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COMPUTED TOMOGRAPHY OF THE ANKLE

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Transverse computed tomography of injured ankles gives additional information compared with conventional roentgen diagnostic techniques. In transverse sections the distal tibio-fibular joint and the suprasyndesmotic region can be examined with regard to incongruence and synostoses. It is also possible to examine the relations between the talus and the malleolar facets in different ankle positions. The technical problems and advantages are discussed.

Key words: ankle, fractures, function of; roentgen diagnostics; computed tomography

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In injuries of the ankle roentgen diagnosis can sometimes meet with problems. Owing to the curvature of the articular surfaces, a detailed evaluation of the different ankle structures is not always possible with conventional roentgen techniques. Tomography in different planes has previously been used to improve the possibilities of assessment. However, conventional axial tomography requires special equipment and often gives images that are much too blurred for a detailed evaluation.

PATIENTS AND METHODS

We have used computed tomography for the examination of nine patients with sequelae to fractures of the ankle joint, in order to evaluate the diagnostic advantages of this method. With an Ohio Nuclear Delta 50 FS body scanner transverse tomograms of the distal end of the leg and the ankle joints were taken with the patient supine and the talocrural joint in the neutral position, in maximal extension and in flexion. Frontal and lateral tomograms were taken at an angle of about 15° to the true frontal plane and to the true sagittal plane, respectively.

RESULTS

In transverse tomograms the space between the fibula and tibia could be assessed with respect to calcifications and to the position of the fibula in the fibular incisure of the tibia (Figure 1). The fit of the trochlea of the talus in the ankle mortise can be seen in Figure 2, which shows transverse sections immediately below the level of the joint space.

Figure 3 shows frontal tomograms. Tibiofibular calcifications can be seen and followed through such sections. Defects of the articular surface and lack of congruence between the distal tibial articular surface, the malleoli and the talar trochlea can also be observed.

The lateral view through the ankle and the 1st metatarsal demonstrates the trochlear curvature and a defect in the distal tibial

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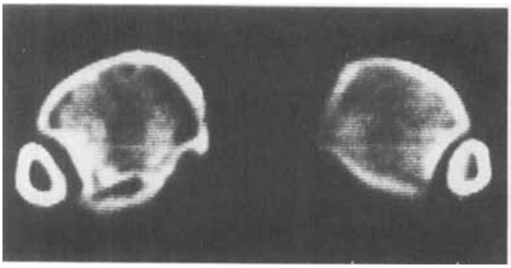

Figure 1. CT-scanner transverse sections through the tibio-fibular joint immediately above the ankle mortise.

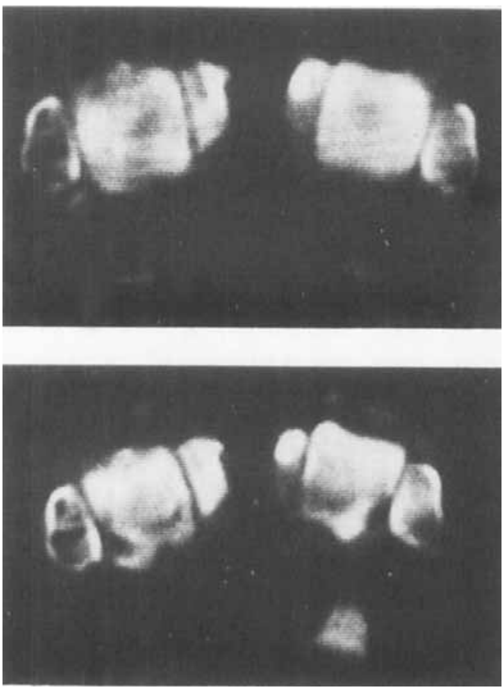

Figure 2. Tranverse section of the ankle in the malleolar plane with the ankle joint in dorsal extension (dorsiflexion) (top) and plantarflexion (bottom).

Figure 3. Section through the ankle at 15° to the frontal plane.

Figure 4. Supination-eversion ankle fracture grade IV.

articular surface. In addition the tarsal sinus and the small joints in the first ray of the midfoot can be evaluated (Figure 8).

To illustrate the usefulness of the method in different conditions resulting from ankle injuries, some typical cases are presented below.

