Chapter 14

Lower Limb and Pelvis

Learning Objectives

At the conclusion of this chapter, you will be able to:

- Name the bones that make up the lower limb and pelvis and identify each on an anatomic diagram and on a radiograph
- Name and identify the significant bony prominences and depressions of the lower limb and pelvis and identify significant positioning landmarks by palpation
- Demonstrate correct body and part positioning for routine projections and common special projections of the lower limb and pelvis
- Correctly evaluate radiographs of the lower limb and pelvis for positioning accuracy
- Describe and recognize on radiographs pathology that is common to the lower limb and pelvis

Key Terms

calcaneus
fabella
femur
fibula (pl. fibulae)
ilium (pl. ilia)
ischium (pl. ischia)
meniscus (pl. menisci)
metatarsals
patella (pl. patellae)
pedal digit
phalanges
prosthesis (pl. prostheses)
pubis (pl. pubes)
talus
tarsal bones
tibia

Many of the bones of the lower limb correspond to similar structures with similar functions in the upper limb. However, there are a number of significant differences, particularly in the ankle and knee joints. The understanding of both upper and lower extremities will be enhanced by comparing the two extremities.

ANATOMY

The lower limb includes the foot, toes, ankle, lower leg, knee, and **femur** (Fig. 14.1). The pelvis connects the lower limb to the axial skeleton, so it is included here.

Foot and Toes

The foot is commonly divided into three basic parts: the forefoot, the midfoot, and the hindfoot (Fig. 14.2). The bones of the forefoot include the **phalanges** and **metatarsals**. They correspond to the phalanges and metacarpals of the hand. The toes, sometimes called pedal digits, are numbered 1 through 5 from medial to lateral, just as are the fingers in the hand. The first **pedal digit** is called the *great toe* and has two phalanges. The rest of the toes have three phalanges. Just as in the hand, the hinge joints that connect the phalanges are called *interphalangeal (IP) joints* and are named *proximal* and *distal* in toes 2 through 5. The great toe has only one IP joint. The metatarsals are numbered 1 through 5, starting with the medial aspect. The numbers correspond to the digits with which they articulate. The distal end of a metatarsal is called its *head*, and the proximal end is referred to as the *base*. The hinge joints between the metatarsals and the proximal phalanges are called *metatarsophalangeal (MTP) joints*.

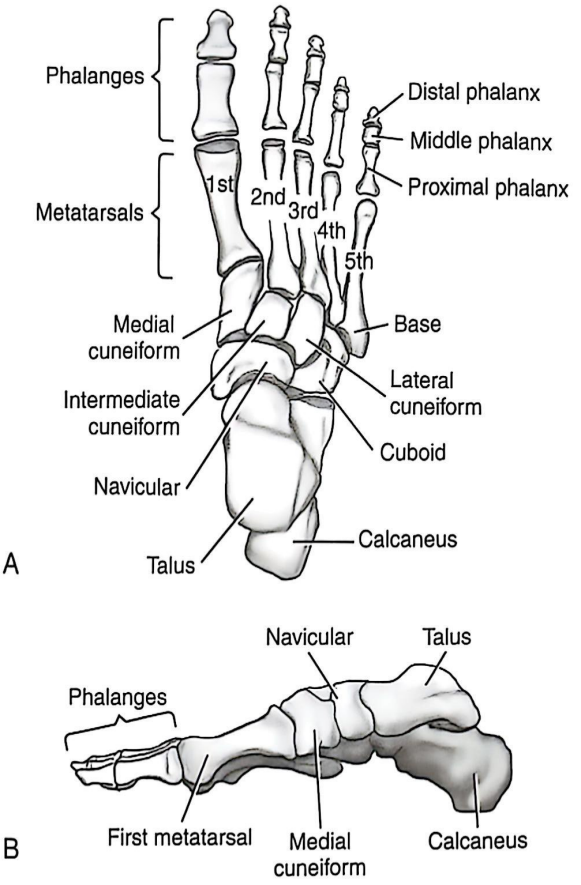


Fig. 14.2 Foot. (A) Anterior (dorsal) aspect. (B) Medial aspect.

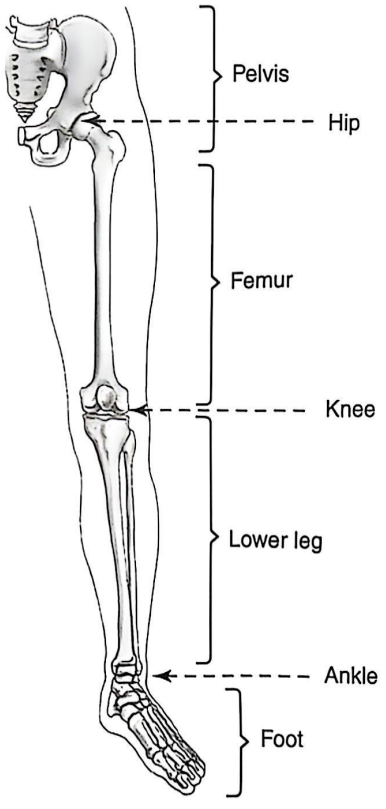


Fig. 14.1 Lower limb.

There are usually two sesamoid bones in the region of the first MTP joint. These small, flat, oval bones were introduced in Chapter 13. They are located within tendons and are not counted among the bones of the body. They serve as levers and to protect the joint.

The midfoot consists of five short bones called **tarsal bones**. The three cuneiform bones are named by location: medial, intermediate, and lateral. They articulate with the first, second, and third metatarsals, respectively. Lateral to the third cuneiform is the cuboid, which articulates with the fourth and fifth metatarsals. Proximal to the cuneiforms is the navicular bone.

The hindfoot includes the **calcaneus** and the **talus**. The calcaneus is commonly referred to as the *heel bone*. The talus is superior to the calcaneus and in addition articulates with the navicular, the **tibia**, and the **fibula**. The intertarsal (between the tarsal) joints are gliding joints with relatively small amounts of motion.

Ankle, Lower Leg, Knee, and Femur

The talus articulates with the tibia and fibula to form the ankle mortise. Weight is transferred from the shaft of the

tibia through the talus, while the malleoli provide stability on either side. The entire joint is shaped like an inverted box (⊓) (Fig. 14.3). It is called a *mortise joint* because it resembles a carpenter's joint of the same name. The ankle is a hinge joint. When it flexes to raise the foot, the motion is called *dorsiflexion*; when it extends, pointing the toe downward, the motion is called *plantar flexion*. Lateral flexion of the ankle tends to roll the foot onto its medial aspect and is called *eversion*. Medial flexion causes the foot to roll onto its lateral aspect and is called *inversion*.

The lower leg (Fig. 14.4) consists of two long bones, the tibia and the fibula. The tibia is the longer, thicker bone on the medial side. The fibula is much thinner and somewhat shorter and is located laterally. The medial malleolus is a bony prominence that can be palpated at the ankle on the medial aspect of the distal tibia. The lateral malleolus is the rounded prominence on the distal aspect of the fibula and can be felt on the lateral aspect of the ankle.

A knoblike protuberance on the anterior surface of the tibia near the proximal end of the shaft is called the *tibial tuberosity*. The articular surface of the proximal tibia is a large, flat surface called the *tibial plateau*. The medial and lateral condyles are palpable projections on either side of the tibial plateau. Near the center of the tibial plateau are two superior projections called the *intercondylar eminences* or *tibial spines*.

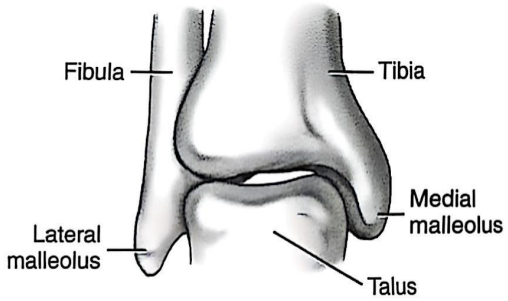


Fig. 14.3 Anterior aspect of ankle joint.

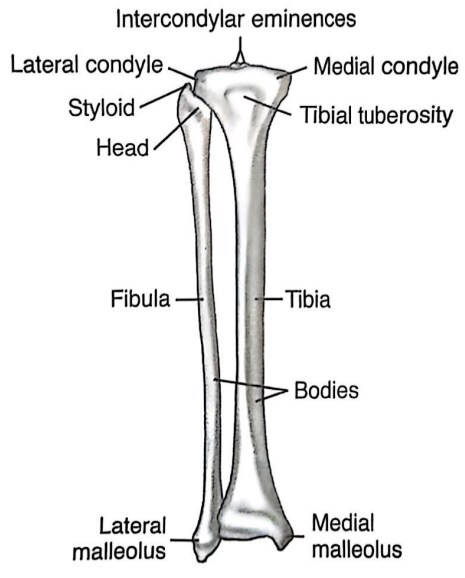


Fig. 14.4 Anterior aspect of tibia and fibula (lower leg).

The rounded proximal portion of the fibula is called the *head*. It terminates in a styloid process. The proximal fibula articulates with the metaphysis of the tibia at the inferior aspect of the lateral condyle. It is not a part of the knee joint.

The single long bone of the thigh is called the femur (Fig. 14.5). It is the largest, heaviest bone of the body. The distal end of the femur flares to form two palpable prominences, the medial and lateral condyles. Between the condyles on the posterior aspect of the leg is the intercondylar fossa. The distal articular surfaces of the condyles articulate with the tibial plateau to form the knee, which is a hinge-type joint. The articular surface of each condyle is cushioned by a C-shaped cartilage called a **meniscus**.

Anterior to the distal femur is the **patella**, commonly called the *kneecap*. It is a flat bone in the shape of a rounded triangle with its apex on the inferior margin. The patella is actually a large sesamoid bone, the only sesamoid bone numbered among the bones of the body. It is not unusual for there to be an additional small sesamoid bone posterior to the knee. This normal variation is called a **fabella**.

The rounded superior end of the femur is called the *head*. A small indentation on its posterior superior surface is called the *fovea capitis*. The narrow portion between the head and the shaft is the *neck*. The neck extends from the shaft at an angle, projecting superiorly and medially. Just inferior to the neck, the proximal shaft of the femur flares to form two prominences, the greater and lesser *trochanters*. The greater trochanter is a large projection on the lateral aspect that is palpable on the side of the upper thigh. The lesser trochanter is inferior to the greater trochanter and projects medially. It is not normally palpable. Between the two trochanters on the posterior aspect of the leg is a bony ridge called the *intertrochanteric crest*.

Fig. 14.6 illustrates the palpable bony landmarks of the lower limb.

Pelvis and Hip

The two bones that make up the halves of the pelvis are called the *hip bones*, also called the *os coxae* or *innominate bones* (Fig. 14.7). Each is a composite bone made up of three bones: the **ilium**, the **ischium**, and the **pubis**.

The ilium forms the upper portion of the pelvis. Its large flat superior portion is called the *ala*, or wing. It articulates with the sacral portion of the spine medially, forming the sacroiliac joint. Its rounded superior margin is palpable and is a common positioning landmark called the *iliac crest*. On the lateral aspect of the ilium is an anterior projection called the *anterior superior iliac spine (ASIS)*. The ASIS is palpable on the anterior surface of the body in the hip region and is also a common positioning landmark.

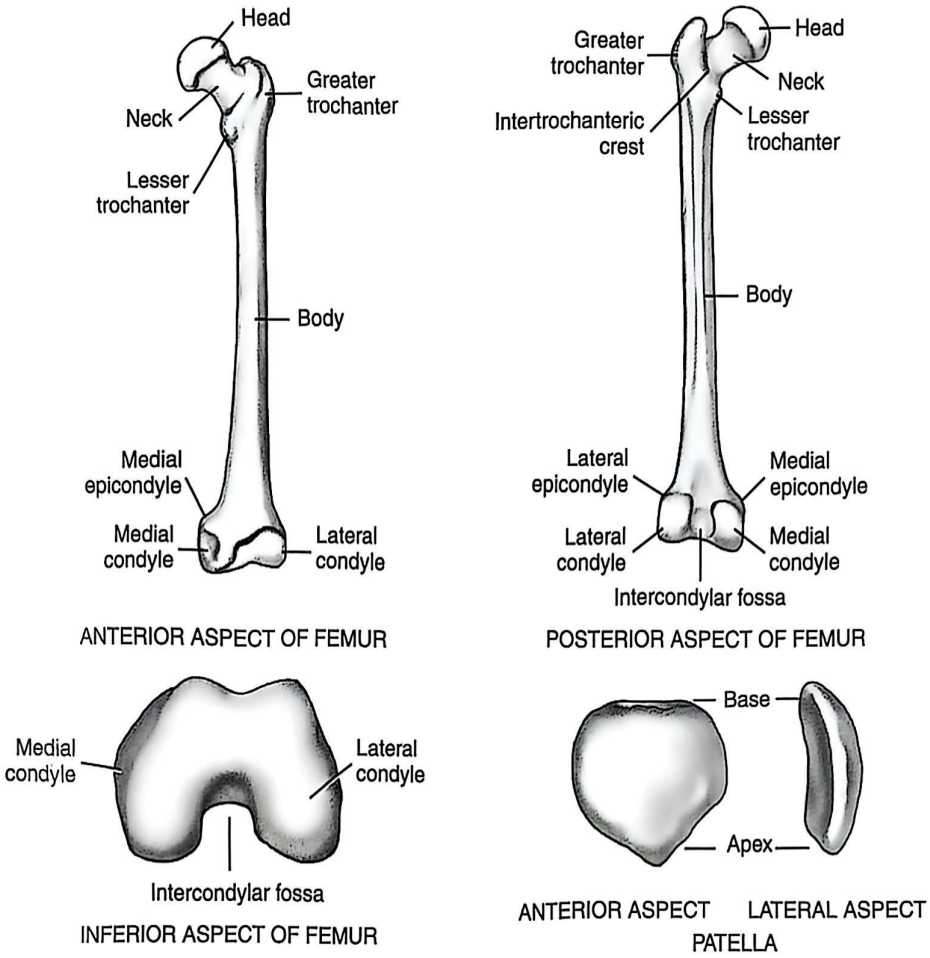


Fig. 14.5 Femur and patella.

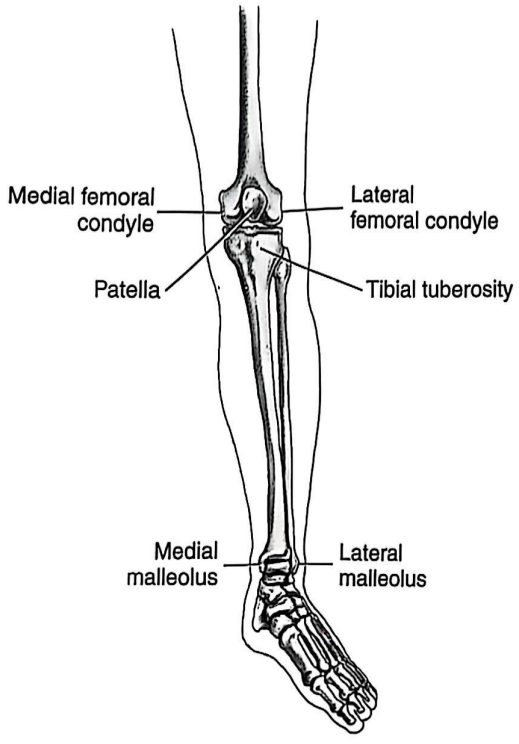


Fig. 14.6 Palpable bony landmarks of the lower limb.

The inferior portion of the pelvis is formed by the ischium, on the posterior aspect, and the pubis, on the anterior aspect. The most inferior portion of the ischium is a bony prominence called the *ischial tuberosity*. When one is sitting erect, the weight of the body is supported on the ischial tuberosities. They are palpable through the inferior portions of the buttocks. Together, the rami (branches) of the ischium and pubis form a bony ring. The hole within this ring is called the *obturator foramen*.

The ilium, ischium, and pubis join to form a synarthrodial joint at the acetabulum. The acetabulum is the rounded fossa that forms the socket of the hip joint. It articulates with the head of the femur. The right and left pubic bones join in the midline to form the pubic symphysis, an amphiarthrodial joint.

Fig. 14.8 illustrates the palpable bony landmarks of the pelvis and hip.

POSITIONING AND RADIOGRAPHIC EXAMINATIONS

Examinations of the lower limb from the toes up to the knee joint are usually done on the tabletop (nongrid), with the patient sitting or lying on the radiographic table.

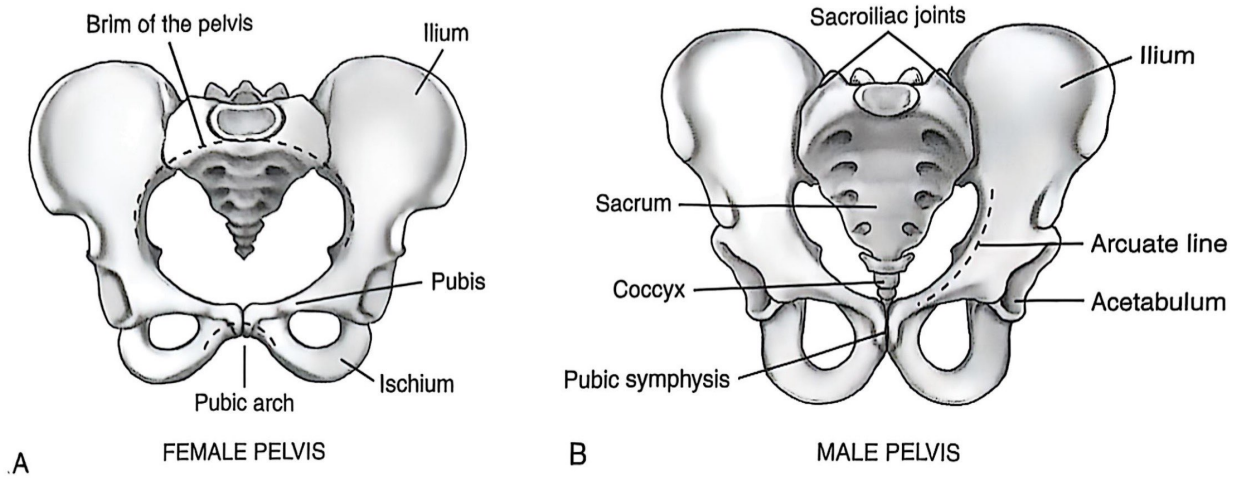


Fig. 14.7 Pelvis. (A) Female. (B) Male.

