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CRUSHING FOOT INJURIES DUE TO EXTERNAL VIOLENCE FROM BELOW

Edward L. Miloslavich

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During the last phases of World War II, repeated attacks were made upon rolling trains loaded with combatants. Explosives of a different type and shape were placed or hidden on the railroad tracks, and they would detonate under a car crowded with soldiers standing between the seats and in the aisles. Losses were terrific. This kind of destruction of human life and property was quite common in the guerilla warfare.

The writer had opportunities to examine the dead bodies and to observe the manifold injuries. At this time, however, only the effects of the explosive action upon the skeletal structure of the foot are to be discussed.

The anatomical dissection of the lower extremities disclosed comminuted fractures of the calcaneus (os calcis) and the adjoining talus (astragalus) with fracture lines through the scaphoid. In some cases all the tarsal and metatarsal bones were involved. In the latter mentioned instances, the tibia and fibula were also fractured.

In many cases roentgenologic pictures were taken, and they often gave useful assistance prior to and during the anatomical dissection in determining the location and extent of the bone involvement. An X-ray apparatus is a very valuable and indispensable piece of equipment for criminalistic and medico-legal investigations.

In comparing the findings of the right and left foot a difference was readily noticed in the extent of the fractural involvement of both heel bones, one being more intensely affected than the other. In some instances there was a complete absence of injuries to one foot, while the calcaneus of the other foot was crushed.

The body weight, namely the *erect posture of the body*, is a significant component in localizing the injury. An individual in upright, standing position, may rest on his right or left leg, or may distribute his body weight on both feet. By unexpected detonation of an explosive beneath the rolling railroad cars, all the men in erect posture acquired crushing injuries to the bony framework of their feet especially of the heel bone. Unilateral or bilateral involvement of the calcaneus depends then upon

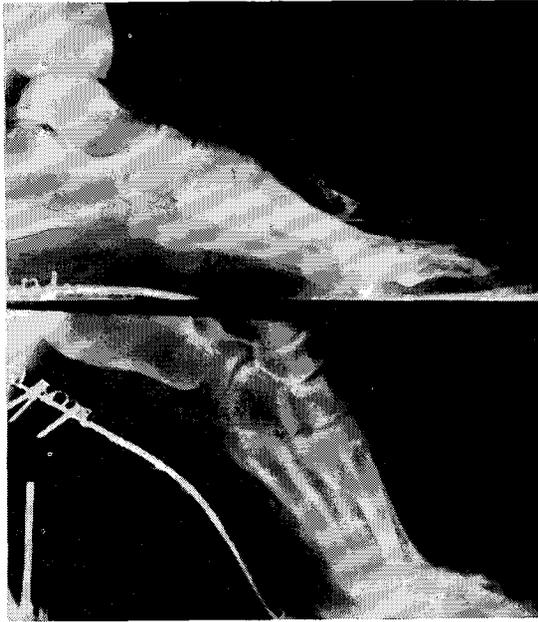


Figure 1.

The upper picture shows the natural position of the foot resting in a low heel shoe (Horizontal position of the metatarsals).

The lower picture illustrates the abnormal position of the foot with highly elevated tarsus (heel bone) and sharply sloping metatarsals.

the fact which leg carries the main body weight at the moment of the explosion.

A similar mechanism can be observed in gunshot wounds through the thigh bone of a person while standing. The axial length of the splintered zone, as well as the size and number of the splinters vary, depending upon whether the body weight was resting on that particular leg at the very moment when the projectile struck the bone. These facts were proven not only by studying the wounded, but conclusively by experiments.¹

EFFECTS OF FALLS

A second group of foot injuries caused by external violence from below relates to instances of falling from a height to the ground in standing position. Such injuries may result when an elevator in motion suddenly drops, or when a workman unexpectedly falls from a high ladder or scaffold and lands on his feet.

Fractures of the bones of one foot or of both feet are the result, and

1. See the writer's article, "Gunshot Wounds and Firearms," Wiener Beitr. gerichtl. Med. 1943 for further discussion.

the heel bones are commonly involved in varying intensity, depending upon whether the individual struck the ground with both feet, otherwise unilateral injuries develop.

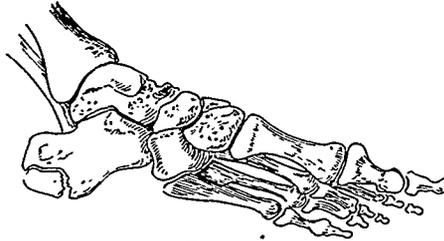


Figure 2.
Fracture of the heel bone.

These occurrences or accidents are well known, but there is a significance in the shoe construction as a localizing factor in development of fractures of different constituent bones of the foot. Particular emphasis must be placed upon the present fashionable, unnatural, high heel feminine shoe. This fact is illustrated by the following accident. One day two young women, 23 and 25 years of age, were riding on an elevator. The older one was corpulent, of medium stature, and wore low heel shoes. The second one was slender and was wearing high heeled shoes. (Fig. 1). As the elevator was reaching the first floor, its mechanism failed, and the elevator dropped to the basement. Both of them sustained fractures. The one with low heels had a fracture of the left calcaneus; the one wearing the high heels showed multiple fractures of the metatarsal bones of the left foot. Both in the erect posture rested their body weight on the left leg.

The roentgenologic examination disclosed the following findings. The first woman exhibited a fracture of the calcaneus with moderate deformity, and a depression of the subastragular joint. The metatarsal bones were not involved. (Fig. 2). In the second case fractures involved the proximal end of the first metatarsal and the distal ends of

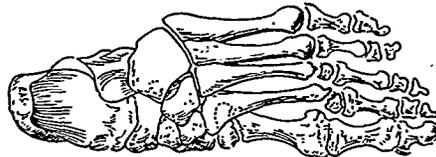


Figure 3.
Fracture of three metatarsal bones.

the second and third metatarsals with medial displacement of the heads of the second and third metatarsals. There was also a moderate lateral

displacement of the shaft of the first metatarsal as well as inferior displacement. The heel bone was intact. (Fig. 3).

In wearing high heel shoes the body weight is projected forwardly, that is, anteriorly to the ankle and heel bone, and it rests on the middle portion of the foot skeleton, particularly on the distal ends of the metatarsal bones (Fig. 3); the plantar hypothenars are carrying the body load. As a consequence, inward stepping is favored, and then the pressure is exerted on the plantar eminence or outer balls of the fourth and fifth toes. Sudden forceful impact from below inevitably produces fractures of the metatarsals.

Three additional cases involving men 46, 50 and 57 years of age, who had the ordinary, normal, low heel working shoes on are to be considered.

The first two fell 20 feet, viz. 12 feet off a ladder, and both showed fracture of calcaneus on one foot only, but no injury to the other tarsal or metatarsal bones. The third mentioned workingman fell approximately 75 feet down an elevator shaft, precipitously sliding down a single rope and landed on both feet. Both calcanei, especially the left, exhibited comminuted fractures. The tuberosity of the fifth metatarsal bone of the left foot showed detachment of a small fragment, but otherwise no involvement of the metatarsals.

If the injuries of the foot skeleton of these three men are compared with the injuries of both women, especially of the second mentioned one, the significance of the shoe construction at the moment of the accident is readily understood. The mechanism of the foot injuries caused by violence from below is thus explained by two main factors: First, by the body weight, and secondly, by the abnormal construction of the shoe (unnatural high heel) as the localizing factor of the fracture.