The first is a grade IV supination-eversion injury in a 40-year-old woman (Figure 4). A post-traumatic arthrosis of the ankle joint developed (Figure 5).

In a series of transverse sections (Figure 6) through both ankles, the subchondral sclerosis in the left ankle can be seen on the upper pair of images, where the section lies immediately above the articular surface plane. On the lower image, where the section passes through the malleoli, the irregularities of the

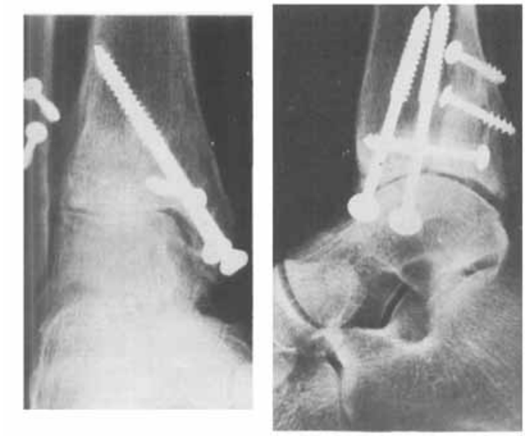

Figure 5. Post-traumatic arthrosis in the ankle shown in Figure 4.

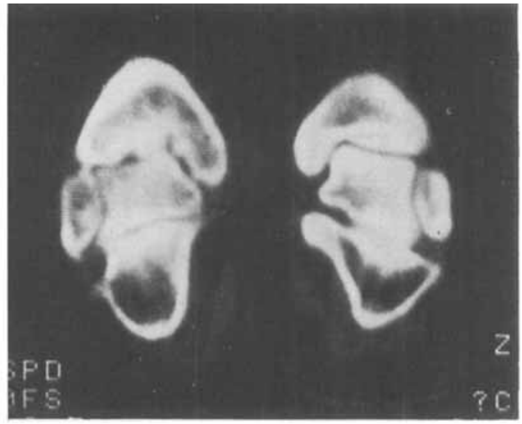

Figure 7. Post-traumatic arthrosis deformans. Section 15° to the frontal plane.

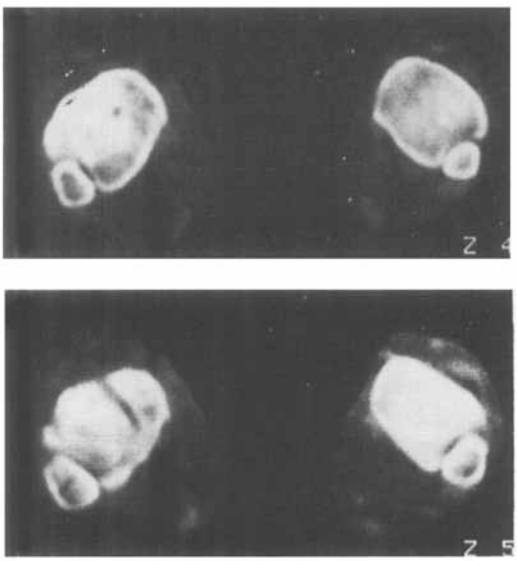

Figure 6. Post-traumatic arthrosis deformans. Transverse section just above and through the distal tibial joint surface.

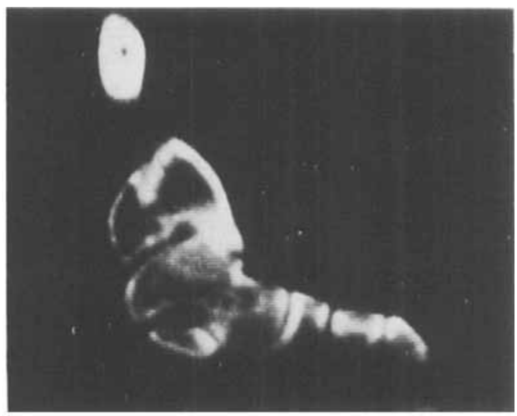

Figure 8. Post-traumatic arthrosis deformans. Section 15° to the sagittal plane.

talar articular surface on the anterior margin are visible. In the frontal tomogram (Figure 7) part of the distal articular surface of the tibia is destroyed, with formation of a gap in the medial angle. Sections in the sagittal plane reveal the corresponding defect on the distal tibial articular surface (Figure 8).