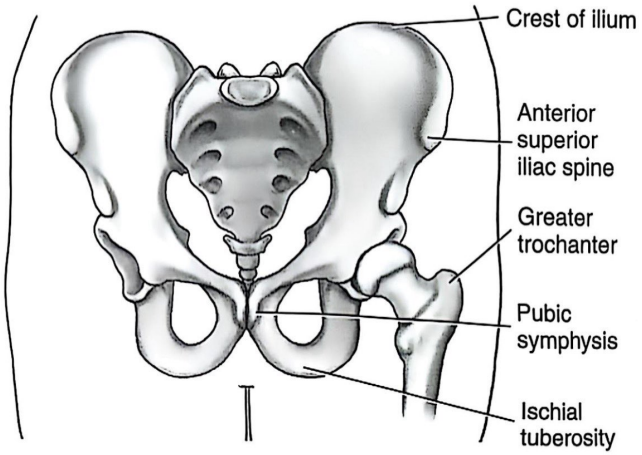


Fig. 14.8 Palpable bony landmarks of the pelvis and hip.

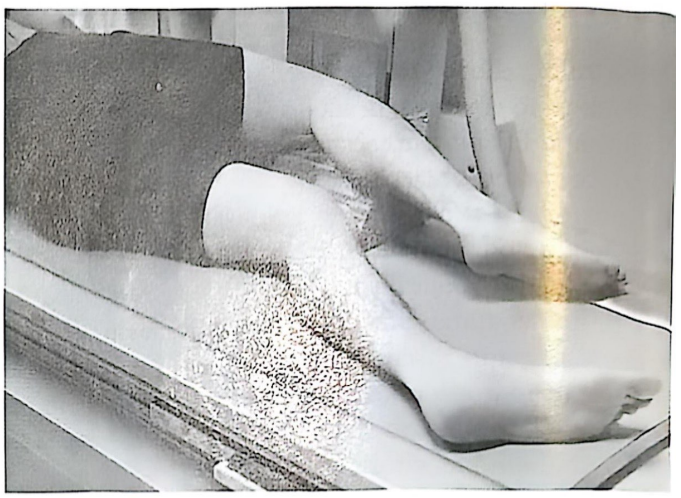


Fig. 14.9 Body position for lateral projections of lower limb.

The shoe and stocking should be removed from the affected leg, as should any jewelry in the region. Trousers should be removed if they cannot be moved out of the radiation field, especially if the fabric is heavy, such as jeans. A rolled or bunched trouser leg will create an artifact on the image that may interfere with seeing pathology.

Although gonad shielding is legally required only for examinations of the femur, it is wise to shield whenever possible. A lead apron is shown for these examinations, when appropriate.

The body position illustrated in Fig. 14.9 places the entire lower limb in lateral position. This body position may be used for any lateral projection of the lower limb. Note that the coronal plane of the pelvis is perpendicular to the table, the knee is flexed approximately 45 degrees, and the ankle is dorsiflexed so that the foot forms an angle of 90 degrees with the lower leg. The unaffected leg is supported to prevent rotation of the pelvis. However, when the patient is unable to attain this position, the unaffected leg can be placed behind the affected leg as long as the lateral position is maintained.

Toes

Although the toes are included in the examination of the foot, separate studies of the toes may be performed when the area of clinical interest is limited to a specific toe. Each projection of the toe should include the entire digit and the distal portion of the corresponding metatarsal.

Toes 2 through 5 tend to curl downward. When the toes are angled in relation to the image receptor (IR), visualization of the joint spaces is compromised. When this is the case, an anteroposterior (AP) axial projection is recommended. For lateral projections of the toes, the foot may be positioned with either its medial or lateral aspect in contact with the IR, depending on which toe is involved. Keep the toe as close to the IR as possible and maintain the toe in a position parallel to the IR.

ROUTINE EXAMINATION

The routine examination of the toe includes the AP or AP axial, AP oblique (medial rotation), and lateral projections

IR: Positioned by manufacturer or department protocol for proper anatomy display orientation; CR plate: 8 × 10 inches (18 × 24 cm)

Grid: No

Source–image receptor distance (SID): 40 inches minimum

Body position: Seated or recumbent on table with knee flexed.

Part position:

AP axial: Plantar surface supported on a 15-degree wedge sponge (Fig. 14.10).

AP: Plantar surface is in contact with IR (Fig. 14.11).

AP oblique: Medial plantar surface of toe and forefoot is in contact with IR. Plantar surface of foot and toes forms a 30- to 45-degree angle with IR (Fig. 14.13).

Lateral: Medial or lateral surface of foot may be in contact with IR, depending on which brings toe of interest nearest to IR. Other toes are flexed or extended as needed to leave affected toe free of superimposition. Affected toe is supported parallel to IR. Toes may be held in position using tape or a bandage (Fig. 14.15) or a wooden tongue blade. Positioning a single toe apart from the others often demands some creativity on the part of the radiographer. Variations may be required depending on which toe is involved, configuration of toe, and movements tolerable for the patient.

Central ray:

AP axial: Angled 15 degrees posteriorly (toward heel) to MTP joints.

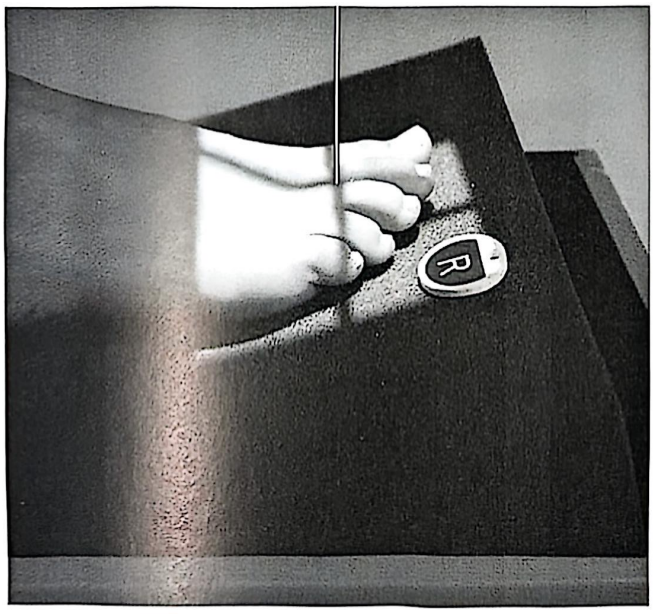


Fig. 14.10 Wedge sponge supports toes parallel to image receptor.

Fig. 14.11 Toes. Position for AP projection.

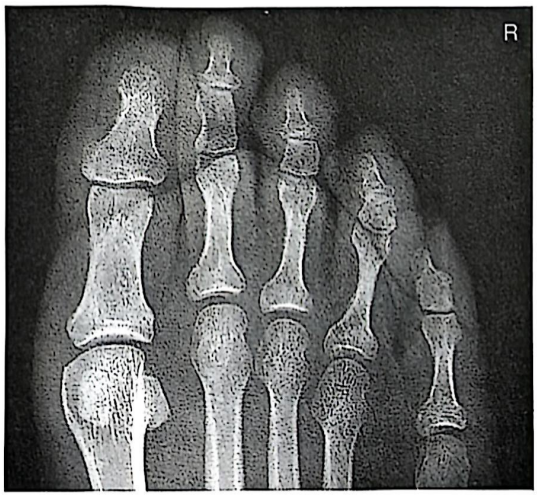


Fig. 14.12 Toes. AP axial projection of toes, elevated on a 15-degree wedge sponge.

AP, AP oblique, and lateral: Perpendicular to MTP joints.

Collimation: Adjust light field to 1 inch (2.5 cm) on all sides of the toes, including 1 inch (2.5 cm) proximal to the MTP joint. Place side marker in the collimated light field.

Patient instruction: Do not move.

Structures seen: Entire digit and distal half of metatarsal with IP and MTP joint spaces open and clearly visualized (Figs. 14.12, 14.14, and 14.16).

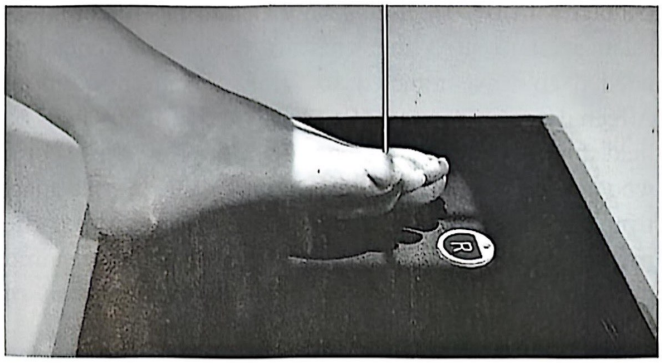


Fig. 14.13 Toes. Position for AP oblique projection—medial rotation.

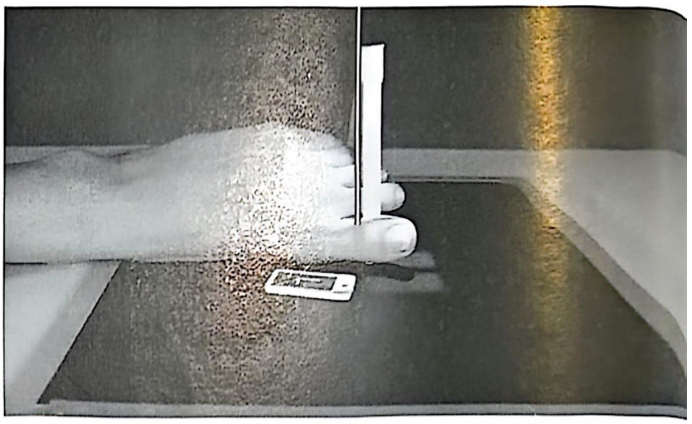


Fig. 14.15 Toes. Position for lateral projection of great toe.

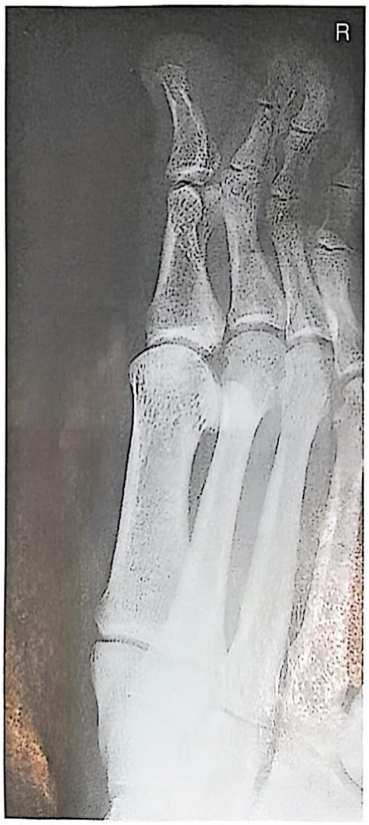


Fig. 14.14 Toes. AP oblique projection of great toe.

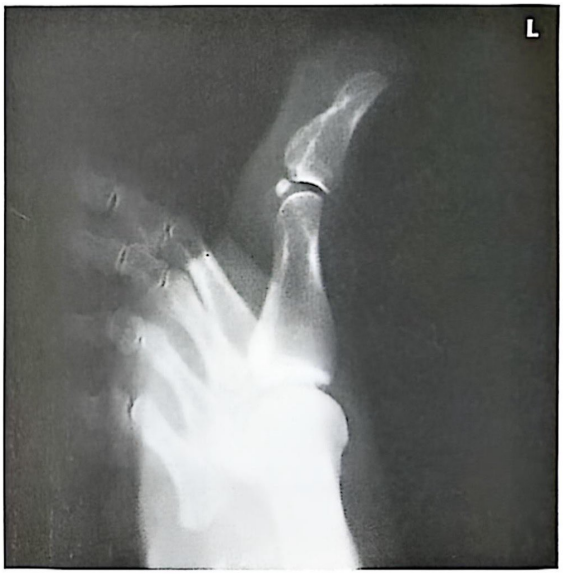


Fig. 14.16 Toes. Lateral projection of great toe.

Sesamoids

The sesamoid bones of the foot are located on the plantar aspect of the first MTP joint. These small bones are occasionally injured and are usually seen on foot radiographs. However, special positioning is required to demonstrate them without superimposition with other bones of the foot.

ROUTINE EXAMINATION

The routine examination of the sesamoids includes the tangential projection.

IR: Positioned by manufacturer or department protocol for proper anatomy display orientation; CR plate: 8 × 10 inches (18 × 24 cm)

Grid: No

SID: 40 inches minimum

Body position: Standing, facing away from collimator, or prone.

Part position: Plantar surface of foot resting on IR in a position of dorsiflexion, and adjusted to place the ball of the foot perpendicular to the IR (Fig. 14.17A). When the patient can't stand, the tangential projection can be performed with the patient seated, the foot pointing up, and the plantar surface at an angle of approximately 70 degrees with the plane of the IR (Fig. 14.17B).

Central ray: Perpendicular and tangential to the first MTP joint.

Collimation: Adjust light field to 3 × 3 inches on the collimator. Place side marker in the collimated light field.

Patient instruction: Do not move.

Structures seen: Sesamoids and first metatarsal head in profile (Fig. 14.18).

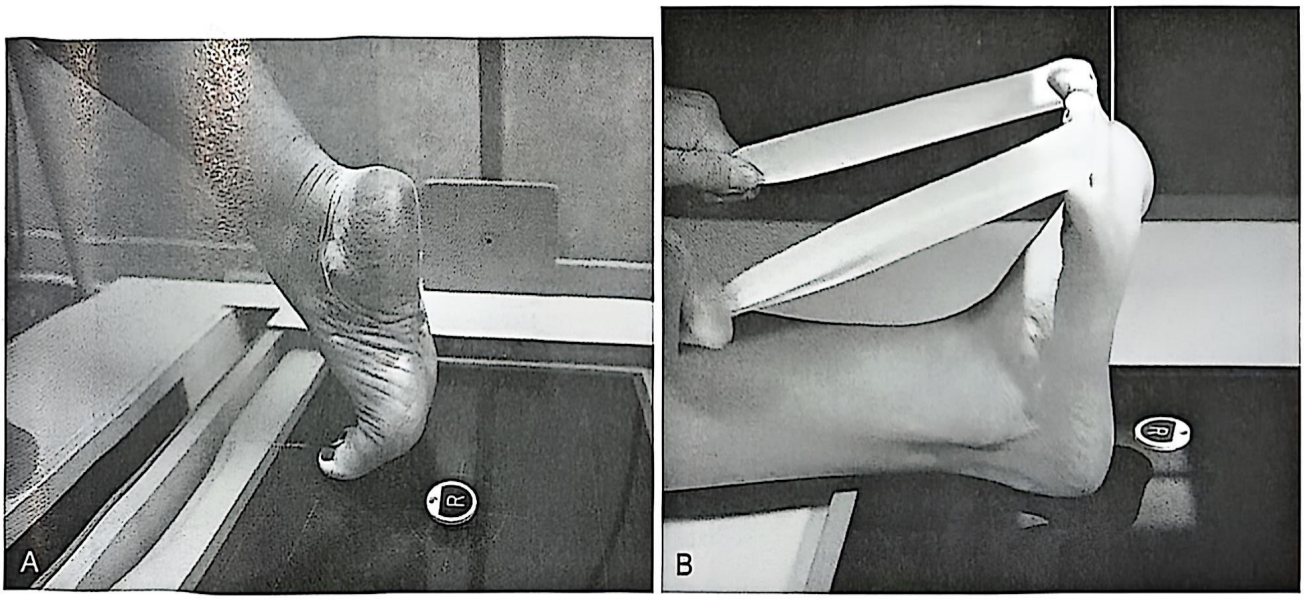


Fig. 14.17 Sesamoids. Position for tangential projection. (A) Toes close to IR. (B) Toes away from IR. This position is used when patient cannot stand.

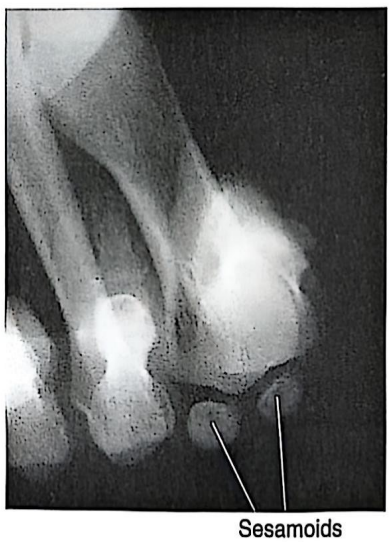


Fig. 14.18 Sesamoids. Tangential projection.

Foot

The top of the foot is its dorsal aspect and the bottom its plantar surface, so the AP axial projection would more correctly be a dorsoplantar (DP) axial projection. However, this term is commonly used only in podiatric medicine. The central ray is angled posteriorly (toward the heel) for this projection to reduce foreshortening of the metatarsals and to better demonstrate the intertarsal articulations.

ROUTINE EXAMINATION

The routine examination of the foot includes the AP axial, AP oblique (medial), and lateral projections.

IR: Positioned by manufacturer or department protocol for proper anatomy display orientation; CR plate: 10 × 12 inches (24 × 30 cm) lengthwise

Grid: No

SID: 40 inches minimum

Body position: Seated or recumbent on table with knee flexed. In podiatric practice, the AP (DP) and AP (DP) oblique projections are performed with the patient standing.

Part position: For all projections, foot is centered with regard to IR so that toes, heel, and both malleoli are within field.

