Radiology of acute ankle injuries

Introduction

Ankle injuries are extremely common conditions presenting to the emergency department. Ankle radiographs account for 10% of all plain films requested by the emergency department, fewer only than chest and cervical spine radiographs. Although most of these are sprains, typically from inversion injuries, several fractures are described.

The Ottawa guidelines suggest when a radiograph will be helpful in diagnosis, and have been shown to be over 98% sensitive in patients over 6 years of age (Bachmann et al, 2009). The Ottawa guidelines suggest plain radiographs should be performed when there is bony tenderness at the posterior edge (within the inferior 6 cm) or tip of the lateral or medial malleoli or if the patient is non-weight bearing immediately after the injury and within the emergency department for four steps.

Radiographs

1. Anteroposterior mortice: this view is taken with slight internal rotation to avoid overlapping of the talus by the fibula
2. Lateral: includes the calcaneum and base of the fifth metatarsal.

Anatomy

The bones involved in the ankle joint are the distal tibia, with a large medial malleolus and a less prominent posterior malleolus; the distal fibula known as the lateral malleolus; the talus and the calcaneus.

The ankle joint comprises two synovial joints:

- A talocrural joint between the talus and the malleoli, allowing dorsiflexion and plantar flexion
- A subtalar joint between the talus and calcaneus, allowing inversion and eversion. This joint was discussed in Gummow and Khan (2010).

The normal apophysis of the base of the fifth metatarsal runs in long axis, parallel to the metatarsal, and should not be mistaken for a fracture line (*Figure 1*).

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Radiological assessment and classical signs

The ABCS system of radiological assessment is followed for systematic evaluation:

Adequacy
Alignment
Bones
Congruity
Soft tissue.

Adequacy

The standard ankle series is made up of anteroposterior 'mortice' and lateral projection. The anteroposterior mortice view, rather than a true anteroposterior, is performed to adequately visualize the talar dome and the entire joint space.

Alignment

On the anteroposterior mortice projection, the joint space is uniform along its entirety. The slight angulation of the mortice view brings the fibula lateral to the talus, allowing the lateral aspect of the joint space to be visualized. The talar dome should be seen along its length.

The lateral projection should include the entirety of the calcaneus and also, historically, the entire navicular and an adequate portion of the base of the fifth metatarsal.

Bones

Fractures generally present as breaks in the cortex with displacement or angulation. Trabecular disruption or dense sclerotic lines may also be seen. It is common for fractures to only be visible on one view and fibular fractures or posterior malleolar fractures are often only visible on the lateral projection. As mentioned, fractures are often associated with ligamentous damage, identified by joint space widening.

Salter–Harris fractures are commonly seen in the ankle.

Accessory ossicles are very common, as are fracture fragments. The latter will typically be tender and have an ill-defined side, possibly with a similar sized ill-defined area on the adjacent bone. Accessory ossicles will typically have a smooth sclerotic margin and be in common sites. These are discussed in detail in Keats and Anderson (2006).

Figure 1. Normal (a) lateral and (b) anteroposterior mortice views showing the talar dome. On the lateral projection the fifth metatarsal is viewed.

Figure 2. Soft tissue swelling overlying the lateral malleolus (arrows), but no fracture is seen.

Congruity

Widening of the joint space is highly suggestive of ligamentous damage. Similar to pelvic rim fractures, this disruption in the bony or ligamentous ring should prompt the films to be scrutinized for a second break elsewhere.

Soft tissue

Fractures may not be obvious at first glance, but the presence of overlying soft tissue swelling may well indicate a fracture and the underlying bone should be carefully examined. Swelling over or just inferior to the lateral malleolus on the anteroposterior projection is common, but is usually present when there is a fracture. The lateral projection may reveal soft tissue swelling around the joint (*Figure 2*), known as the teardrop sign, again suggesting a fracture.

Figure 3. A fracture of the base of fifth metatarsal (arrow). This can easily be missed if the observer concentrates solely on the ankle joint.

