NEW ASPECTS IN STRESS FRACTURES OF THE FOOT

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SUMMARY: The aetiology of fatigue fracture is repeated, unaccustomed stress. The distribution of stress fracture in German military recruits is shown, the most frequent being the calcaneus. General views on the clinical symptoms and radiological signs of stress fracture in the calcaneus and metatarsal bones are presented.

Treatment consists of weight relief. Prevention by special training programmes is possible and necessary.

Introduction

Stress fractures, fatigue fractures or as the condition is often designated, march fracture, has been known for many years. The first description was given by Breithaupt in 1855, who observed swelling of the feet in soldiers. During the last twenty years however the predominant location of stress fractures in soldiers of the Federal Forces, Germany changed from the metatarsal bones to the calcaneus. This report is based on 382 cases of stress fractures in 269 patients.

Definition and aetiology

Stress fracture can be defined as a break in the continuity of presumably normal bone caused by rhythmically recurring subthreshold traumata. The aetiological conditions are greatest in untrained military recruits who are under repeated, unaccustomed stress.

Location and distribution

The location and distribution of stress fractures of the foot is given in Table I. The predominant location now is in the calcaneus, whereas the distribution of

Table I
Location and distribution of stress fractures

Bone involved	Federal Forces Germany 1962—1964		Military Hospital, Zwischenahn 1970—1976	
	No. of cases	percentage	No. of cases	percentage
Calcaneus	9	2.0	232	86.2
Metatarsal	398	86.5	18	6.7
Tibia, fibula	34	7.4	12	4.5
Femur	8	1.7	2	0.7
Pubic ramus	11	2.5	5	1.9
Totals	460		269	

the stress fractures in other bones of the lower extremities was nearly constant in the last decade. Most remarkable is the fact that fatigue fractures of the calcaneus occur more frequently today than the typical march fractures of the metatarsal bones. The cause lies in the altered method of training with repeated jumping exercises and increased strain on the calcaneus.

Calcaneus

Clinical symptoms

Symptoms of stress fracture of calcaneus are gradual onset of pain and swelling of the heel without acute sudden trauma in the history. There is usually a delay from several days to two weeks between the onset of symptoms and the first visit to our hospital. The physical examination reveals swelling around the calcaneus and a considerable tenderness on pressure on both sides of the calcaneus. There is frequently tenderness also along the course of the Achilles tendon. Surprisingly, there is little or no tenderness over the inferior or plantar aspect of the heel. Numerous patients came under the false diagnosis of tenosynovitis and 17 per cent of our patients with stress fractures of the calcaneus were sent to us to receive instep-raisers.

In our study 111 patients had bilateral fractures (48 per cent), 58 patients on the left side alone (25 per cent) and 63 patients on the right side alone (27 per cent). The early and correct diagnosis is difficult because most of the patients will have negative X-rays on their first visit to hospital (Gilbert and Johnson 1966).

Radiographic findings

The constant roentgen signs of stress fracture is a dense line of increased bone reaction in the calcaneus which can be first seen about 10 days after the beginning of clinical symptoms. Two types of stress fracture of calcaneus can be differentiated in the X-ray: in 70 per cent the dense line is running parallel and near the epiphysis in the dorsal part of the calcaneus (Fig. 1) and in 30 per cent the zone of densification lies in the middle part of the calcaneus near the calcaneo-

Fig. 1. Stress fractures of the calcaneus. Two weeks after onset of pain—dense line in the dorsal part of the calcaneus on both sides.

talar joint (Fig. 2). The dense line runs at right angles to the normal trabecular pattern, which consequently is disrupted in this area of increased bone reaction. The second type of stress fracture in the middle part (Fig. 2), show a definite cortical fracture line with periosteal reaction, whereas a defect in the cortex was never seen in the other type. For two or three weeks the density increased in length inferiorly and then remained relatively constant for six weeks. The osteosclerosis then gradually faded and the normal trabecular pattern reappeared.

Fig. 2. Stress fracture of the calcaneus. Zone of densification in the middle part of the calcaneus—10 days after onset of pain.

Metatarsal

Clinical symptoms

Clinical signs of metatarsal stress fracture (march fracture) are onset of pain and swelling of the forefoot during a long march. Physical examination reveals local tenderness over the fractured metatarsal, occasionally swelling and erythema. Most frequently the third metatarsal is fractured (Fig. 3) (Maurer 1970). Bilateral stress fractures of the metatarsal are rare. March fracture of two metatarsal bones in the same foot is possible.

Fig. 3. Typical "march fracture" of metatarsal III.

Radiographic findings

Radiographic findings depend upon the clinical stage of the disease. If the first X-ray is made early, that means during seven days after onset of pain, there may be no radiographic abnormalities or only questionable minimal indistinctness in the periosteum and cortex of the affected area. Two to three weeks later the fracture line or early callus formation might be visible. Later on, more abundant bony callus may be palpated easily in the form of a firm, localised mass around the shaft of the bone as the fracture heals. Radiographic findings are typical and confirmatory (Fig. 3). Deformity or dislocation of metatarsal stress fracture is rare but possible depending on the location and on continued weight bearing, despite discomfort.

Treatment and prevention

Patients with a suspected stress fracture should be managed as a stress fracture regardless of early negative X-ray findings. Therapy depends on the individual bone involved and is usually conservative. In the foot, treatment consists of relief of weight bearing for two weeks until the complaint disappears.

Stress fracture which is a fairly common injury among military recruits could be prevented by a controlled training programme. Indoctrination of troop leaders on the causes and prevention of stress fractures could do much towards lowering the incidence of the condition.

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(Editor's note: This most interesting paper suggests an explanation for the recruits painful heel. Stress fractures of the os calcis in the British Army are rare. Pathologically one would see trabecular micro fractures and studies of areas of increased density by bone scan, by Xerography, or by micro tomography would be instructive.

The development of such areas in a painful heel with eventual resolution must be accepted as a stress fracture.

The lower incidence in our recruits suggests a different training requirement or possibly a more effective protection from the boot.)