AP axial: Plantar surface of foot is in contact with IR (Fig. 14.19).

AP oblique: Leg is rotated medially so that medial plantar aspect of foot is in contact with IR. Plantar surface of foot forms a 30-degree angle with IR (Fig. 14.21).

Lateral: Lateral aspect of foot is in contact with IR and foot is in true lateral position with plantar aspect of forefoot perpendicular to IR. Ankle is dorsiflexed so that long axis of foot is perpendicular to tibia (Fig. 14.23).

Central ray:

AP axial: Angled 10 degrees posteriorly (toward heel) and entering base of third metatarsal.

AP oblique and lateral: Perpendicular to base of third metatarsal.

Collimation:

AP axial and AP oblique: Adjust light field to 1 inch (2.5 cm) on the sides and 1 inch (2.5 cm) beyond the calcaneus and distal tip of the toes. Place side marker in the collimated light field.

Lateral: Adjust light field to 1 inch (2.5 cm) on the sides of the shadow of the foot including 1 inch (2.5 cm) above the medial malleolus. Place side marker in the collimated light field.

Patient instruction: Do not move.

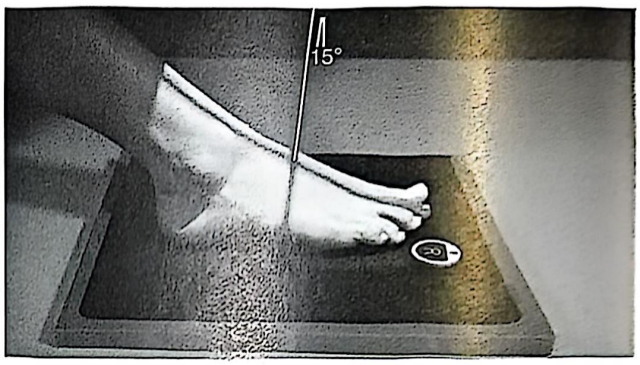


Fig. 14.19 Foot. Position for AP axial projection.

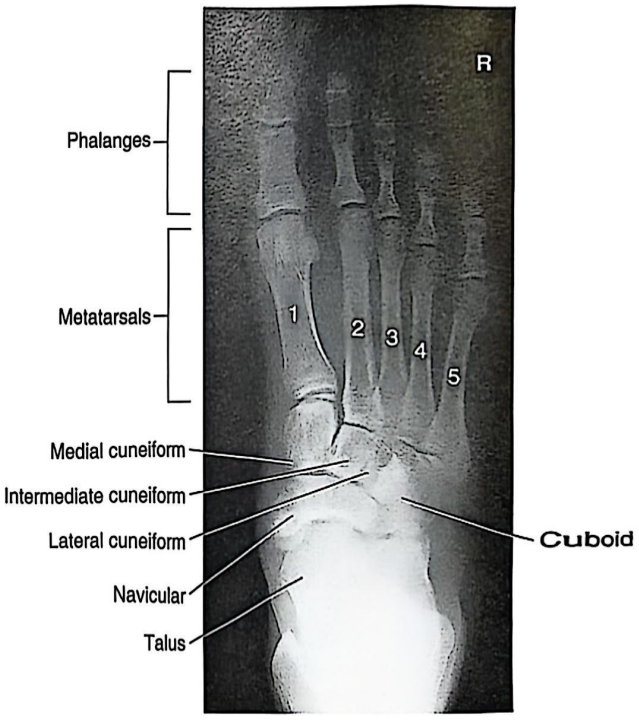


Fig. 14.20 Foot. AP axial projection.

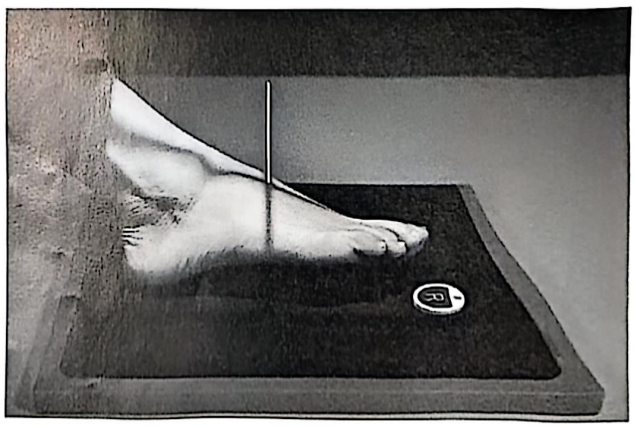


Fig. 14.21 Foot. Position for AP oblique projection—medial rotation.

Structures seen: Entire foot, including toes, metatarsals, and tarsal bones. On AP axial projection, calcaneus is obscured by superimposition of lower leg (Fig. 14.20). AP oblique projection with medial rotation should demonstrate the metatarsals and some tarsals (cuboid, navicular, lateral cuneiform) with minimal superimposition on one another (Fig. 14.22). Too much superimposition of these structures indicates that angle between plantar surface of foot and IR was too great; that is, foot was everted too much. Lateral projection shows superimposition of metatarsals, more proximal than distal. It should include the ankle joint (Fig. 14.24).

Compensating filter: A wedge-type compensating filter, attached to the collimator, may be used to produce a more even radiographic density on the AP axial projection, preventing overexposure of the toes and distal metatarsals. The filter is placed so that its thicker portion is projected over the toes and its thin edge is projected in the midmetatarsal region.

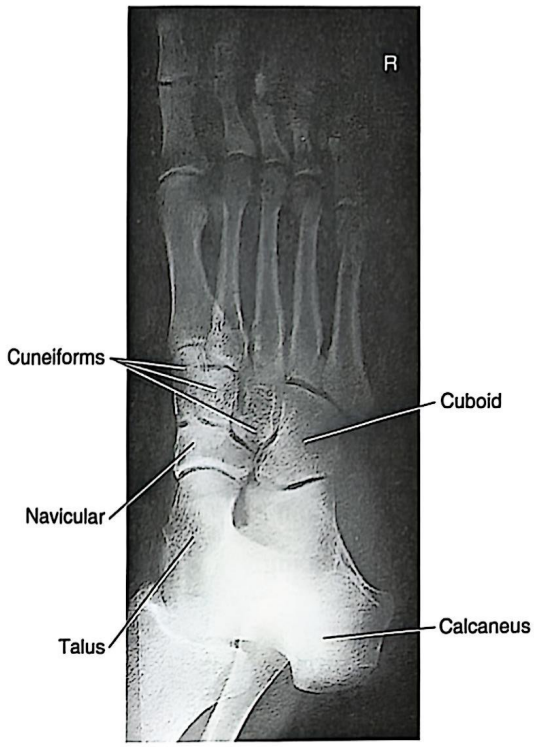


Fig. 14.22 Foot. AP oblique projection—medial rotation.

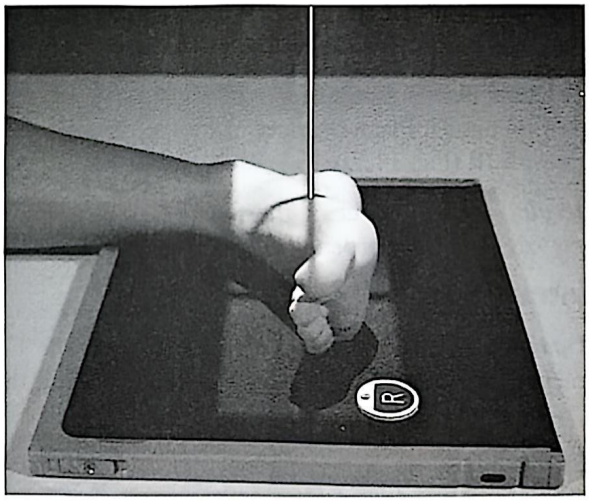


Fig. 14.23 Foot. Position for lateral projection.

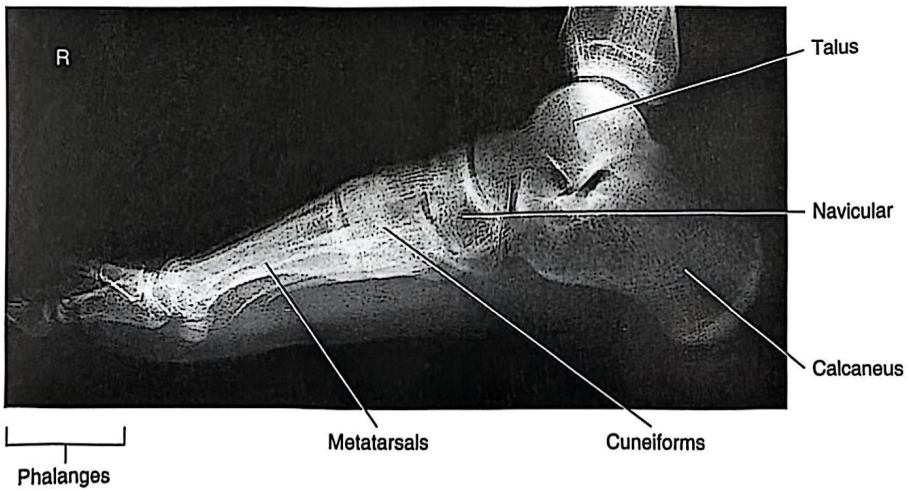


Fig. 14.24 Foot. Lateral projection.

PODIATRY EXAMINATION

Radiographic examination of the foot in podiatric practice is usually performed with the patient standing to demonstrate the relationship of the bony structures during weight bearing. A podiatry examination includes AP axial, AP axial obliques (medial and lateral rotation), and lateral projections. The AP axial projection may include both feet taken with one exposure (bilateral) or a single foot (unilateral).

IR: Positioned by manufacturer or department protocol for proper anatomy display orientation; CR plate: 10 × 12 inches (24 × 30 cm) lengthwise

Grid: No

SID: 40 inches minimum

Body position: Standing.

Part position:

AP axial: Plantar surface of feet or foot in contact with IR or surface of IR tunnel (Fig. 14.25).

AP axial oblique (medial rotation): Foot is rotated to place medial plantar aspect of foot in contact with IR or surface of IR tunnel. Plantar surface of foot forms a 30-degree angle with IR (Fig. 14.27).

AP axial oblique (lateral rotation): Foot is rotated to place lateral plantar aspect of foot in contact with IR or surface of IR tunnel. Plantar surface of foot forms a 30-degree angle with IR (Fig. 14.29).

Lateral: Medial aspect of the foot in contact with IR. Long axis of foot is perpendicular to tibia (Fig. 14.31).

Central ray:

AP axial: Angled 10 to 15 degrees toward the heel. Directed between the feet at the level of the third metatarsal base for the bilateral exam. Directed to the third metatarsal base for a unilateral exam.

AP axial obliques: Angled 10 to 15 degrees toward the heel. Directed to the third metatarsal base.

Lateral: Horizontal and perpendicular to the third metatarsal base.

Collimation:

AP axial and AP axial obliques: Adjust light field to 1 inch (2.5 cm) on the sides and 1 inch (2.5 cm) beyond the calcaneus and distal tip of the toes. Place side marker in the collimated light field.

Lateral: Adjust light field to 1 inch (2.5 cm) on the sides of the shadow of the foot including 1 inch (2.5 cm) above the medial malleolus. Place side marker in the collimated light field.

> **NOTE:** An AP oblique projection is sometimes performed with the foot flat on the IR or IR tunnel and the CR angled 30 degrees or 45 degrees from lateral to medial (Fig. 14.33).

Patient instruction: Do not move.

Structures seen: Entire foot, including toes, metatarsals, and tarsal bones. On AP axial projection, calcaneus is obscured by superimposition of lower leg (Fig. 14.26). AP oblique projection with medial rotation should demonstrate the metatarsals and some tarsals (cuboid, navicular, lateral cuneiform) with minimal superimposition on one another (Fig. 14.28). AP oblique projection with lateral rotation should demonstrate the medial and intermedial cuneiforms and the navicular (Fig. 14.30). Lateral projection shows superimposition of metatarsals, more proximal than distal. It should include the ankle joint (Fig. 14.32).

Fig. 14.25 Foot. (A) Position for bilateral AP axial projection, patient standing. (B) Position for AP axial projection, patient standing.

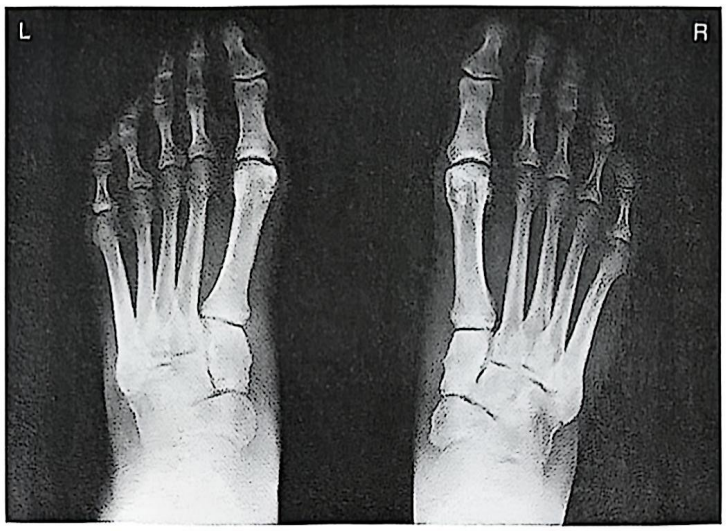


Fig. 14.26 Foot. Bilateral AP axial projection, patient standing.

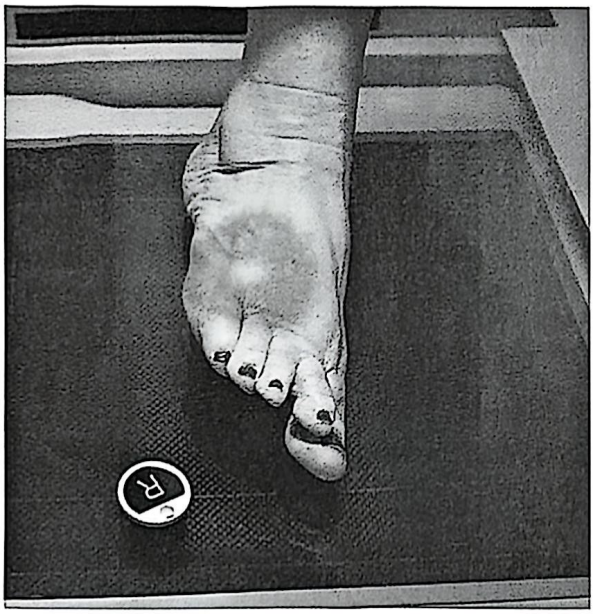


Fig. 14.27 Foot. Position for AP axial oblique projection—medial rotation, patient standing.

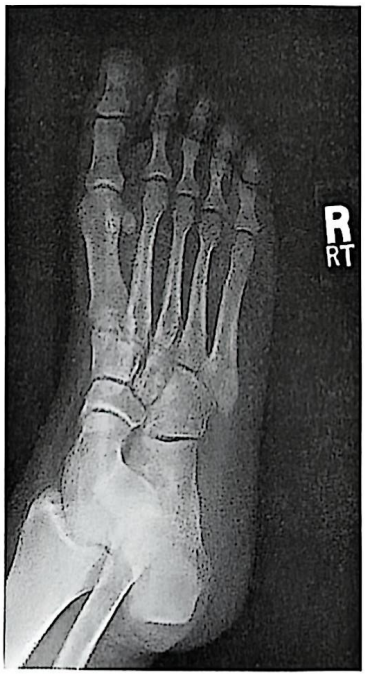


Fig. 14.28 Foot. AP axial oblique projection—medial rotation, patient standing.

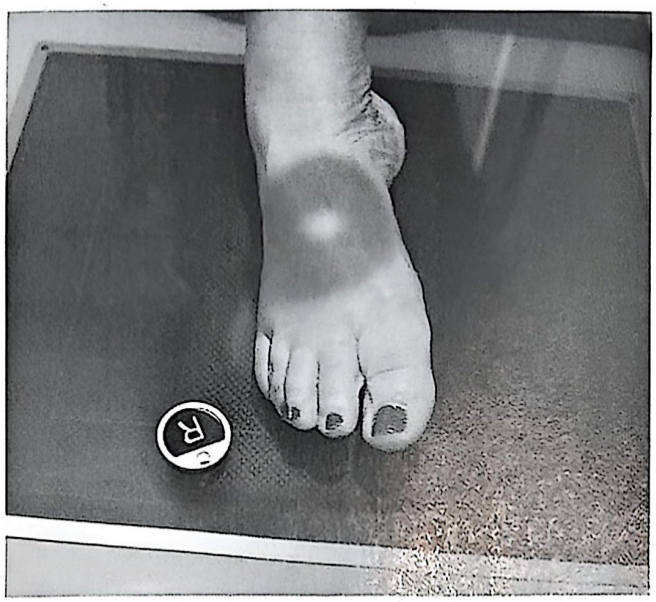


Fig. 14.29 Foot. Position for AP axial oblique projection—lateral rotation, patient standing.

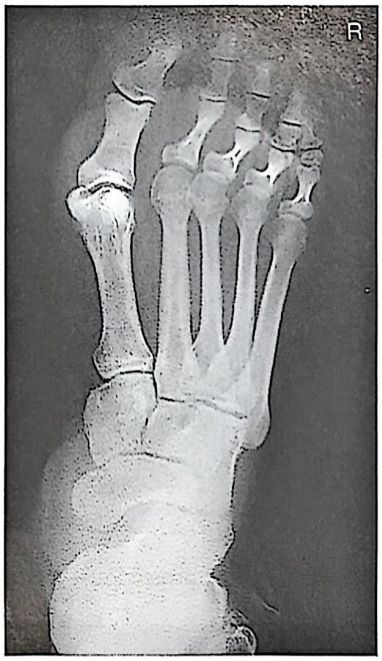


Fig. 14.30 Foot. AP axial oblique projection—lateral rotation, patient standing.

Fig. 14.31 Foot. Position for lateral projection, patient standing.

