Radiological Screening

Contents

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3.1 Conventional Radiographs

Whenever possible, all conventional radiographs should be performed standing, under bipodal weight-bearing conditions. This is one of a number of factors that allows for comparative studies and as it is the condition which most closely approaches the normal function of the foot, it is the true counterpart of the clinical picture obtained during clinical examination.

3.1.1 Hindfoot

3.1.1.1 Antero-Posterior View (Frontal Plane)

This view is critical to assess the ***axis of the hindfoot within the frontal plane***.

If the forefoot is normal, the projection of the second metatarsus should be vertical. Some essential aims are the visualization of the following:

1. The angulation of the talus beneath the tibia
2. The shape of the distal fibula
3. The plantar aspect of the tuber calcanei in relation to the upper ankle joint
1. The angle of the talus dome to the vertical in a standing patient (talar tilt) should be very close to 90 degrees. This angle bears testimony to stability though the axis of the tibia is not relevant in itself due to evident mechanical reasons.
2. The shape of the fibula is critical in reduced malleolar fractures. Anatomical congruency of the tibiotalar joint through the distal fibula is essential for functional stability ***(O230)***.
3. The plantar edge of the tuber calcanei shows the exact weight-bearing spot of the heel. In a stable hindfoot, the centre of the tuber must be located lateral to the centre of the talar dome [33] ***(A9) (E18)***.

Hindfoot Varus

The image of the tuber calcanei is situated medial of or on the vertical line passing through the middle of the talar dome ***(E19)***.

The varus component is ***located at the subtalar joint level.***

The angulation may be ***located within the upper ankle joint,***


163

thus demonstrating a talar tilt.

Hindfoot Valgus

It is essential to determine the fulcrum of the angulation. It is either ***in the upper ankle joint***


164

or ***in the lower ankle joint*** (subtalar).


165

3.1.1.2 Lateral View (Sagittal Plane)

In this view, the radiological beam is centred on the upper ankle joint. The upper ankle joint must therefore be fully visible. This view should ***always be taken from medial to lateral***

166

with the aim of achieving a true lateral image of the upper ankle joint. The mutual alignment between the talus, the calcaneus, the navicular and the cuboid are seen.

The calcaneal pitch is the angle between the lower tangential straight line to the calcaneus and the weight-bearing plane. The distal convergence of both talus and calcaneus axes is noted.

Arthrosis of the upper ankle joint

Due to the conical shape of the talar dome within the horizontal plane, the ***talus tends to shift anteriorly***

if improperly retained by the ligaments, thus creating a progressive incongruency with the tibial joint surface.

3.1.2 Foot

3.1.2.1 Antero-Posterior (Dorso-Plantar) View (Horizontal Plane)

This view must always be taken for each foot individually to obtain a true vertical "shadow" of the foot. The beam is centred on the second cuneiform with an inclination of 15 degrees from distal to proximal in order to be vertical to the dorsum of the foot. In this way, the joints can be observed and the talus and calcaneus axes can be seen. In the normal foot, the straight alignment of the talus on the first metatarsus is essential.

The four bones**,** ***talus, navicular, medial cuneiform and first metatarsus,*** are aligned on one axis**.**

The lateral wall of the calcaneus is more or less aligned on the fifth metatarsus. Eventual misalignment must be localized specifically for optimal surgical correction. The morphotype of the foot is determined. By 'index metatarsus' the relative length of the metatarsi 1 and 2 is meant ***(R174-175)***. The alignment of the metatarsal heads should run on a parabolic line [34].

Pes Abductus

The axis of the talus does not fit with the axis of the first metatarsus.

If the abductus is ***located at the talo-navicular joint,***

the coverage of the talar head by the navicular bone is reduced.

The abductus may be ***centred on the TMT joints***

and the navicular bone and the first cuneiform are well aligned on the axis of the talus.