A few patients with tibio-fibular synostosis were examined. Figure 9 shows transverse sections above the ankle joint revealing distinct bridging callus between the tibia and fibula. In Figure 10 corresponding images from another patient are seen, but here there is an open gap in the synostosis.

DISCUSSION

Our investigation has shown that computed tomography can be used for examination of the ankle joint both in more conventional projections and in transverse sections for evaluating, for example, a tibio-fibular synostosis, the fit of the fibula into the fibular incisure of the tibia at the level of the syndesmosis, or

Figure 9. Tibio-fibular synostosis as seen in transverse sections through the distal leg.

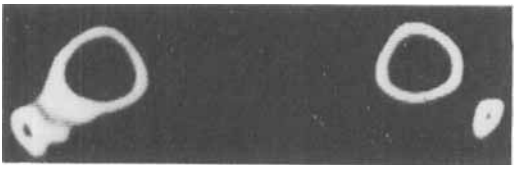

Figure 10. Tibio-fibular synostosis without complete bridging. The open gap in the callus is clearly visible in a transverse section through the distal leg.

the position of the talus in relation to the malleoli in different ranges of movement.

Many theories have been put forward concerning the shape of the talus and its fit into the ankle mortise. The talar trochlea has been considered to be wedge-shaped and a certain degree of play between the talar trochlea and the ankle mortise has been assumed to occur on plantar flexion (Fick 1911, Bonnin 1950). Computed tomograms taken as horizontal sections in the malleolar plane in living patients show that neither in dorsiflexion nor in plantar extension does any play occur between the talus and the malleolar facets. The talar trochlea fits well between the malleoli on all images. This is in agreement with the observations of Inman (1976), who described the trochlea tali as a section of a frustrum of a cone.

After injuries of the interosseous membrane and the syndesmosis and also after the use of suprasyndesmotic screws, a bony bridge between the distal ends of the fibula and tibia is sometimes seen. It may be of importance to be able to determine whether there is a complete synostosis or whether an open gap is present. Soft tissue ossifications in the syndesmotic area are more easily evaluated by

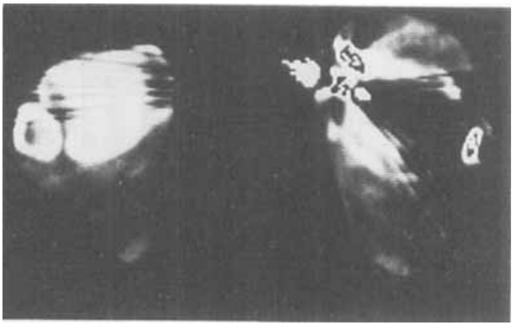

Figure 11. Artefacts from metallic implants. Transverse sections just above the ankle joint.

transverse computed tomography than by more conventional methods.

The technical problems encountered in our examinations have been partly related to the position of the patient. It is difficult, for example, to examine a standing patient with a whole-body scanner that is constructed and intended for a supine patient. It is also difficult, therefore, to take pictures under weight-bearing stress.

Even the slightest difference in the length of the legs makes it difficult to get exactly comparable tomographic sections of the injured and intact ankle joints. Furthermore, screws and plates used for internal fixation may cause interfering blurs which make it impossible to evaluate tomographic sections passing through metallic implants (Figure 11).

In frontal and sagittal sections the image quality offers no advantages over conventional tomographic techniques. In transverse computed tomographic sections the detailed resolution in the image is better than in many conventional axial tomographic methods. The density of the image can be varied and information regarding the bone structure, the appearance of the joint spaces, and the soft tissues, muscles, tendons and blood vessels can be obtained. Studies using the image processing unit are of considerably greater value than those in which only paper copies of screen images are employed.

The costs of conventional roentgen diagnostic methods and computed tomographic examination of the ankle are about the same.

If a computed tomograph is available in the hospital for other purposes it is well worthwhile using it also for the analysis of selected cases of ankle injury.

CONCLUSIONS

Computed tomography of the ankle gives greater diagnostic information than conventional roentgenography in certain cases. The method also permits experimental studies of joint congruence in different ranges of movement. If used correctly and with strict indications, computed tomography constitutes a valuable addition to the diagnostic arsenal in pathological conditions following ankle injuries.

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