ABSTRACT

The position of the posterior portion of the foot is difficult to evaluate and document on the basis of clinical examination. Conventional roentgenographic techniques also do not allow objective determination of hindfoot position. A new roentgenographic technique utilizing a double-exposure has been developed to allow accurate documentation of the position of the calcaneus relative to the ankle. Normal adult values for this technique have been determined from 60 normal feet.

Treatment of problems of the posterior portion of the foot has been impeded by an inability to define and document hindfoot position accurately. Clinical examination regarding hindfoot position is subjective and difficult to document. Diagnostically, this lack of objective measurements can sometimes present a problem, and therapeutically it is often difficult to evaluate results of treatment. Conventional roentgenographic views in both the anteroposterior and the lateral projections, while giving an indication of the position of the hindfoot by the relationships between the long axes of the talus and calcaneus, fail to define the exact position in any particular individual. This is due, in part, to individual variations in the relationships between the long axes.

As a solution to this problem, a new roentgenographic technique has been developed which allows accurate documentation of the position of the calcaneus relative to the talus and ankle. Sixty normal hindfeet have been examined to establish a range of normal for the technique.

DETAILS OF TECHNIQUE

This technique utilizes a weight-bearing double-exposure of the ankle and hindfoot. The foot to be examined is placed on a horizontal piece of plexiglass which is supported on each end, thus leaving the portion directly under the foot unsupported. The X-ray film is then placed directly behind the heel, and the foot is internally rotated until the malleoli are equidistant from the film plane (Fig. 1). The foot is positioned in this manner because the malleoli are the only prominent bony landmarks in this region, and it is necessary to evaluate the position of the calcaneus relative to the ankle regardless of the position of the forefoot. An anteroposterior X-ray exposure is then made in this position using standard ankle exposure technique. After this exposure, the patient is left standing in the same position, and the film cassette is not moved. The X-ray beam is then angled cephalad at an angle of 20° from the horizontal and centered on the malleoli (Fig. 2). A second exposure on the same film is made from this angle using the same exposure technique. As shown in Figure 3, the first exposure outlines the talus and the ankle very well; however, there is a lack of exposure in the region of the calcaneus because of the multiple overlying bones. Figure 4 is the same ankle after the second exposure which shows the outline of the calcaneus in addition to the talus. Thus, the weight-bearing relationship between the ankle and the calcaneus is accurately outlined on the same film.

The angle of 20° was arrived at on a trial and error basis. With less than 20°, it was found that the outline of the calcaneus was frequently obliterated by the forefoot on the second exposure. Greater than 20° sometimes resulted in an almost superimposition of the calcaneus on the talus in a severe valgus hindfoot.

It is important to position the malleoli equal distances from the film plane in order to obtain an accu-
The Code of Practice for the Protection of Persons Against Ionizing Radiation Arising from Medical and Dental Use, the dose limits for gonadal radiation of members of the public is 500 mrem per year. The calculated dose from this procedure would be approximately 0.006% of the maximum permitted level.

The position of the calcaneus relative to the ankle is measured by first drawing a line which intersects the superolateral portion of the ankle and is perpendicular to the surface supporting the foot. Next, the medial and lateral edges of the calcaneus are identified, and the center of the calcaneus is measured and marked. The distance between the perpendicular line and the center of the calcaneus gives the absolute value for the hindfoot position (Fig. 5).

Normal values in adults for this technique were determined from 60 normal feet of an equal number of male and female medical students and nurses. In 60 normal feet, the center of the calcaneus was found to be medial to the perpendicular line, a mean distance of 3 mm, with a standard deviation of 3.2 mm.

This technique has also been used in the evaluation of the immature foot. Although the number of normal...
Fig. 4. Same foot and ankle as in Figure 3 with the addition of the second exposure angled 20° cephalad which shows the outline of the calcaneus relative to the talus and ankle.

Fig. 5. Hindfoot view with line perpendicular to weight-bearing surface and point indicating center of the calcaneus. The measured distance between this point and the perpendicular line is the absolute value for the hindfoot position.
immature subjects studied is less than adults, it was found that in the normal foot the center of the calcaneus falls within several millimeters of the vertical line. Clearly, the amount of displacement is at least partially a function of size; therefore, in the growing skeleton the absolute displacement will vary with age.

CLINICAL APPLICATION

This method has now been in use clinically for several years, and has been found to be reproducible and simple to perform. Therapeutic results can be documented by comparing pretreatment values with those obtained following therapy. Progression of deformity can also be evaluated by using this technique.

It is recognized that hindfoot deformities can occur at either the ankle or the subtalar joint. Using this technique, the relative contribution of each joint can also be determined. As shown in Figure 6, part of the deformity is occurring at the ankle joint itself. To determine the relative contributions of the two joints, the technique for measuring the position is modified. Using the modified technique, the vertical perpendicular line is drawn perpendicular to the horizontal surface of the body of the talus rather than the surface upon which the foot is resting. The calcaneus is measured in the same way. This allows determination of the amount of deformity occurring at the subtalar joint and also the amount at the ankle.

REFERENCE