Unstable First Ray

The unstable first ray demonstrates a sagittal hypermobility which reduces the antero-medial weight-bearing ability. Consequently, ***the second metatarsus***, which is strongly fixed at its base, takes the functional load and ***undergoes hyperplasia*** [4].

Splay Foot

The ***divergence between the axis of the first and the fifth metatarsi is increased***.

In general, these feet present a hypermobile first ray within the sagittal and the horizontal planes and the space between the first cuneiform and the second metatarsus is increased.

The second metatarso-phalangeal joint is subluxed due to the insufficient first ray and the consecutive local overload on the second metatarsus ***(E43)***.

The relevant congenital pathomorphological parameters of the unstable first ray are probably the ***oblique orientation of the cuneometatarsal joint*** within the horizontal plane and the presence of a ***small articular facet between the basis of the first and the second metatarsus.***


173

The hold of the first metatarsus to the lesser metatarsi is insufficient due to the missing ligamentous structures. The head of the first metatarsus thus slips off the sesamoid bones which are firmly tightened to the second metatarsus.

Index Metatarsus Minus

The normal alignment of all metatarsal heads follows a parabola. Here, the ***first metatarsus is proximal to the parabola***


174

and is shorter. This foot may thus present an overloaded second (and third) metatarsus which is larger [4] ***(E61-63)***.

Index Metatarsus Plus

The ***first metatarsus is longer than the second***.

Here, the big toe is also longer than the second toe. This constellation jeopardizes the first metatarso-phalangeal joint which may be overloaded and undergo premature degeneration ***(O413-414)***.

3.1.2.2 Lateral View (Sagittal Plane)

This view should always be taken from medial to lateral and the plane includes the lateral edge of the hindfoot (calcaneus). In cases where the mid-foot or forefoot is deformed, it is advisable to achieve a true lateral incidence to the hindfoot as a reference. The straight alignment of the talus to the first metatarsus is essential. Here too, the four elements, ***talus, navicular, medial cuneiform and first metatarsus,*** are aligned on one axis.

Within the sagittal plane, a flat foot may demonstrate a ***sag at the talo-navicular joint.***

The talus protrudes the acetabulum pedis. A curved dorso-lateral osteophyte (dorsal beak) of the talar head is a sign demonstrating the pathological motion of the navicular on the talar head ***(O239)***. The whole hindfoot undergoes an equinus position because the midfoot is collapsed. The foot lever is not effective.

The misalignment of the flat foot may be localized anywhere on the first ray. The sag must be localized specifically for optimal surgical correction. On this image, ***plantar gapping of the naviculo-cuneiform and cuneo-metatarsal joints***

should be noted. A sag such as this is very common in Charcot diabetic arthropathy [14] ***(C1041)***.

The longitudinal arch might have increased which is the case in many muscular imbalances, and thus linked to neuromuscular abnormalities. The localization of the apex of the arch gives an idea of the cause. The ***posterior pes cavus***

is present in weak calf muscles such as in poliomyelitis. Note that the talus is aligned with the first metatarsus.

The ***anterior pes cavus***

may be associated with an imbalance between tibialis posterior and fibularis musculature.

Here, the talus is not aligned with the first metatarsus.

3.1.3 Special Incidences

3.1.3.1 Oblique

This view is not made under weight-bearing conditions. The foot is inclined towards medial and the ***beam is orthogonal to the lateral metatarsus***.

The calcaneo-navicular space (coalitions) and the lateral TMT joints are seen better.

3.1.3.2 Brodén View

This view [35] is not made under weight-bearing conditions. The foot is held in an orthogonal position and the beam is inclined towards proximal by about 20–40 degrees.