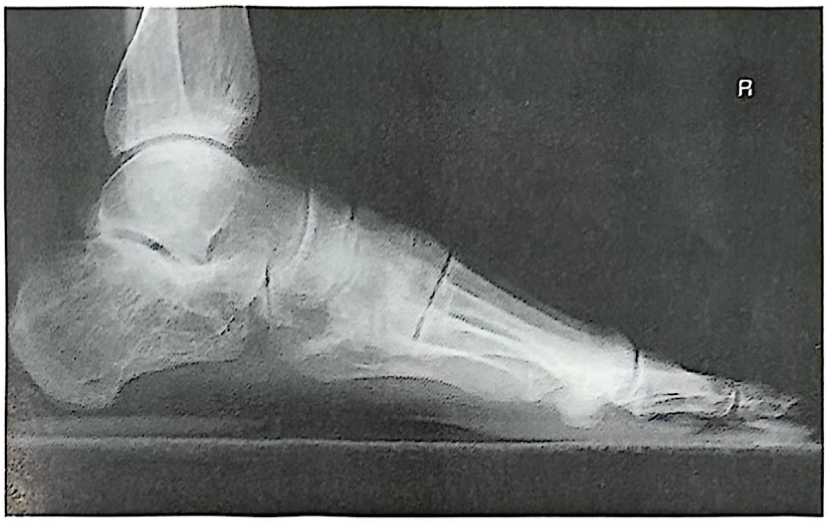


Fig. 14.32 Foot. Lateral projection, patient standing.

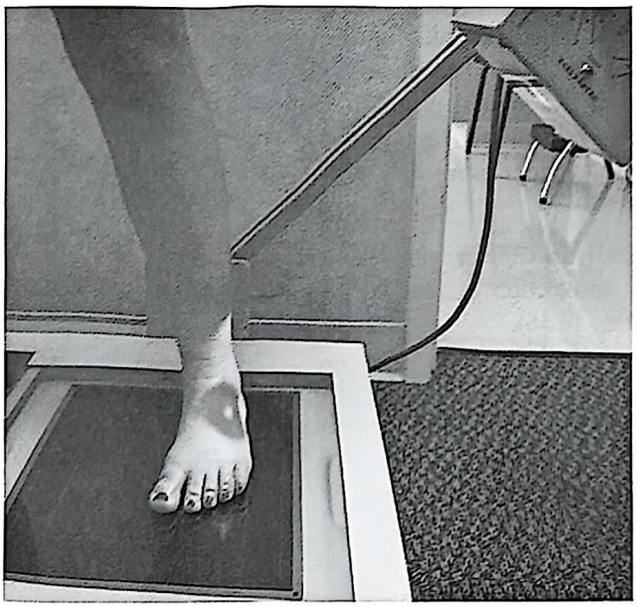


Fig. 14.33 Foot. Position for AP oblique projection (45-degree lateral to medial CR angle), patient standing. Note DR image receptor unit (dark rectangle) inside standing platform.

Calcaneus

ROUTINE EXAMINATION

The routine examination of the calcaneus includes the axial (plantodorsal) and lateral projections.

IR: Positioned by manufacturer or department protocol for proper anatomy display orientation; CR plate: 8 × 10 inches (18 × 24 cm)

Grid: No

SID: 40 inches minimum

Body position:

Axial (plantodorsal): Seated or recumbent on table with leg extended.

Lateral: Seated or recumbent on table with knee flexed.

Part position:

Axial (plantodorsal): Posterior surface of ankle and heel is in contact with IR. Place foot so that malleoli are centered with regard to middle of IR. Sagittal plane of foot is perpendicular to IR. Foot is dorsiflexed as much as possible and held in position by patient using a strap or bandage (Fig. 14.34).

Lateral: Lateral surface of heel is in contact with IR. Part is positioned as for lateral projection of foot but with calcaneus centered to IR (Fig. 14.36).

Central ray:

Axial (plantodorsal): Angled 40 degrees cephalad to center of IR, entering at third metatarsal base.

Lateral: Perpendicular to center of IR, entering about 1 inch (2.5 cm) distal to medial malleolus.

> **NOTE:** In podiatric practices, an axial (DP) projection may be taken with the patient standing on the IR. The central ray is angled 45 degrees anteriorly, entering the dorsal surface of the ankle joint and exiting the plantar surface of the heel at the level of the fifth metatarsal base (Fig. 14.38). This projection may be called the Harris-Beath method, skier's position, or coalition position.

Collimation:

Axial (plantodorsal): Adjust light field to 1 inch (2.5 cm) on three sides of the shadow of the heel. Place side marker in the collimated light field.

Lateral: Adjust light field to 1 inch (2.5 cm) past the posterior and inferior shadow of the heel. Include the medial malleolus and base of the fifth metatarsal. Place side marker in the collimated light field.

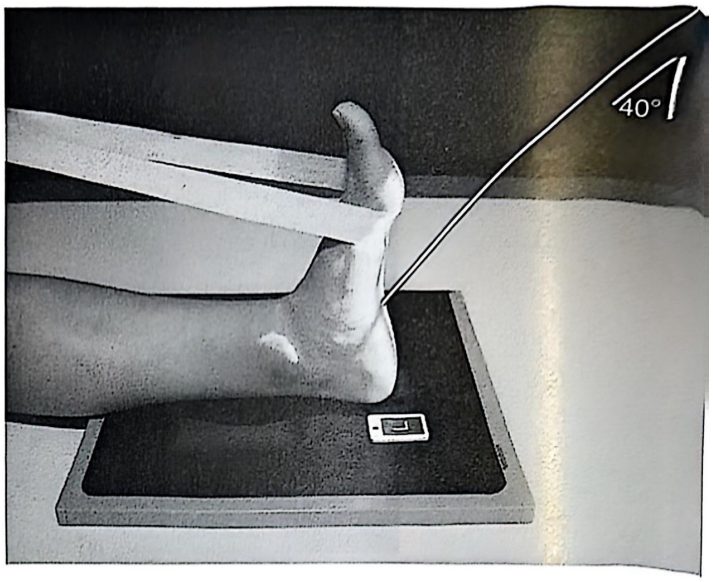


Fig. 14.34 Calcaneus. Position for axial (plantodorsal) projection.

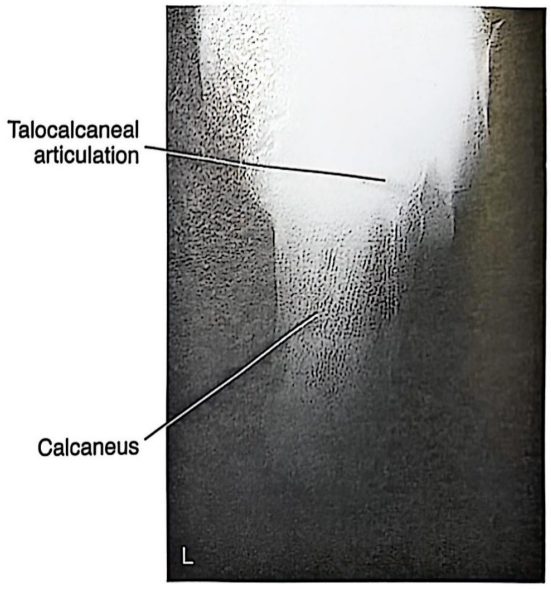


Fig. 14.35 Calcaneus. Axial (plantodorsal) projection.

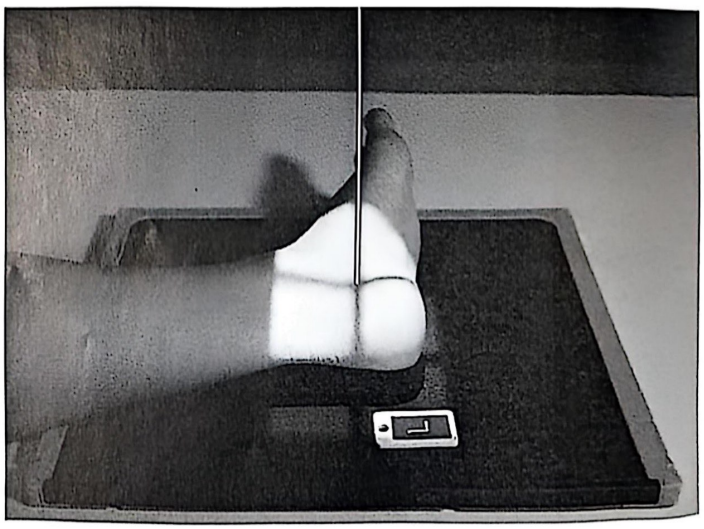


Fig. 14.36 Calcaneus. Position for lateral projection.

Patient instruction: Do not move.

Structures seen: Both projections demonstrate entire calcaneus and its articulation with talus (Fig. 14.35). Lateral projection also shows calcaneal articulations with cuboid and navicular anteriorly (Fig. 14.37).

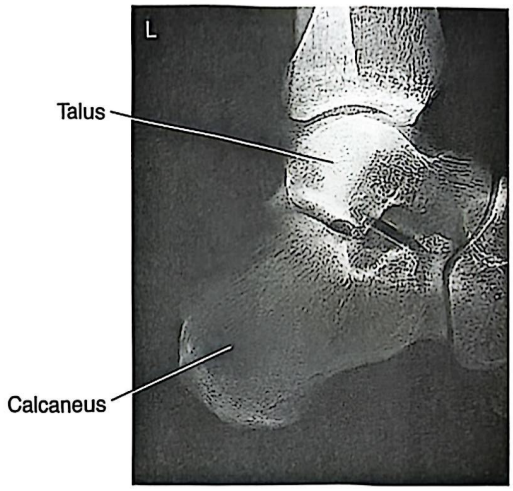


Fig. 14.37 Calcaneus. Lateral projection.

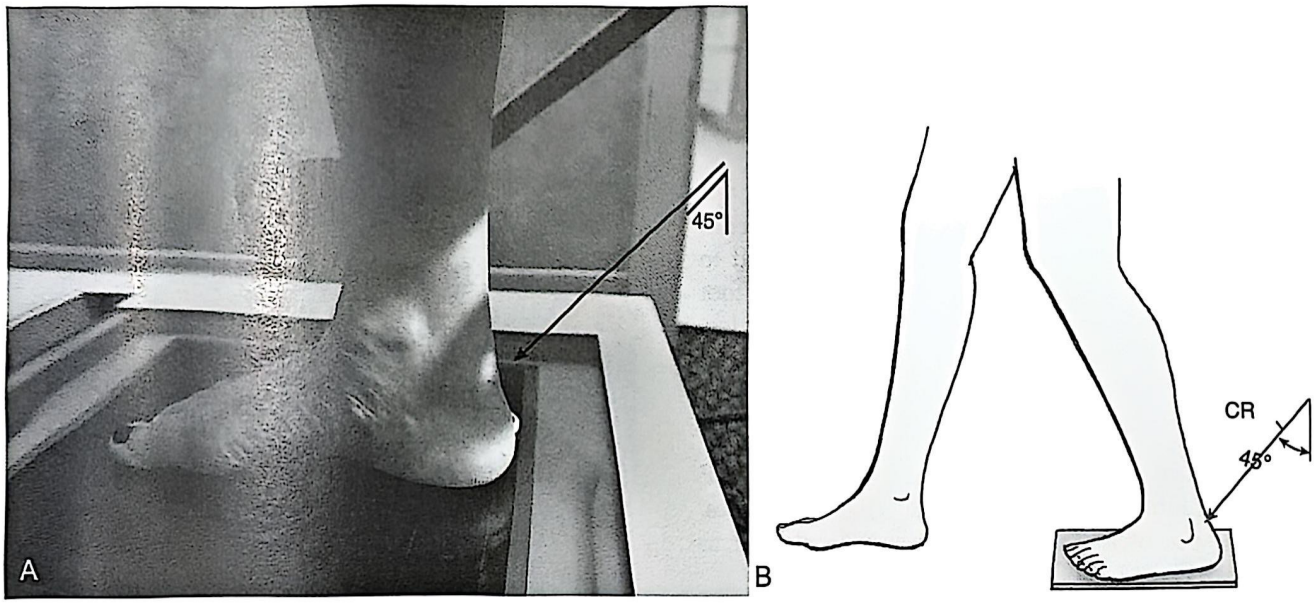


Fig. 14.38 Calcaneus. (A) Position for axial (dorsoplantar) projection, patient standing. (B) Drawing demonstrating relationship between CR, calcaneus, and IR.

Ankle

There are two medial oblique ankle projections, one that best demonstrates the ankle mortise joint and one that best demonstrates the tibiofibular joint. The projections that constitute a routine examination must be determined by the physician who will interpret the images.

ROUTINE EXAMINATION

The routine examination of the ankle includes the AP, AP oblique (medial rotation), AP oblique (medial rotation—mortise joint), and lateral projections.

IR: Positioned by manufacturer or department protocol for proper anatomy display orientation; CR plate: 10 × 12 inches (24 × 30 cm) lengthwise

Grid: No

SID: 40 inches minimum

Body position:

AP and AP obliques: Seated or recumbent on table with affected leg extended.

Lateral: Recumbent or semirecumbent on affected side with knee flexed 30 to 45 degrees.

Part position:

AP: Posterior surface of heel and lower leg is in contact with IR. Midpoint between malleoli is centered to IR. Foot is dorsiflexed so that plantar surface of foot forms a 90-degree angle with coronal plane of lower leg. Sagittal planes of leg and foot are perpendicular to IR (Fig. 14.39). Foot may be held in position by patient using a strap or bandage.

AP oblique (medial rotation): From position for AP projection, entire leg is rotated medially 45 degrees. Sagittal planes of foot and leg must remain aligned to each other (Fig. 14.41).

Fig. 14.39 Ankle. Position for AP projection.

NOTE: In podiatric practice, an AP oblique projection with a 45-degree lateral rotation may also be performed.

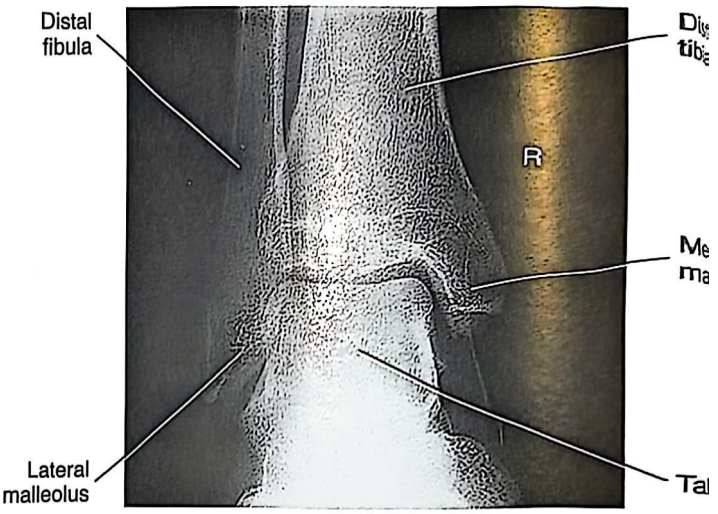


Fig. 14.40 Ankle. AP projection.

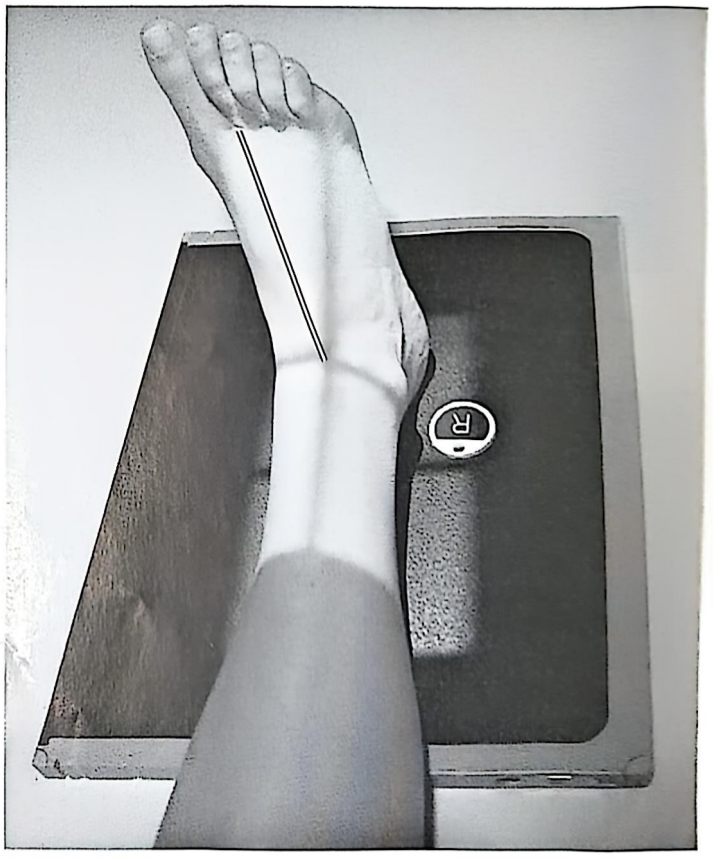


Fig. 14.41 Ankle. Position for AP oblique projection—45-degree medial rotation.

AP oblique (medial rotation—mortise joint): From position for AP projection, entire leg is rotated 15 to 20 degrees medially. Sagittal planes of foot and leg must remain aligned with each other (Fig. 14.43).

Lateral: Lateral surface (medial surface, if upright) of ankle is in contact with IR. Sagittal plane of foot and leg is parallel to IR. Foot is dorsiflexed so that plantar surface of foot forms a 90-degree angle with coronal plane of lower leg (Fig. 14.45).

TIP: When pressure on the lateral malleolus is painful for the patient, a small sponge may be placed under the distal portion of the leg.

Central ray:

AP and AP obliques: Perpendicular to point midway between malleoli.

Lateral: Perpendicular to medial malleolus.