Pitfalls

1. Accessory ossicles are very common and should be distinguished from fractures by means of clinical correlation, site and appearance.
2. A Maissoneuve fracture should not be missed when there appears to be isolated widening of the joint space or a single fracture of the medial or posterior malleoli. In this scenario, a knee radiograph should be performed.
3. Fractures of the base of the fifth metatarsal (*Figure 3*) or navicular bone should not be missed on the ankle radiographs. The normal long axis apophysis should not be mistaken for a fracture.

Injuries

Soft tissue swelling

Following trauma, soft tissue swelling is common, even in the absence of a fracture.

Fractures

Fractures of the medial malleolus, the lateral malleolus or the posterior malleolus may be seen. Bimalleolar fractures consist of fractures in the medial and lateral malleoli. Trimalleolar fractures also involve the posterior malleolus (*Figure 4*).

Fibular fractures are described according to the Weber classification. This depends on the relationship of the fracture to the anterior inferior tibiofibular ligament.

Weber A fractures

These occur below the ligament (*Figure 5*). The syndesmosis is intact, and the medial malleolus is often fractured.

Figure 4. a. Lateral and (b) anteroposterior radiograph of ankle showing trimalleolar fracture: fracture of both medial and lateral malleolus and the posterior malleolus. Note the posterior malleolar fracture is well demonstrated on the lateral radiograph.

Figure 5. Weber A fracture. The fracture line is seen on the lateral aspect below the level of the tibiofibular ligament (arrow). This ligament lies just superior to the syndesmosis, hence any fracture distal to the syndesmosis will be a Weber A fracture. Note the soft tissue swelling.

Weber B fractures

These occur at the level of the ligament (*Figure 6*). The syndesmosis may be intact or partially torn.

Weber C fractures

These occur above the ligament (*Figure 7*). The syndesmosis is disrupted and the distal tibiofibular articulation is widened.

A Maisonneuve fracture (*Figure 8*) is a Weber C fracture plus a tear of the distal tibiofibular syndesmosis and interosseous membrane. The fibular fracture may well be above the area X-rayed and hence this should be suspected in radiographs with an apparent isolated widening of the joint space or medial or posterior malleolar fracture. It is similar to Galeazzi and Monteggia fractures of the forearm.

Weber A fractures are usually stable, depending on whether the deltoid ligament is intact. Weber B fractures are often unstable. All Weber C fractures are unstable with deltoid injury inevitable, and these require open reduction and internal fixation. A posterior malleolar fracture suggests that the joint is unstable. BJHM

Conflict of interest: none.

Bachmann LM, Kolb E, Koller MT, Steurer J, ter Riet G (2009) Accuracy of Ottawa ankle rules to exclude fractures of the ankle and mid-foot: systematic review. *BMJ* **326**(7386): 417

Keats ET, Anderson MW (2006) *Atlas of Normal Roentgen Variants that may Simulate Disease.* 8th edn. Mosby, St Louis

Gummow AD, Khan SHM (2010) Radiology of acute foot injuries. *Br J Hosp Med* **71**(5): M70–M73

Further reading

Raby N, Berman L, De Lacey G (2004) *Accident & Emergency Radiology, A Survival Guide.* WB Saunders, London

Figure 6. Weber B fracture. Here the fracture line (arrow) is seen above the syndesmosis at the level of the anterior inferior tibiofibular ligament.

Figure 7. a. Lateral and (b) anteroposterior radiograph of the ankle showing a bimalleolar fracture; fractures of the lateral and medial malleoli are clearly identified. The position of the fibular fracture (arrow), along with widening of the joint, denotes a type C fracture.

Figure 8. Maissoneuve fracture. a. A fibular neck fracture (arrow) is identified on the knee radiograph and (b) is associated with a fracture of the lateral malleolus (arrow) in the ankle radiograph.

KEY POINTS

- The anteroposterior mortice view is used to allow scrutiny of the talar dome.
- The posterior malleolus should be carefully examined for fractures.
- The site of lateral malleolar fractures helps determine the stability of the joint.
- Accessory ossicles have a smooth sclerotic margin and should not be mistaken for fractures.
- The base of the fifth metatarsal and navicular fractures should not be missed.