The whole leg is internally rotated about 45 degrees and the beam is ***centred on the sinus tarsi***

182

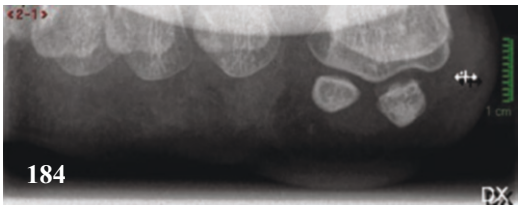
with the aim of visualizing the posterior subtalar joint facet. This image is relevant in checking the joint morphology after trauma and is the most appropriate radiograph for the diagnosis of an articular fracture.

3.1.3.3 Forefoot Axial

The patient is standing on a double-wedged, radiolucent, solid structure with the aim of ***raising the toes and the heel from the horizontal surface.***


183

The radiological beam is conducted horizontally [36] from the back towards the toes and the film is placed vertically in the frontal plane in front of the foot. The objective is to demonstrate the ***vertical alignment of the metatarsal heads***


184

and, in particular, the sesamoid bones of the first ray.

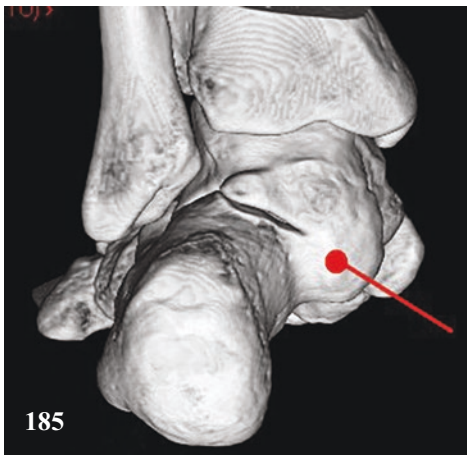
3.1.3.4 Stress Views of TMT Joints

In rare cases in which the post-traumatic stability of the TMT joints are questioned, the forefoot can be stressed in adduction or abduction under a dorso-plantar radiological incidence. This test can be performed under fluoroscopy to adjust the view axis.

3.2 Computed Tomography

As computed tomography (CT) is not yet commonly performed under weight-bearing conditions, the foot is placed and held in an orthogonal position within both sagittal and frontal planes. This simulates the weight-bearing position of the osteoarticular structures. The bony structures are better seen, including bone necrosis.

The three-dimensional reconstruction shows the spatial aspect of the deformities such as ***subtalar coalition***


185

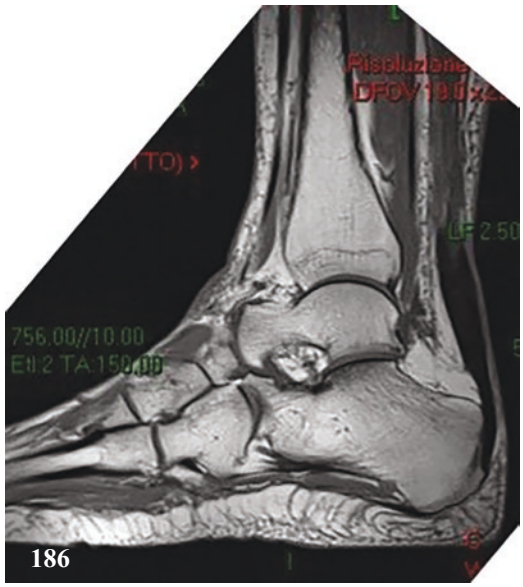
or impingements.

Intra-articular disorders may be best visualized by intra-articular contrast with CT. Intra-articular bodies and osteochondritis tali are good indications for this technique.

3.3 Magnetic Resonance Imaging

Magnetic resonance imaging (MRI) should be done in the same position as the CT. This exam shows qualitatively soft tissue lesions or abnormalities within the joint (cartilage) or without (tendons, tumours, nerves, joint capsules) but lacks precision in demonstrating bone necrosis.