NOTE: In podiatric practice, all projections are performed with the patient standing. The IR will be vertical and the central ray horizontal. Part positions and central ray placement are as described for the AP (Fig. 14.47) and AP oblique (Fig. 14.48). However, the central ray enters at the lateral malleolus for the lateral (lateromedial) projection (Fig. 14.49).

Collimation:

AP and AP obliques: Adjust light field to 1 inch (2.5 cm) on the sides of the ankle and 8 inches (18 cm) lengthwise to include the heel. Place side marker in the collimated light field.

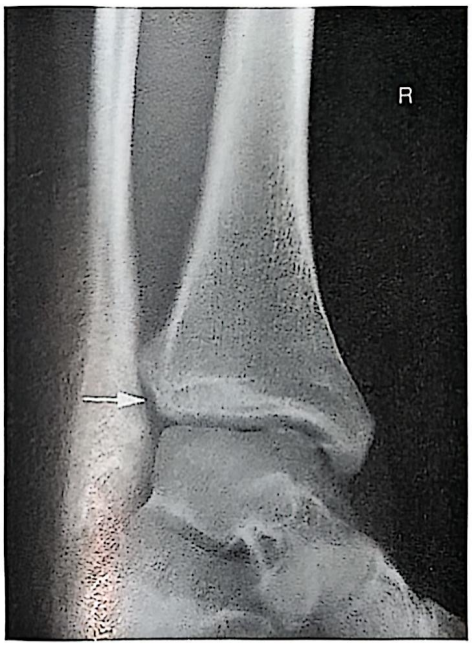


Fig. 14.42 Ankle. AP oblique projection—45-degree medial rotation. Note open tibiofibular joint *(arrow)*.

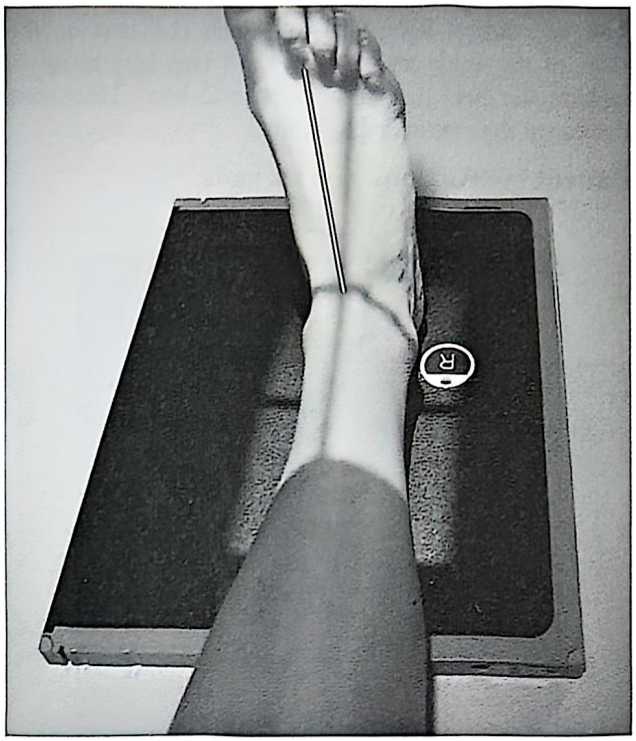


Fig. 14.43 Ankle (mortise joint). Position for AP oblique projection—15- to 20-degree medial rotation.

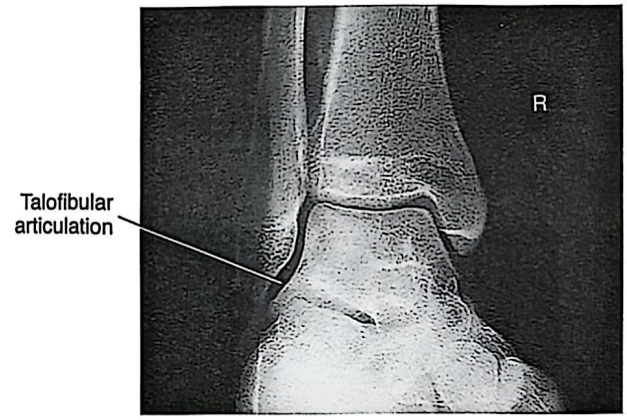


Fig. 14.44 Ankle (mortise joint). AP oblique projection—15- to 20-degree medial rotation.

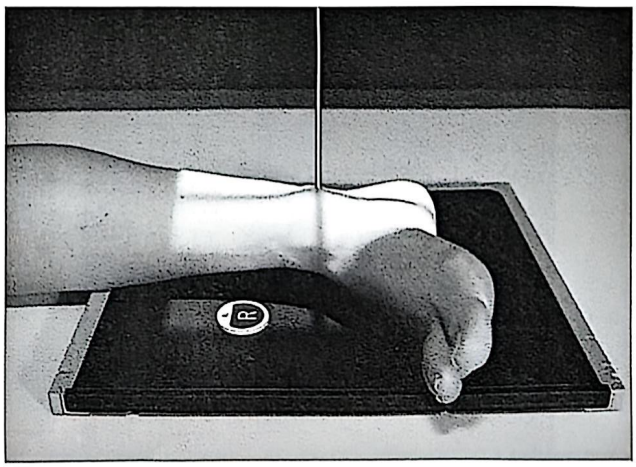


Fig. 14.45 Ankle. Position for lateral projection.

Lateral: Adjust light field to 1 inch (2.5 cm) on the sides of the ankle and 8 inches (18 cm) lengthwise to include the heel and fifth metatarsal base. Place side marker in the collimated light field.

Patient instruction: Do not move.

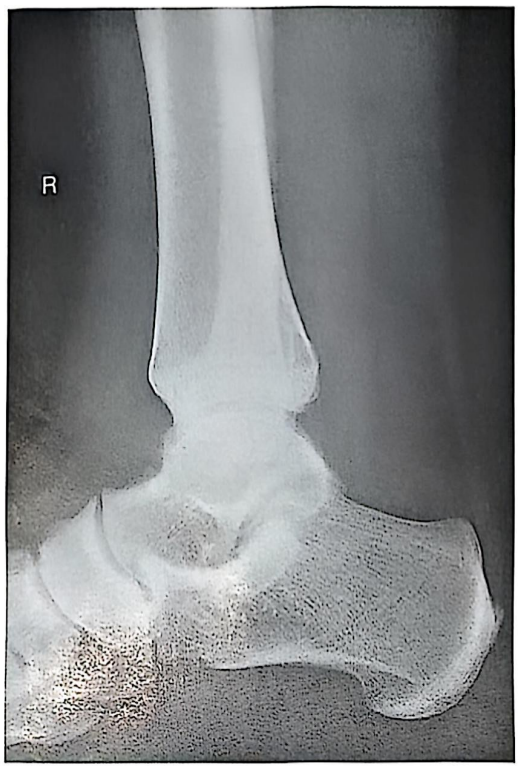


Fig. 14.46 Ankle. Lateral projection.

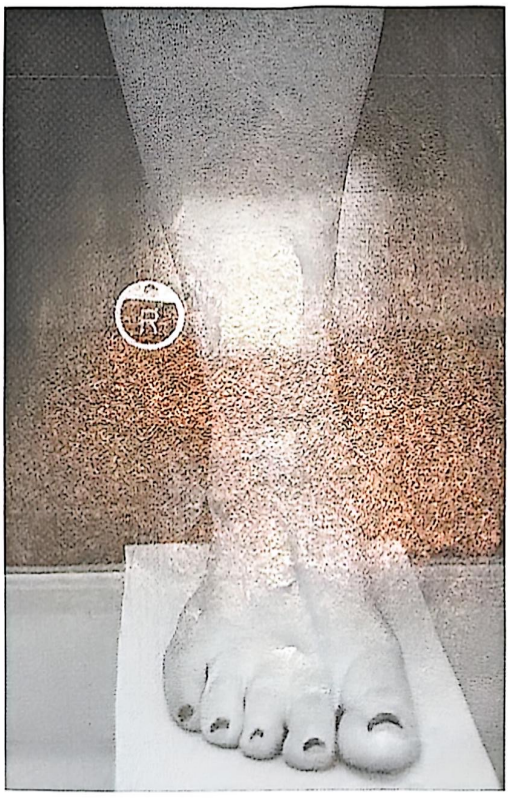


Fig. 14.47 Ankle. Position for AP projection, patient standing.

Structures seen: Superior portion of talus and distal portions of tibia and fibula (Fig. 14.40). AP oblique projection with a 45-degree medial rotation demonstrates tibiofibular joint without superimposition (Fig. 14.42). AP oblique projection with 15- to 20-degree medial rotation demonstrates mortise joint spaces without superimposition (Fig. 14.44). Lateral projection demonstrates tibiotalar and subtalar joints, and includes fifth metatarsal base (Fig. 14.46).

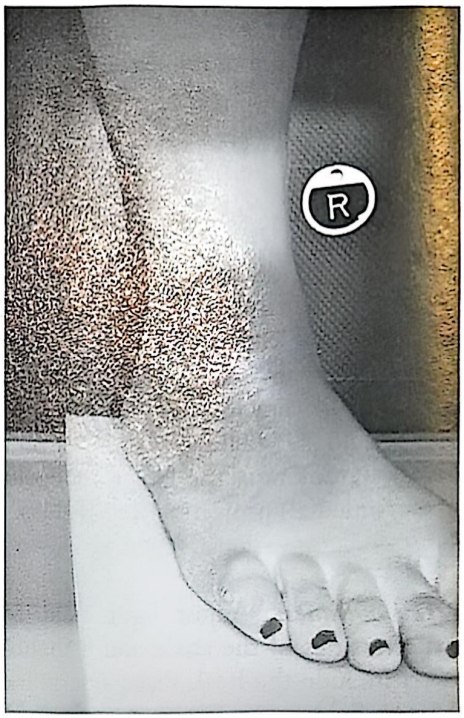


Fig. 14.48 Ankle. Position for AP oblique projection—medial rotation, patient standing.

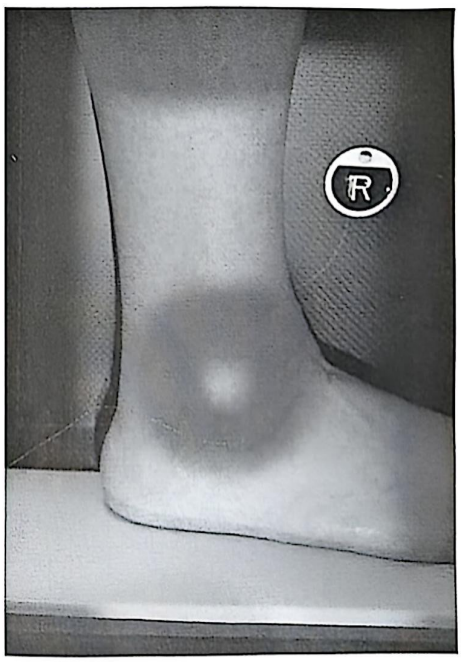


Fig. 14.49 Ankle. Position for lateral (lateromedial) projection, patient standing.

Lower Leg

The lower leg examination should include the entire tibia and the fibula and their articular surfaces. Visualization of both knee and ankle joints is preferable. If only one joint can be included on the largest IR available, the *same* joint must be demonstrated on both projections. In this case, additional radiographs will be needed to demonstrate the other joint. It is often necessary to use two 14 × 17 inch (35 × 43 cm) IRs diagonally to demonstrate both joints on adult patients.

ROUTINE EXAMINATION

The routine examination of the lower leg includes the AP and lateral projections.

IR: Positioned by manufacturer or department protocol for proper anatomy display orientation; CR plate: 14 × 17 inches (35 × 43 cm) lengthwise or diagonal

Grid: No

SID: 40 inches minimum

Body position:

AP: Seated or recumbent on table.

Lateral: Recumbent on affected side with contralateral leg anterior or posterior to affected leg.

Part position:

AP: Leg is fully extended with posterior surface of lower leg in contact with IR. Margin of IR is placed 1 to 2 inches beyond joint of primary interest. Foot is dorsiflexed so that plantar surface of foot forms a 90-degree angle with coronal plane of lower leg. Sagittal planes of leg and foot are perpendicular to IR (Fig. 14.50). Foot may be held in position by patient using a strap or bandage.

Lateral: Knee may be flexed, if necessary, to ensure a true lateral position. Lateral surface of lower leg is in contact with IR. Leg is rotated to place sagittal plane of leg parallel to IR and coronal plane through patella perpendicular to IR. Margin of IR is placed 1 to 2 inches beyond joint of primary interest (Fig. 14.52).

Central ray: Perpendicular to center of IR entering midshaft of tibia.

Collimation: Adjust light field to 1 inch (2.5 cm) on the sides and 1.5 inches (4 cm) beyond the ankle and knee joints. Place side marker in the collimated light field.

Patient instruction: Do not move.

Structures seen: Entire lower leg and at least one joint (Figs. 14.51 and 14.53).

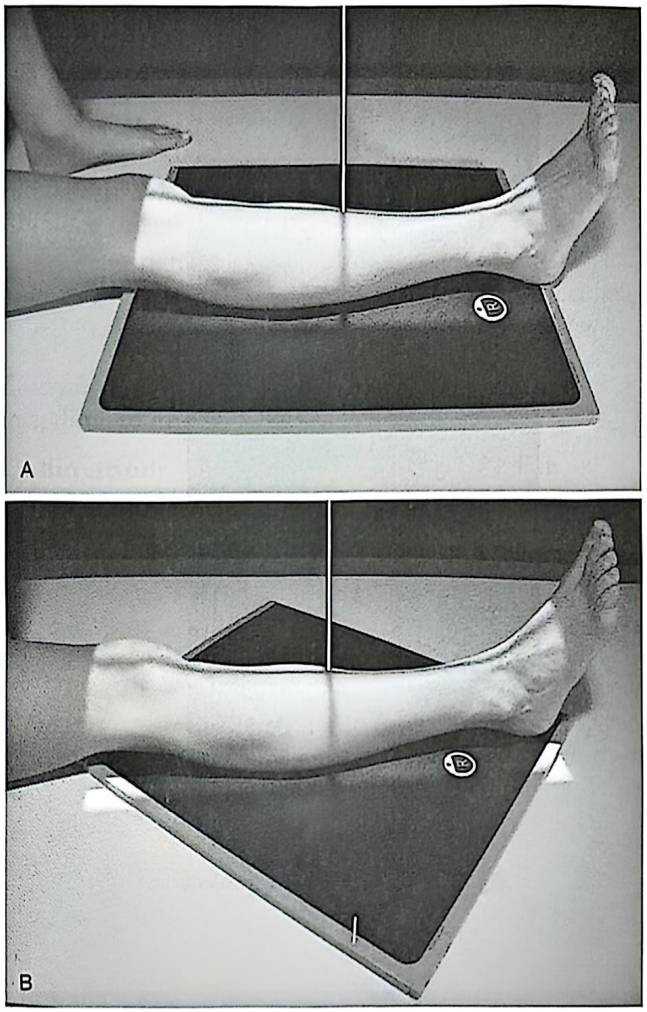


Fig. 14.50 Lower leg. Position for AP projection. (A) Usual orientation of IR. (B) Diagonal placement of IR, when lower leg is too long to fit within the long dimension of the IR. Exposure field must include entire corners of a computed radiography imaging plate to ensure good image quality.

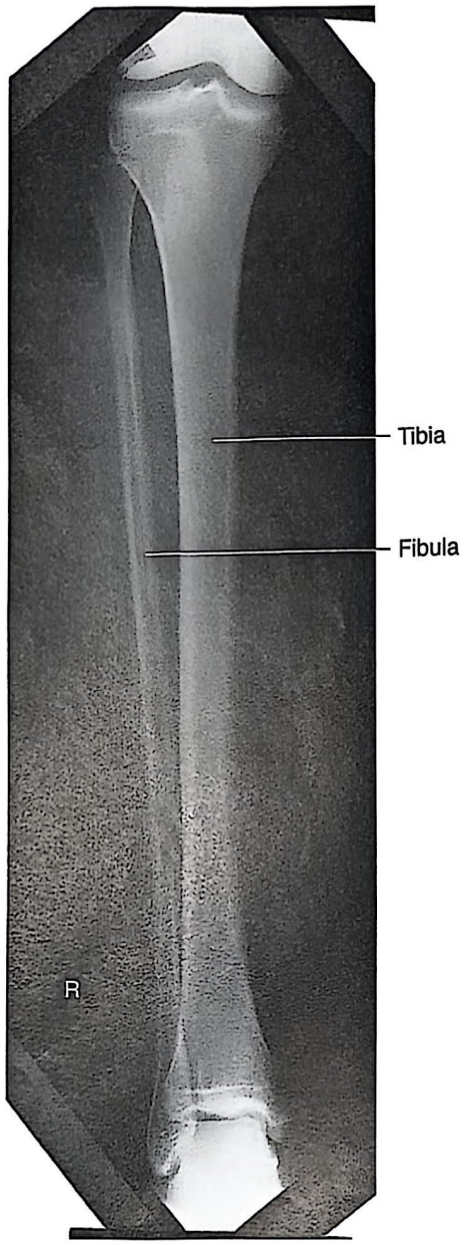


Fig. 14.51 Lower leg. AP projection.

