Overuse injuries

Objectives

1. Define overuse syndrome
2. Discuss the natural history of a stress fracture
3. Discuss factors predisposing to stress fracture
4. Discuss the distribution of stress fractures in the skeletally immature
5. Discuss differential diagnosis of stress fractures
6. Discuss imaging modalities useful for the evaluation of overuse injuries in children and their indications
7. Discuss factors which may render the female gymnast, figure skater, ballet dancer, and/or runner especially prone to developing a stress fracture

Discussion

Overuse, or stress injuries have received a great deal of attention in the past two decades; prior to that time a stress injury in a child was regarded as a curiosity. The great increase in overuse injuries is probably a result of both more intense training in some skeletally immature athletes in addition to a better understanding of the subject. A stress or overuse injury is defined as an extension of the spectrum of physiologic adaptation that occurs in response to stimuli from normal use. Military recruits have been most studied. Overuse injuries can occur at the bone-muscle, muscle-tendon, and tendon-bone interfaces as well as in bone. At the myotendinous junction, in mammalian models, the inflammatory response peaks at age 2. A fibrotic response follows, peaking between days 4-11. This fibrosis prevents restoration of normal muscle structure. However, tensile strength is returning by this time. Small hemorrhages occur, but hematoma formation does not. Strength in healing myotendinous tissue is not affected by NSAIDs. Soft tissue overuse injuries are less well defined than stress fractures, and discussions of these injuries often do not have a basic science structure. The bone tendon interface is somewhat better defined, in conditions such as Osgood Schlatter syndrome (listed separately) or the so-called Sever disease. It is increasingly apparent that radiographic findings have limited clinical significance, and that symptoms most likely are a result of soft tissue inflammation.

There is a much better defined data base for stress fractures. These have been studied most extensively in military recruits, who are often subjected to a sudden increase in physical activity during training. It is well established that new bone formation in response to increased loads does not occur for about 2 weeks, during which time osteoclastic activity is continuous. This may be due to a transient exercise induced ischemia in the bone - the site of fracture is not necessarily the portion of the bone subjected to greatest strain. Leg strength and hamstring flexibility have both been recently shown to have a protective effect on the development of stress fractures in military recruits. Diagnosis of stress fracture is usually not difficult if the examiner considers the possibility. Radiographs are negative in the initial phase of stress fracture before the phase of new bone formation. Bone scintigraphy can be helpful in the early phases, but of course is not specific for etiology. MR imaging can be helpful in increasing the specificity of diagnosis if a biopsy is being considered. The differential diagnosis of stress fracture includes neoplasia, infection, and osteoid osteoma. Treatment for most stress fractures is relatively simple; discontinuing the activity to allow sufficient time for regaining bony strength before embarking on a controlled incremental increasing exercise program to allow osteoblastic activity to continue pace with osteoclastic. A particularly nasty variant of stress fracture is that of the anterior tibia. Femoral neck stress fractures can be catastrophic if displaced, but these injuries are rare in children.

Studies of stress fractures indicate that about 10% occur in children under 16. The tibia is most often injured, as in the adult, followed by the fibula, pars interarticularis, femur metatarsal, and tarsal navicular. In the upper limb, stress reactions in children have also been well documented. Little league elbow, or osteochondritis dissecans (listed separately) can be a disabling affection of the capitellar epiphysis. Little league shoulder is more benign. Gymnasts develop physeal changes of the distal radial physis, presumably from the conversion of the wrist to a weightbearing structure. Traction injuries to the olecranon apophysis can also affect young gymnasts. The risk of stress fracture is higher in female than male gymnasts. High level training and eating disorders are not infrequent among young female gymnasts and can result in amenorrhea or oligomenorrhea. Although bone density may be normal in such gymnasts, the hypoestrogenemia accompanying this condition may impede the development of greater bone strength necessary to meet increased demands of training. Finally, young musicians can also sustain physeal overuse injuries of the upper limb.

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