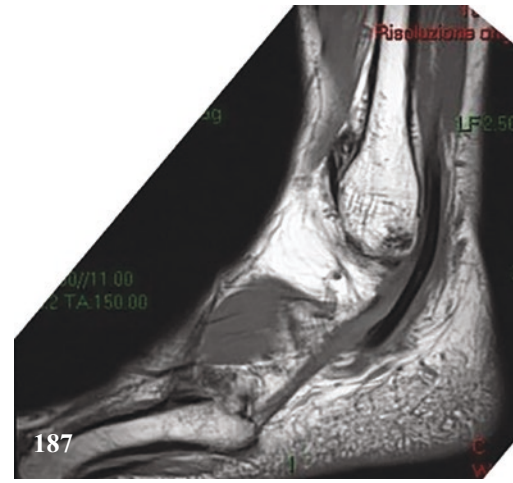
Achilles chronic degeneration can be visualized in detail ***(E17)***



186

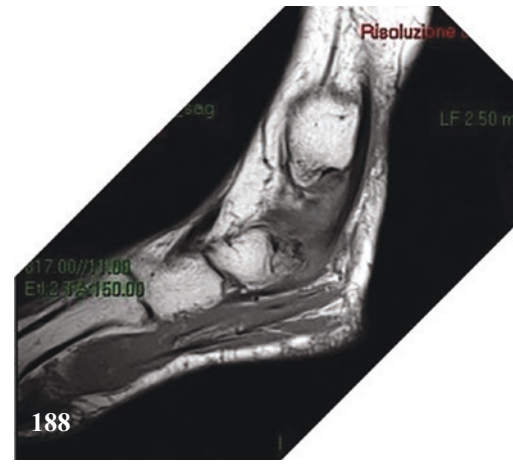
as well as

chronic fibularis tendon lesions (T903) and



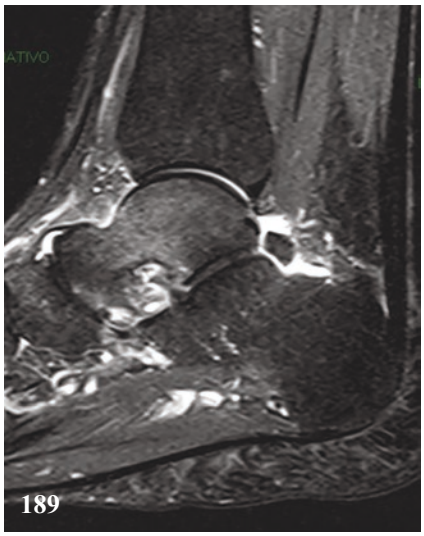
187

posterior tibial tendon degeneration and scarring ***(T906)***.



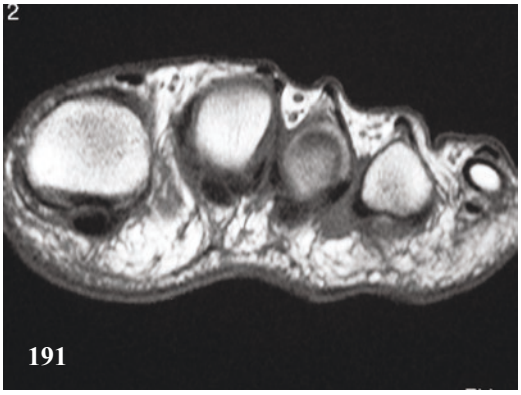
188

Fractured postero-lateral process of the talus



may be evaluated in the context of tibio-talar and talo-calcaneal impingement ***(T668-669)***. Soft tissue abnormalities such as an occasional ***musculus soleus accessorius*** (red arrow)

located anteriorly to the normal soleus and inserting into the medial aspect of the tuber calcanei ***(E155)*** and ***pseudoneuroma***



between the third and the fourth metatarsal heads ***(E143)*** are best seen with this technique ***(T947)***.

The plantar fascia is also well visualized and can reveal occasional fibromatic lesions. Such fibromatosis is mostly localized at the ***medial edge of the fascia (E98).***