 1%, the incidence in runners may be as high as 20%. But with the increasing emphasis on exercise for the elderly and the recreational athletic population, stress fractures should not be overlooked in this population.

Although stress fractures have been described in nearly every bone, they are most common in the weight-bearing bones of the lower extremities. Specific anatomic sites for stress fractures may be associated with individual sports, such as the humerus in throwing sports, the ribs in golf and rowing, the spine in gymnastics, the lower extremities in running activities, and the foot in gymnastics (Bennell and Brukner 1997). In a review of 370 athletes with stress fractures, the tibia was the most commonly involved bone (49.1% of cases), followed by the tarsals (25.3%), the metatarsals (8.8%) (Boden and Osbahr 2000) and pelvis. Bilateral stress fractures occurred in 17% of cases.

Pain in the lower leg brought on by exercise but relieved by rest is a common complaint. Stress injuries involving the tibia account for up to 75% of exertional leg pain, and encompass several clinical syndromes such as medial tibial syndrome (shin splints), chronic compartment syndrome, soleus syndrome, and stress fracture (Bhatt et al. 2000).

Accurate diagnosis of a stress lesion is essential in the early phase after the onset of pain to apply specific treatment and to insure an early return to sports activity.

**7.2 Pathophysiology**

**7.2.1 Anatomy of Bone**

Bone has both cortical and cancellous components (Fig. 7.1). Cortical bone is dense and highly organized and withstands stress in compression better than in tension. Cancellous (trabecular) bone is an irregularly shaped meshwork and withstands stress according to the alignment of the fiber matrix. The outer shafts of long bones are mainly cortical, with

![Fig. 7.1. Anatomy of bone. Bone is made up of cortical and trabecular bone surrounded by periosteum. The cortical bone unit is the osteon](image)