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Selected Topics: Sports Medicine

COMMINUTED FEMUR FRACTURE SECONDARY TO STRESS DURING THE BOSTON MARATHON

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□ **Abstract—We report a case of a comminuted femur fracture secondary to repetitive stress in a healthy marathon runner. Stress fractures are common orthopedic injuries that result from normal muscular activity on deficient bone ("insufficiency fractures") or excessive, repetitive stresses on normal bone ("fatigue fractures"). Of recreational and professional sports, running accounts for a higher incidence of stress fractures, which have been reported to cause up to 15% of all injuries to runners. We report a case of a sub-trochanteric comminuted femoral stress fracture in a female marathon runner. © 2006 Elsevier Inc.**

□ **Keywords—stress fracture; femoral fracture; marathon; endurance athletes; running injuries**

INTRODUCTION

Stress fractures are overuse injuries, due to normal activity on deficient bone, or more commonly, due to repetitive, excessive stress on normal bone. Athletes who participate in endurance and long-distance activities are particularly at risk for developing stress fractures. The following report is of an otherwise healthy Boston marathon runner who developed a comminuted femur fracture after completing 24 miles of the 26.2-mile course. Included is a discussion of the emergency evaluation and management of acute stress fractures, appropriate imaging techniques, and considerations for consultation and follow-up.

CASE REPORT

A 48-year-old woman was brought to the Emergency Department (ED) by emergency medical technicians (EMTs) after she was carried across the finish line of a marathon (26.2 miles). She began to feel pain in her left thigh at mile 24, but continued on. Half a mile later, she felt a "snap," saw a grossly distorted left thigh, and collapsed. Several fellow runners carried her the remainder of the way, to a waiting ambulance. The left leg was immobilized in the field, and on arrival she was hemodynamically stable with normal neurovascular supply in the leg distal to the deformity.

The patient had previously run four marathons, and had been running regularly for many years. She reported discomfort in the left groin for several months before this event, however, she was still able to complete her marathon training. She denied a history of amenorrhea, smoking, disordered eating behavior, steroid use, or other fractures. She had no medical problems, no allergies, and was not taking any medications.

Vital signs on arrival were normal. Most laboratory test results were within normal limits, including hematocrit, calcium, phosphorus, sodium, and potassium. She

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did have a mild leukocytosis (WBC = 16.72) and elevated creatine kinase (CK = 494 U/L). After administration of analgesics, the immobilizer placed in the field was removed, revealing a shortened, externally rotated left hip with an obvious deformity one-third of the way down the femur. The distal limb was warm, well perfused, and had 2+ femoral, posterior tibialis, and dorsalis pedis pulses. Motor and sensory systems were grossly intact, though the motor examination was limited by pain.

Figure 1A shows the initial radiograph (X-ray), an AP view of the left femur, which shows a comminuted subtrochanteric fracture extending through the lesser trochanter.

The rest of the patient's bones appear normal, without stigmata of osteoporosis, and there was no evidence on plain film of underlying pathology. To rule this out, a computed tomography (CT) scan of the pelvis and thighs was performed. The fractured area showed no abnormal enhancement or lesions to indicate an underlying pathologic process weakening the bone (Figures 1A and 1B). As seen in Figure 1, the diameter of the femoral cortex on the left is hypertrophied as compared to the right. The patient had an open reduction-internal fixation performed. Postoperative X-rays showed an intramedullary femoral rod with proximal sliding and distal interlocking screws. The patient was discharged to rehabilitation on post-operative Day 3 in stable condition without complications. She returned to her home state where she completed her recovery, thus, we have no data regarding her long-term outcome.

DISCUSSION

Running or jogging is a popular pastime, with approximately 30 to 40 million Americans running as a source of exercise (1). Despite the benefits of running (cardiovascular conditioning, weight control, and reduced risk of osteoporosis), it is not without potential dangers: 35% to 45% of runners will suffer a running-related injury each year (2). These injuries include sprains, tendinitis, medial tibial stress syndrome ("shin splints"), and stress fractures, which reportedly cause up to 15% of all injuries to runners (3). Stress fractures of the lower extremity occur most commonly in the lower third of the tibia, the metatarsals, and the fibula. In a retrospective review of 320 stress fractures in athletes, the femur was found to be the fourth most common fracture site (accounting for 5% of stress fractures) (4–6). Due to repetitive stresses from the insertion points of the adductor brevis muscle and the origin of the vastus medialis, the area between the proximal and middle third of the femoral shaft are most susceptible to stress fracture.

Stress fractures are commonly divided into two groups. *Insufficiency fractures* result from normal activity on deficient bone. *Fatigue fractures* result from extraordinary activity, such as repetitive stress, on normal bone. This patient had no evidence of underlying bone pathology to account for the fracture, which was likely the result of repetitive stress (a marathon run) on a bone with a previously unidentified stress fracture (the "groin pain" she had experienced during training). Pain from femoral shaft fractures often radiates to the groin or thigh and can be insidious at onset, with variable presentation from subtle intermittent pain to overt fracture (7). All stress fractures have the potential to cause serious problems including distraction, complete fracture, and chronic pain syndromes. Early diagnosis and treatment of stress fracture in those patients who present with gradual onset of pain over several days to weeks, and whose symptoms are exacerbated by exercise and relieved by rest is important, as stress fractures diagnosed and treated earlier in their course are, like most overuse syndromes, easier to treat successfully. Athletes pose a significant challenge to treat, as the consequences of treatment will temporarily prohibit participation in competition and athletes may be reticent to comply with therapeutic recommendations, as they can often "play through the pain" early in the disease.

Early symptoms and signs of stress fractures include pain with activity and tenderness with palpation at the site. This patient's groin pain, alleviated by rest, was likely an early symptom of stress fracture. Plain X-ray studies may take 2–10 weeks to show evidence of fracture. Triple phase nuclear bone scans are more sensitive than plain films in detecting early stress fractures, which manifest as "hot spots" at the point of tenderness (8). Magnetic resonance imaging (MRI) is also highly sensitive for proving the presence of stress fractures, and is often more easily available than a bone scan. The asymmetry of this patient's femoral cortices (left greater than right) may indicate a protective response by the bones to the repetitive stress of running as the bone remodels in response to increased pressure; an uneven gait or stride

Figure 1. (A) AP view of the pelvis showing comminuted subtrochanteric femoral neck fracture on the left. (B) CT scan of the pelvis, soft tissue windows, showing left femoral neck fracture. (C) CT scan of the pelvis, bone windows, showing left femoral neck fracture.