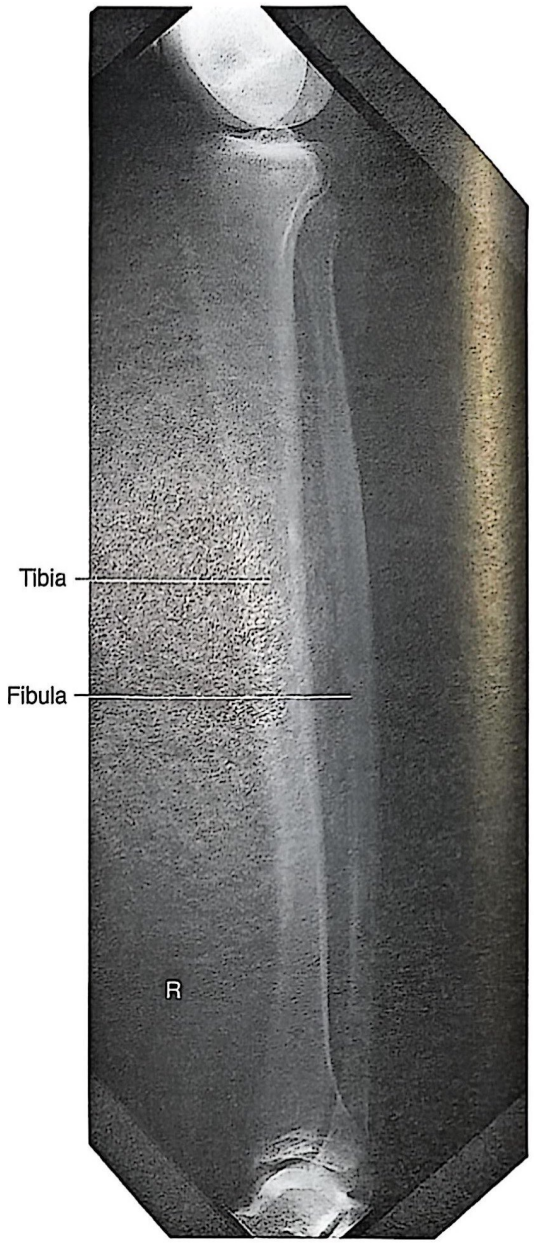


Fig. 14.53 Lower leg. Lateral projection.

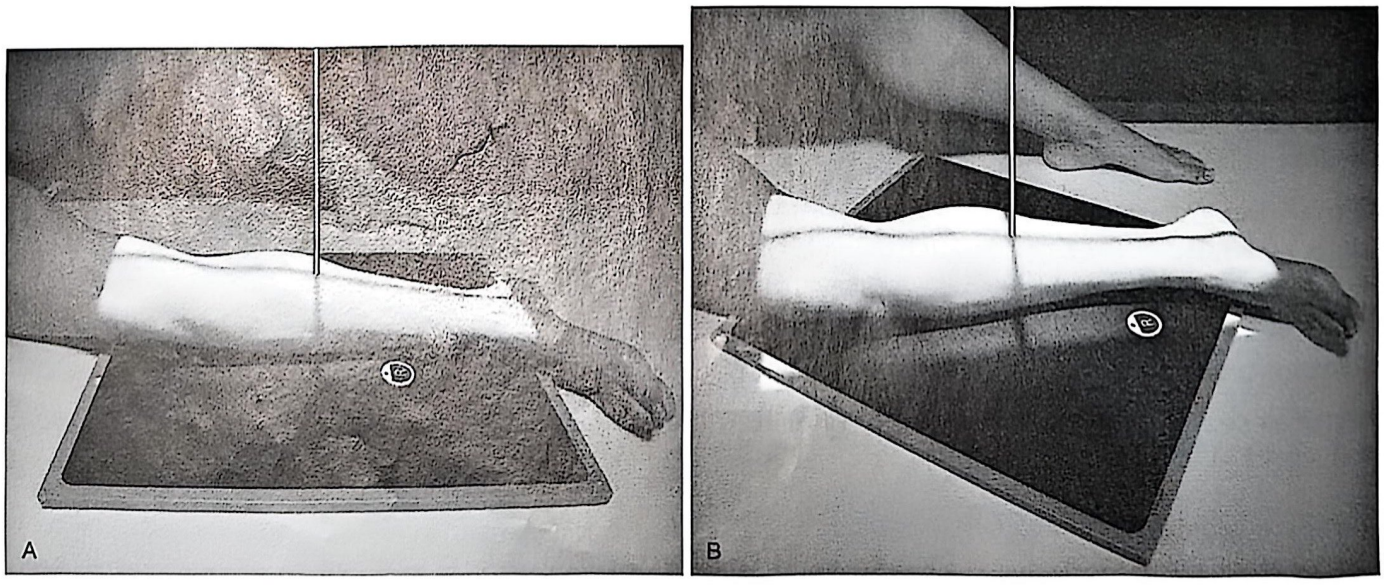


Fig. 14.52 Lower leg. Position for lateral projection. (A) Usual orientation of IR. (B) Diagonal placement of IR, when lower leg is too long to fit within the long dimension of the IR.

Knee

The routine examination of the knee consists of AP and lateral projections. However, an axial projection of the intercondylar fossa ("tunnel" or "notch") and a tangential projection of the patella are frequently requested for the evaluation of chronic knee complaints.

When the area of clinical interest is the patella, the routine examination includes posteroanterior (PA) and lateral projections. A tangential projection of the patella may be added for chronic conditions but should not be included when there is suspicion of patellar fracture. *Do not flex the knee more than 10 degrees when there is suspicion of fracture of the patella.* When this is the case, the lateral projection is taken with the knee extended.

ROUTINE EXAMINATION

The routine examination of the knee includes the AP and lateral projections.

IR: Positioned by manufacturer or department protocol for proper anatomy display orientation; CR plate: 10 × 12 inches (24 × 30 cm) lengthwise

Grid: With or without is acceptable. For large knees, radiographic contrast is superior with a grid.

SID: 40 inches minimum

Body position:

AP: Seated or supine on table with leg extended.

Lateral: Recumbent on affected side with femur aligned with center of table. Unaffected leg is anterior or posterior to affected leg.

Part position:

AP: Leg is fully extended with sagittal plane of leg perpendicular to IR (Fig. 14.54).

Lateral: Knee is flexed 20 to 30 degrees. Sagittal plane of femur and lower leg is parallel to IR (Fig. 14.56).

Central ray:

AP: Entering 0.5 inch distal to apex of patella. Angle is variable, depending on the measurement between the ASIS and the tabletop, as follows:

< 19 cm (thin patient)	3 to 5 degrees *caudad*
19 to 24 cm	0 degrees (perpendicular)
> 24 cm (large pelvis)	3 to 5 degrees *cephalad*

Lateral: Angled 5 to 7 degrees cephalad entering 1 inch distal to medial epicondyle of femur.

Collimation: Adjust light field to 10 × 12 inch (24 × 30 cm) size on the collimator. Place side marker in the collimated light field.

Patient instruction: Do not move.

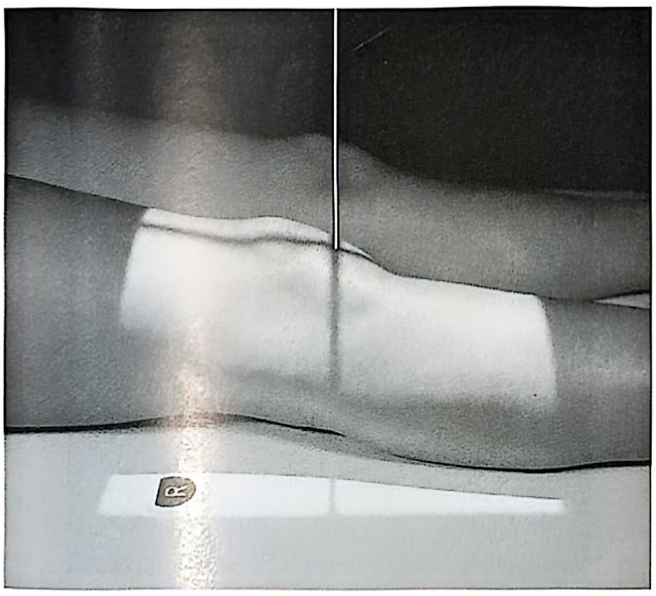


Fig. 14.54 Knee. Position for AP projection.

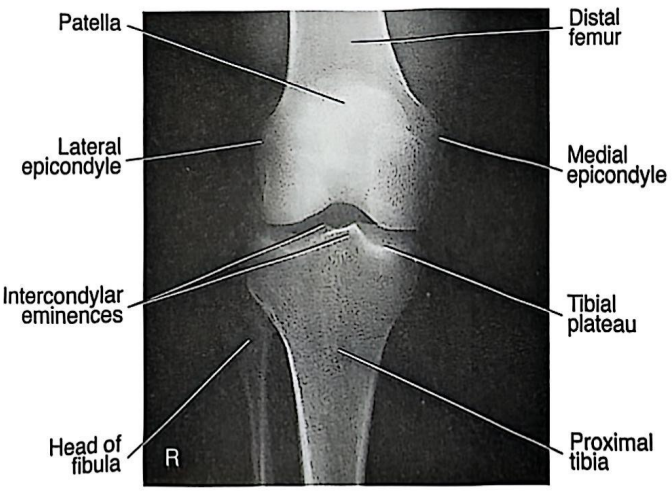


Fig. 14.55 Knee. AP projection.

Structures seen: Knee joint with portions of distal femur and proximal lower leg (Fig. 14.55). Lateral projection includes a profile of tibial tuberosity. It should demonstrate distal femur with condyles superimposed and joint space free of superimposition. Entire patella and retropatellar joint space should also be clearly visualized (Fig. 14.57).

ALTERNATIVE PROJECTION

The PA projection of the knee is sometimes substituted for the AP projection. This is especially desirable when the patella is of particular clinical interest.

IR size and orientation, **grid, SID**, and **collimation** are the same as for routine knee projections.

Body position: Patient prone.

Part position: Affected leg extended and sagittal plane of leg perpendicular to IR; foot on affected side is plantar flexed and rests on its dorsal aspect (Fig. 14.58).

Central ray: Directed 5 to 7 degrees caudad to exit 0.5 inch (1.3 cm) inferior to the patellar apex.

Structures seen: Knee joint with portions of distal femur and proximal lower leg. Greater visibility of the patella than on the AP projection (Fig. 14.59).

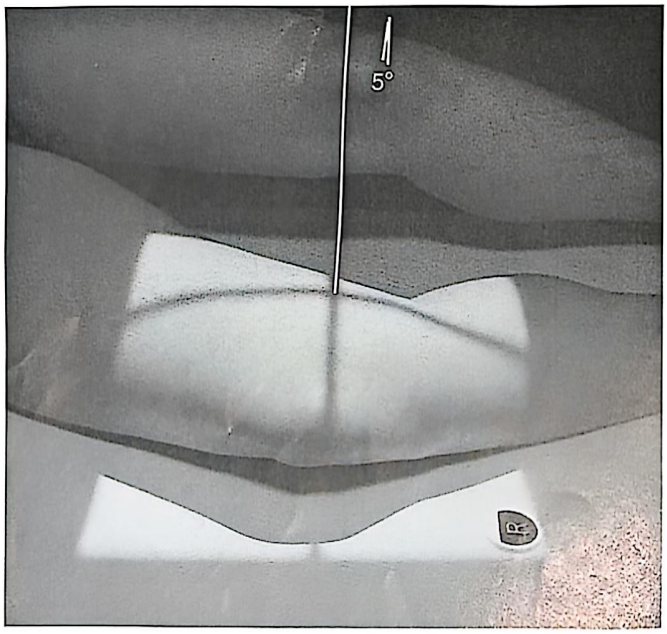


Fig. 14.56 Knee. Position for lateral projection.

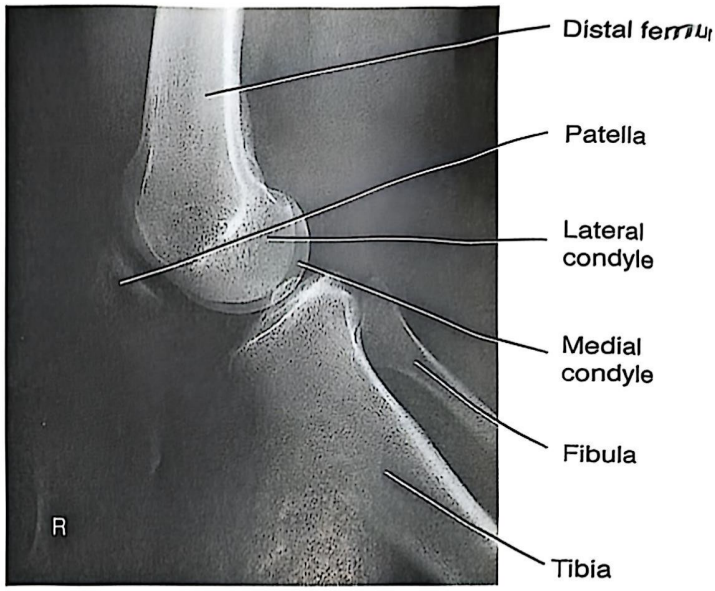


Fig. 14.57 Knee. Lateral projection.

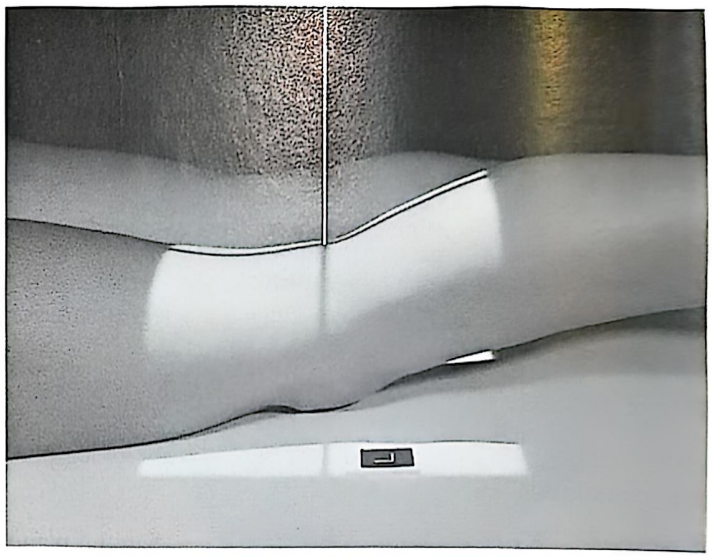


Fig. 14.58 Knee. Position for PA projection.

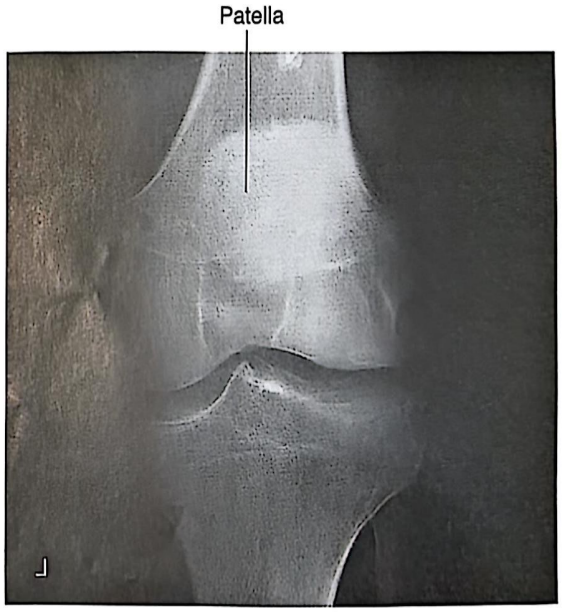


Fig. 14.59 Knee. PA projection.

SUPPLEMENTAL PROJECTIONS

PA AXIAL PROJECTIONS OF THE INTERCONDYLAR FOSSA ("TUNNEL")

Two methods are presented for demonstration of the intercondylar fossa. The Holmblad method, in which there is less distortion caused by tube angulation, is often preferred. The Camp-Coventry method may be desirable if the patient is unable to assume the correct position for the Holmblad method.

IR size and orientation, **grid, SID**, and **collimation** are the same as for routine knee projections.

PA AXIAL PROJECTION—HOLMBLAD METHOD

Body and part position: Patient is on hands and knees on radiographic table with affected knee flexed so that angle between femur and table is 70 degrees. Contralateral knee is flexed more and is forward to provide support (Fig. 14.60). Pelvis must remain level and sagittal plane of affected leg must remain perpendicular to the IR.

Central ray: Perpendicular to center of IR through center of knee joint.

Structures seen: Knee joint with portions of distal femur and proximal lower leg. Open intercondylar fossa (Fig. 14.61).

TIPS:

- Placing small level sponges under the knees helps provide patient comfort in this position.
- An increase in milliampere-seconds (mAs) of 50% from that used for the AP or PA projection is needed to compensate for the increased tissue thickness at the distal femur.

PA AXIAL PROJECTION—CAMP-COVENTRY METHOD

Body and part position: Prone with affected knee flexed to form an angle of 40 or 50 degrees between tibia and table (Fig. 14.62).

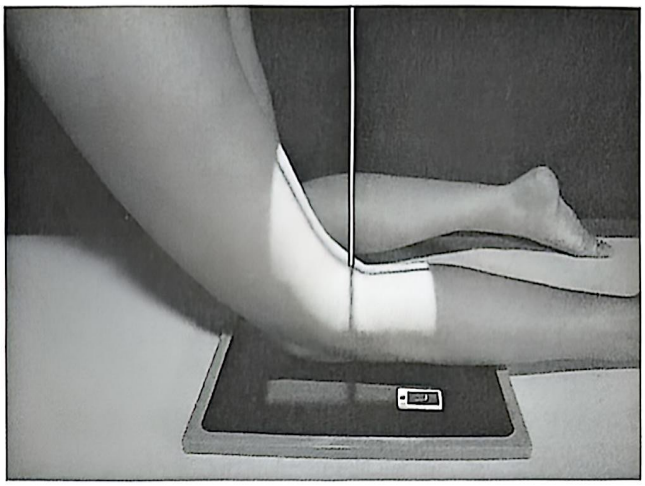


Fig. 14.60 Knee (intercondylar fossa). Position for PA axial ("tunnel") projection—Holmblad method.

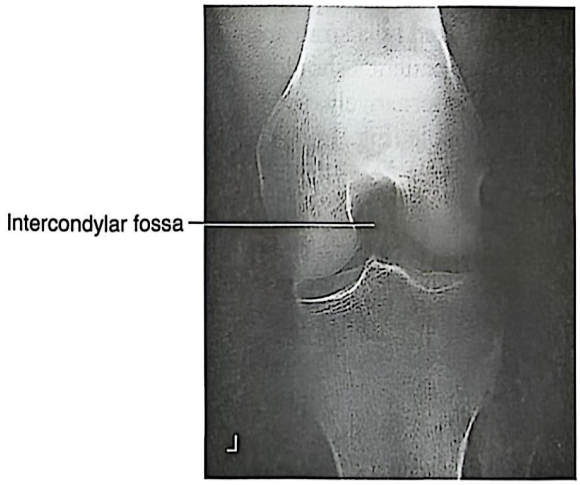


Fig. 14.61 Knee (intercondylar fossa). PA axial ("tunnel") projection—Holmblad method.

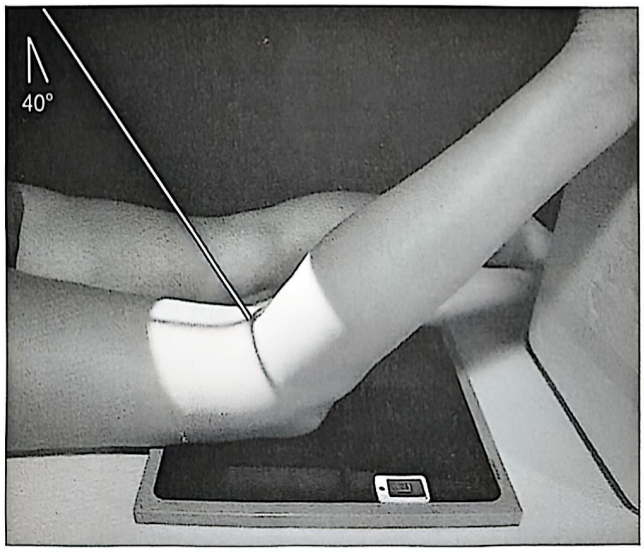


Fig. 14.62 Knee (intercondylar fossa). Position for PA axial ("tunnel") projection—Camp-Coventry method.

Central ray: Angled 40 degrees caudad through knee joint to center of IR if leg is 40 degrees, and 50 degrees if leg is 50 degrees.

Structures seen: Knee joint with portions of distal femur and proximal lower leg. Open intercondylar fossa (Fig. 14.63).

> **TIP:** An increase in mAs of 50% from that used for the AP or PA projection is needed to compensate for increased tissue thickness caused by the angulation of the x-ray beam.

TANGENTIAL ("SUNRISE") PROJECTION OF THE PATELLA—SETTEGAST METHOD

IR size and orientation, **grid, SID**, and **collimation** are the same as for routine knee projections.

Position: Prone with affected knee flexed as much as possible or until the patella is perpendicular to the IR. Sagittal plane of femur is perpendicular to IR. Position may be supported by a strap around the ankle that is extended over patient's shoulder and held by patient (Fig. 14.64). Alternatively, patient may be seated on the radiographic table (Fig. 14.65).

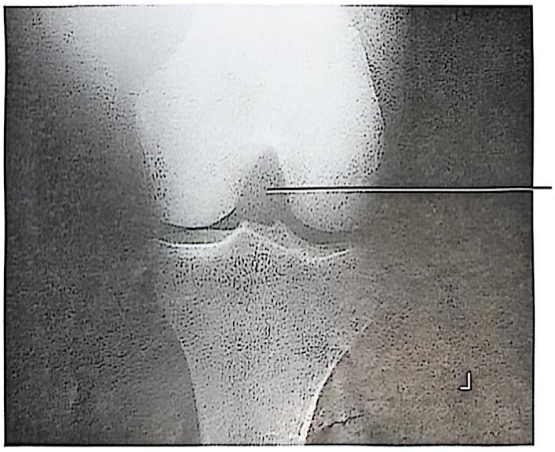
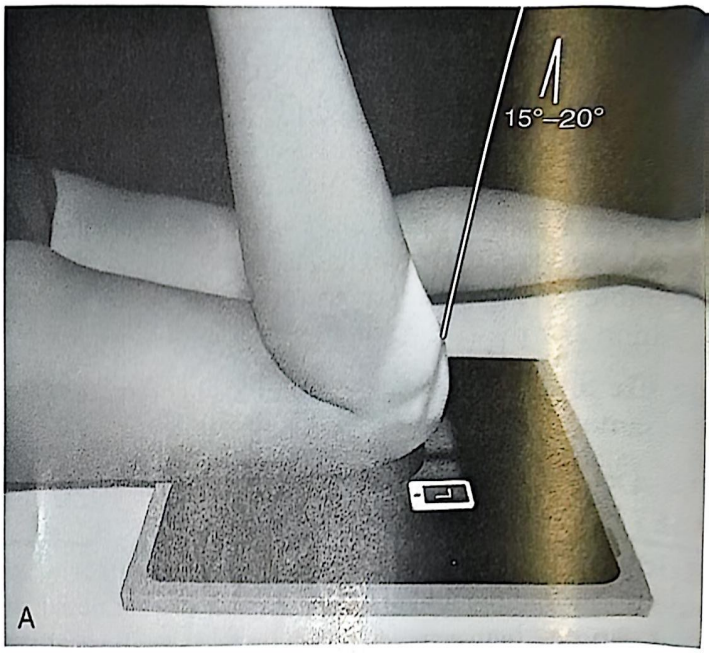


Fig. 14.63 Knee (intercondylar fossa). PA axial ("tunnel") projection—Camp-Coventry method.



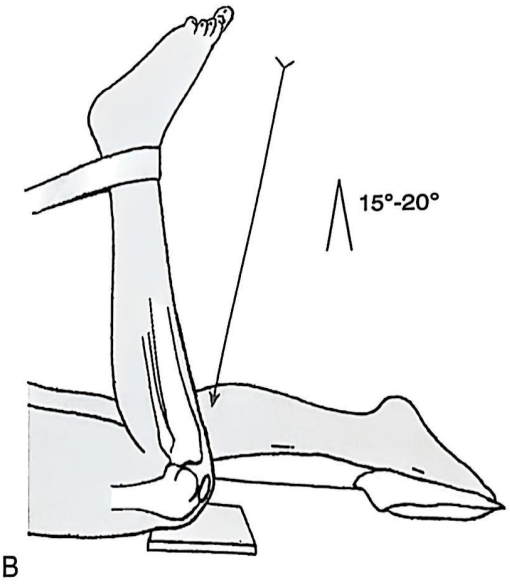


Fig. 14.64 Patella. (A) Position for tangential ("sunrise") projection—Settegast method (patient prone). (B) Drawing demonstrating relationships between central ray, patellofemoral joint space, and image receptor.

Central ray: Angled 15 to 20 degrees cephalad and centered to inferior margin of patella. Angulation is adjusted so that central ray passes between patella and distal femur.

Structures seen: Patella in profile and open patellofemoral joint (Fig. 14.66).

Fig. 14.65 Patella. Position for tangential ("sunrise") projection—Settegast method (patient seated).

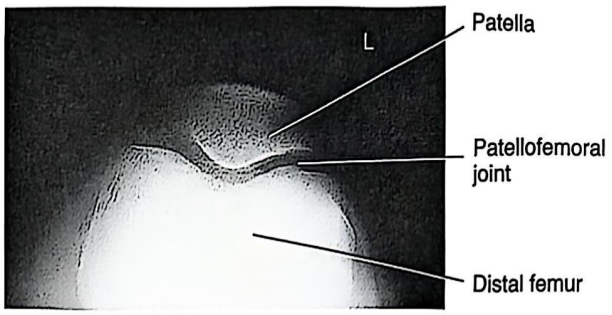


Fig. 14.66 Patella. Tangential projection.

Femur

For most adults, the entire femur is too long to be included on a 35 × 43 cm IR, so a choice must be made about which portion to include. Radiographs of the distal femur include the knee, whereas those of the proximal femur include the hip joint. When the entire femur is imaged, AP and lateral radiographs of both the proximal and distal femur are included.

ROUTINE EXAMINATION

Distal Femur: The routine examination of the distal femur includes the AP and lateral projections.

IR: Positioned by manufacturer or department protocol for proper anatomy display orientation; CR plate: 14 × 17 inches (35 × 43 cm)

Grid: Yes

SID: 40 inches minimum

Body position:

AP: Supine with affected femur aligned with center of table.

Lateral: Recumbent on affected side with affected femur aligned with center of table. Knee and hip of unaffected limb are flexed, and leg is supported anterior to the body.

Part position:

AP: Leg is extended with sagittal plane perpendicular to IR. Ensure plane through epicondyles is parallel with IR. Inferior margin of IR is placed 1 to 2 inches below knee joint (Fig. 14.67).

Lateral: Knee of affected leg is flexed 30 to 45 degrees. Sagittal plane of femur is parallel to IR. Inferior margin of IR is placed 1 to 2 inches below knee joint (Fig. 14.69).

Central ray: Perpendicular to midpoint of IR.

Collimation: Adjust light field to 1 inch (2.5 cm) on the sides of the shadow of the femur and 17 inches (43 cm) in length. Place side marker in the collimated light field.

Patient instruction: Do not move.

Structures seen: Knee joint and distal three-fourths of femur (Figs. 14.68 and 14.70).

Fig. 14.67 Femur. Position for AP projection of distal femur.

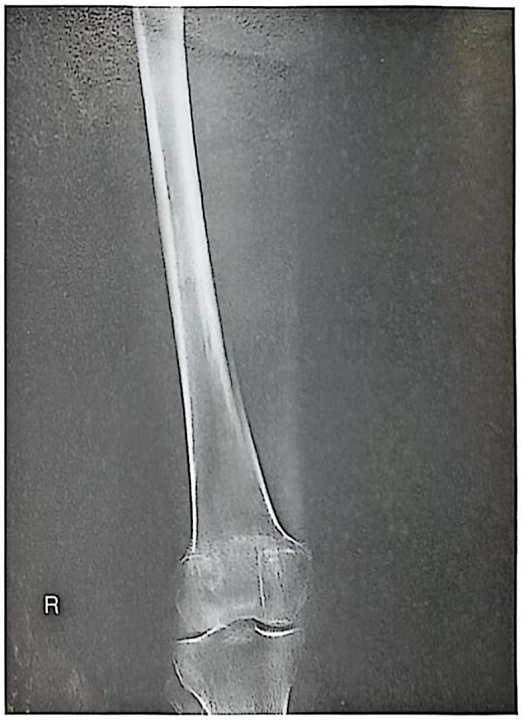


Fig. 14.68 Femur. AP projection of distal femur.

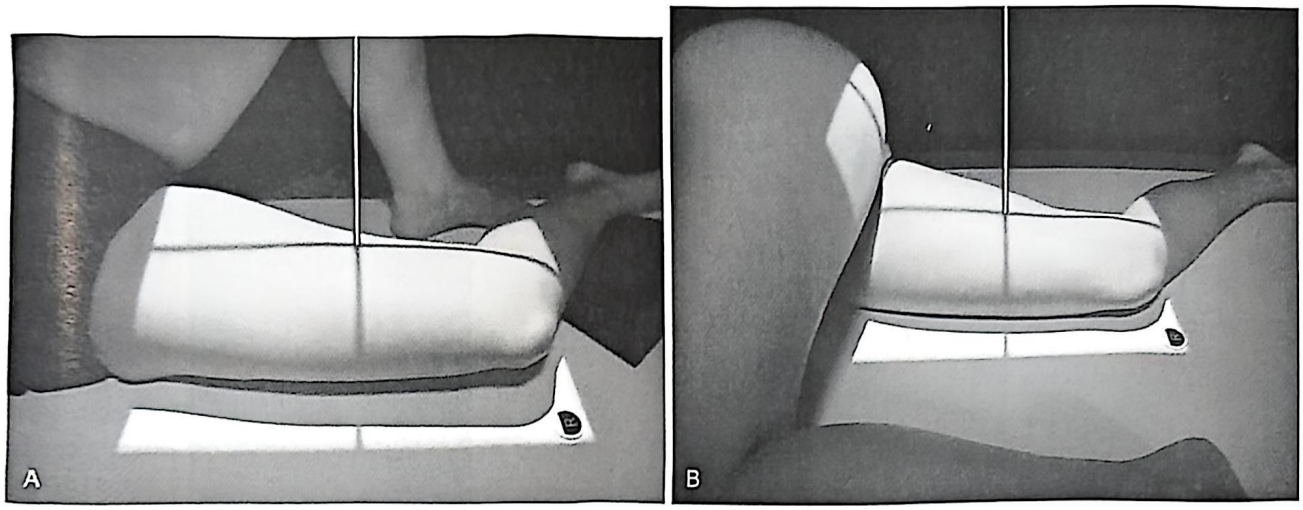


Fig. 14.69 Femur. Positions for lateral projection of distal femur. (A) Unaffected leg posterior. (B) Unaffected leg anterior and supported.

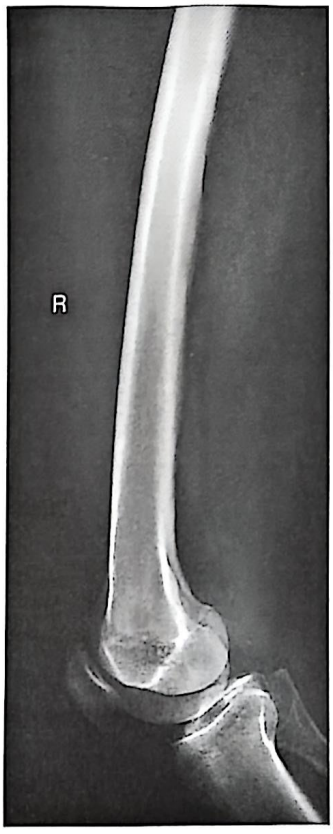


Fig. 14.70 Femur. Lateral projection of distal femur.

Proximal Femur: The routine examination of the proximal femur includes the AP and lateral projections.

IR: Positioned by manufacturer or department protocol for proper anatomy display orientation; CR plate: 14 × 17 inches (35 × 43 cm) lengthwise

Grid: Yes

SID: 40 inches minimum

Body position:

AP: Supine with affected femur aligned to center of table.

Lateral: Recumbent in oblique position on affected side with support under unaffected hip. Affected femur aligned to center of table. Knee and hip of unaffected limb are flexed and leg is supported posterior to body.

Part position:

AP: Leg is extended with sagittal plane perpendicular to IR. Rotate the limb internally 10 to 15 degrees to place the femoral neck in profile. Superior margin of IR is placed at level of ASIS (Fig. 14.71).

Lateral: Rotate pelvis posteriorly 10 to 15 degrees from lateral position to prevent superimposition. Sagittal plane of femur is parallel to IR as much as possible. Superior margin of IR is placed at level of ASIS (Fig. 14.73).

Central ray: Perpendicular to midpoint of IR.

Patient instruction: Do not move.

Structures seen: Hip joint and proximal three-fourths of femur (Figs. 14.72 and 14.74).

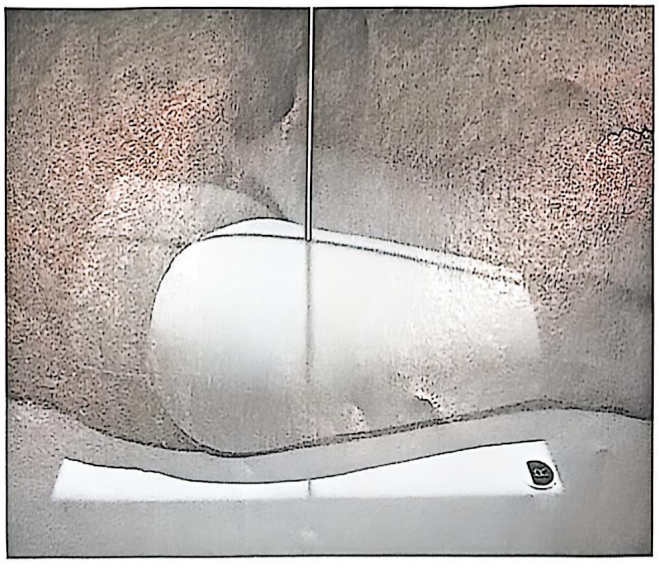


Fig. 14.71 Femur. Position for AP projection of proximal femur.

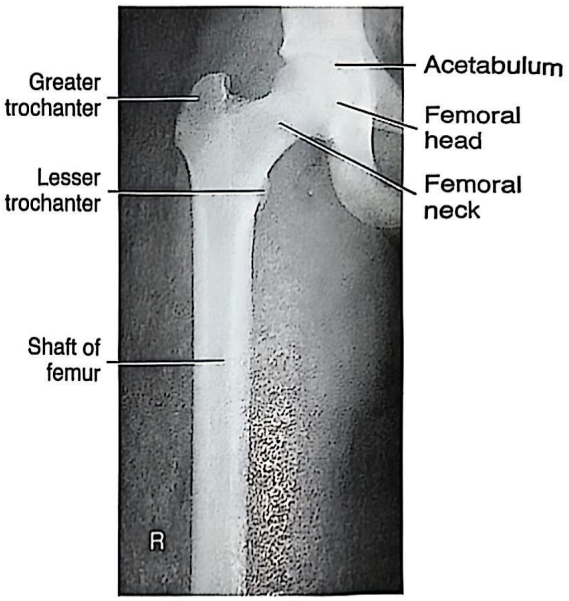


Fig. 14.72 Femur. AP projection of proximal femur.

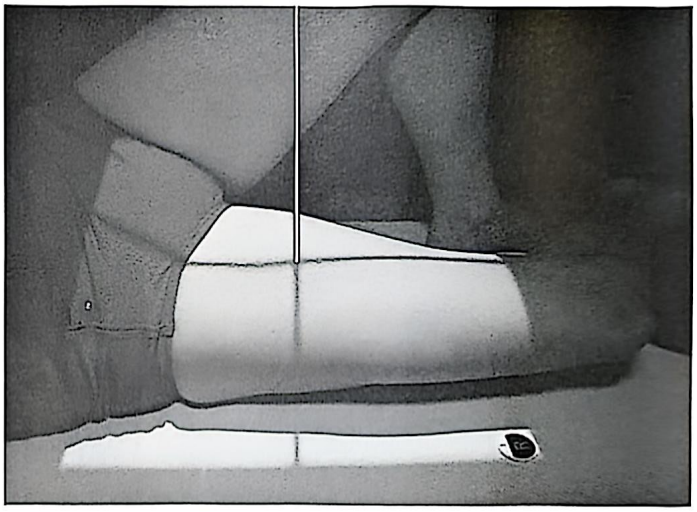


Fig. 14.73 Femur. Position for lateral projection of proximal femur.

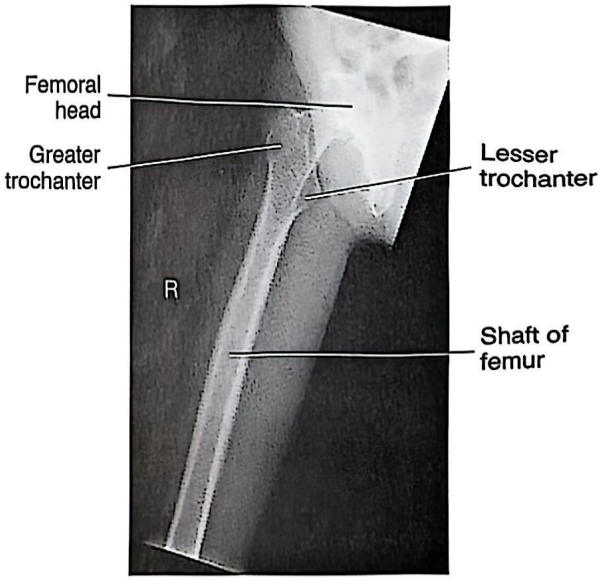


Fig. 14.74 Femur. Lateral projection of proximal femur.

Pelvis

ROUTINE EXAMINATION

The routine examination of the pelvis includes the AP projection.

IR: Positioned by manufacturer or department protocol for proper anatomy display orientation; CR plate: 14 × 17 inches (35 × 43 cm) crosswise

Grid: Yes

SID: 40 inches minimum

Body position: Supine on table. Coronal plane of body is parallel to IR (Fig. 14.75). If there is no suspicion of recent fracture, femurs are rotated medially 15 to 20 degrees to place femoral necks parallel to IR. The heels will be 8 to 10 inches apart (Fig. 14.76).

IR placement: Center IR midway between ASIS and pubic symphysis.

Central ray: Perpendicular to midpoint of IR.

Collimation: Adjust light field to 14 × 17 inches (35 × 43 cm) on the collimator. Place side marker in the collimated light field.

Patient instruction: Stop breathing. Do not move.

Structures seen: Entire pelvis and proximal portion of femurs (Fig. 14.77).

Fig. 14.75 Pelvis. Position for AP projection. (NOTE: A gonad shield is not used unless hips are of primary interest.)

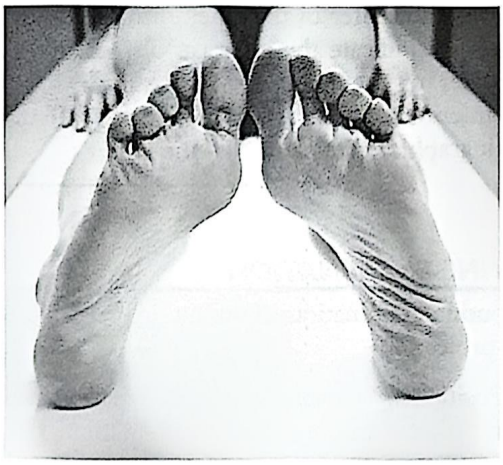


Fig. 14.76 Pelvis. Position of knees and feet for AP projection.

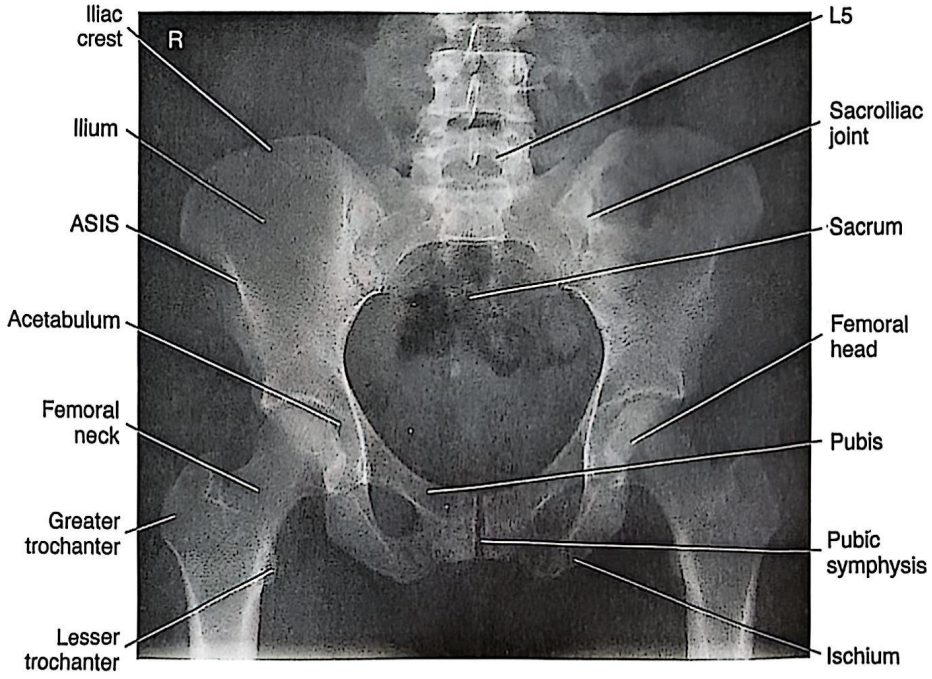


Fig. 14.77 Pelvis. AP projection.

Hip

When there has been recent trauma to the hip with a possibility of hip fracture, it is usual for the examination to begin with an AP projection of the entire pelvis. *Do not move the affected leg, regardless of its position*, until a physician has checked the pelvis image. If a lateral projection is needed in cases of recent hip fracture, an axiolateral projection is done without moving the affected leg.

Routine hip examinations are commonly performed as follow-up studies after treatment for hip fracture or for evaluation of chronic hip complaints.

Fig. 14.78 illustrates a method to locate the hip joint, the long axis of the femoral neck, and the centering point for hip radiographs. The midpoint of an imaginary line between the ASIS and the pubic symphysis marks the superior margin of the acetabulum. This area must be included in examinations of the proximal femur and in all hip studies. When a perpendicular line is drawn inferior to the center of this line, forming a T, this second line will indicate the long axis of the femoral neck. The center of the femoral neck is approximately 2.5 inches inferior to the junction and is the centering point for radiographic examinations of the hip.

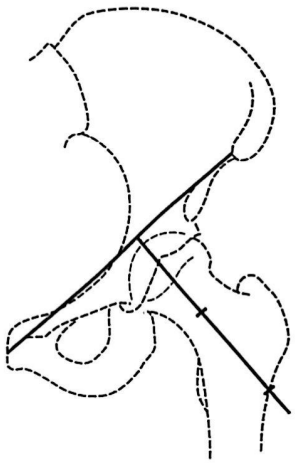


Fig. 14.78 Hip localization. Palpate the anterior superior iliac spine (ASIS) and the pubic symphysis. A line between these two points forms the crossbar of a T with the dome of the acetabulum at its center. The leg of the T is perpendicular to the crossbar and indicates the axis of the femoral neck. The midpoint of the femoral neck is the center point for hip radiographs. It is located along the leg of the T, approximately 2.5 inches inferior to its junction with the crossbar.

ROUTINE EXAMINATION

The routine examination of the hip includes the AP and lateral projections.

IR: Positioned by manufacturer or department protocol for proper anatomy display orientation; CR plate: 10 × 12 inches (24 × 30 cm)

Grid: Yes

SID: 40 inches minimum

Body position: Supine on table.

Part position:

AP: Femur is medially rotated 15 degrees as for pelvis (Fig. 14.79).

Lateral ("frog-leg" position): Hip is flexed as much as possible and femur abducted 45 degrees. If patient cannot abduct femur sufficiently from supine position, pelvis may be rotated toward affected side (Fig. 14.81).

Central ray: Perpendicular to midfemoral neck.

Collimation: Adjust light field to 10 × 12 inches (24 × 30 cm) on the collimator. Place side marker in the collimated light field.

Patient instruction: Do not move.

Structures seen: Proximal fourth of femur, acetabulum, and portion of pelvis surrounding acetabulum (Figs. 14.80 and 14.82).

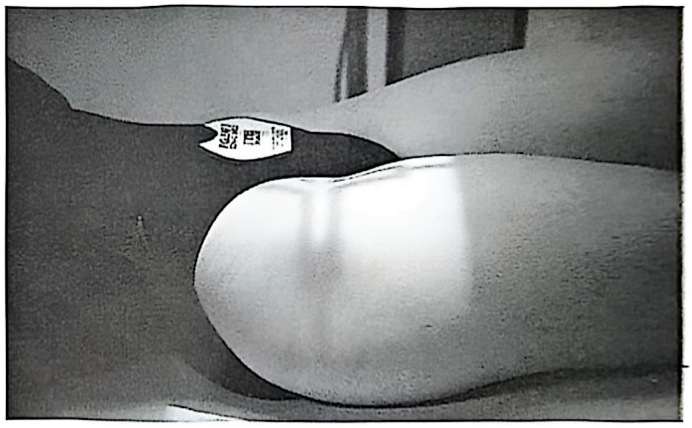


Fig. 14.79 Hip. Position for AP projection.

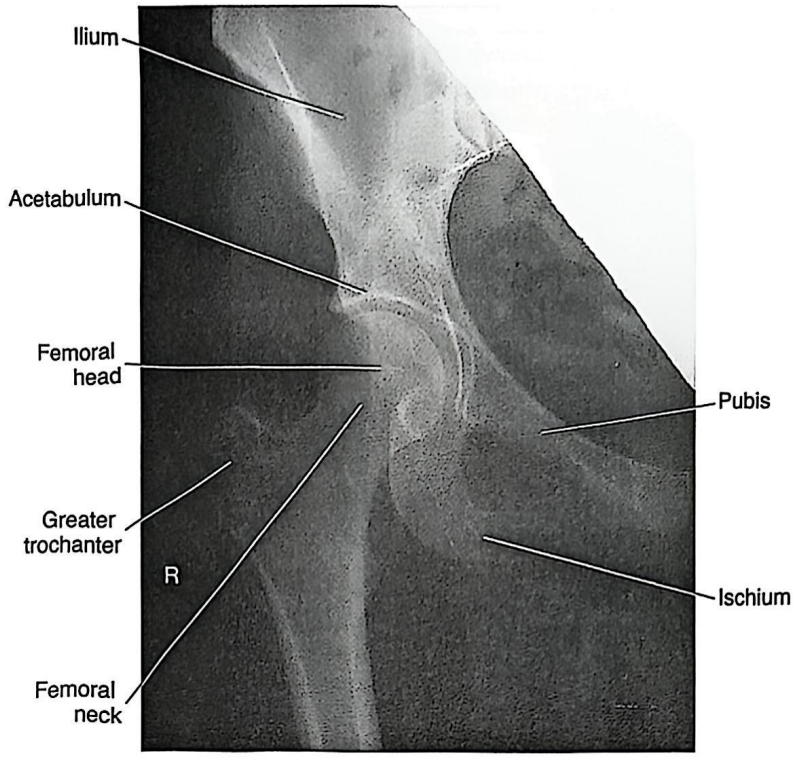


Fig. 14.80 Hip. AP projection.

Fig. 14.81 Hip. Position (frog-leg) for lateral projection.

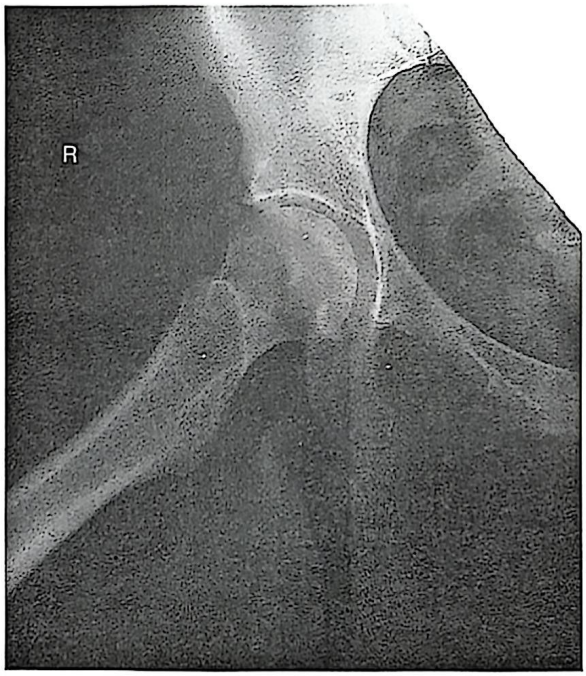


Fig. 14.82 Hip. Lateral projection (frog-leg position).

ALTERNATIVE LATERAL PROJECTION

When a lateral projection is needed in cases of known or suspected recent hip fracture, the axiolateral projection (Danelius-Miller method), also called the *cross-table lateral* or *surgical lateral projection*, is substituted for the frog-leg lateral projection. This radiograph is taken without moving or rotating the affected leg.

IR: Positioned by manufacturer or department protocol for proper anatomy display orientation; CR plate: 10 × 12 inches (24 × 30 cm) crosswise

Grid: Yes

SID: 40 inches minimum

Body position: Supine on table.

Part position: The hip and knee of the unaffected limb are flexed 90 degrees and supported above the table. A 10 × 12 inch grid cassette is used or a stationary grid is attached to a 24 × 30 cm IR. The IR is oriented vertically and crosswise, angled parallel to the long axis of the femoral neck, and the medial margin of the IR is placed solidly into the soft tissue just proximal to the iliac crest (Fig. 14.83).

Central ray: Horizontal and perpendicular to the center of the IR, entering through the patient's groin.

Collimation: Adjust light field to 10 × 12 inches (24 × 30 cm) on the collimator. Place side marker in the collimated light field.

Patient instruction: Do not move.

Structures seen: Proximal fourth of femur, acetabulum, and portion of pelvis surrounding acetabulum (Fig. 14.84).

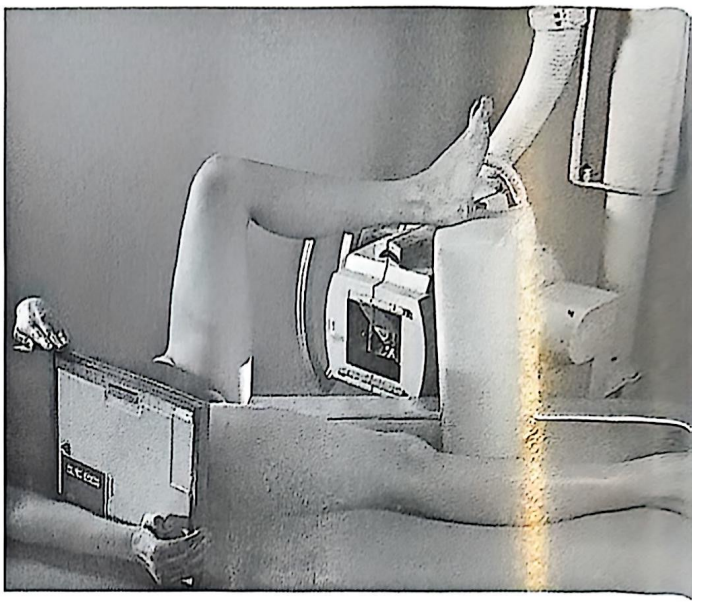


Fig. 14.83 Hip. Position for axiolateral projection (Danelius-Miller method). Also called a *cross-table lateral* or *surgical lateral projection.*

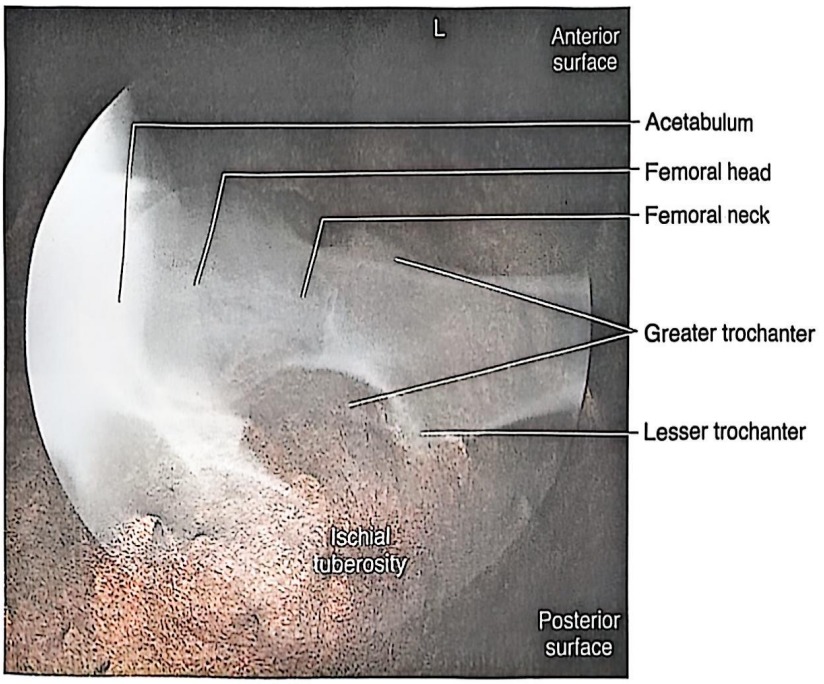


Fig. 14.84 Hip. Axiolateral projection (Danelius-Miller method).

PATHOLOGY

Probably the most significant pathology affecting the lower limb from the radiographer's viewpoint is trauma. Fractures and other conditions affecting this portion of the anatomy may vary greatly, and only those most commonly seen in radiography are discussed here.

Common Fractures

Stress fractures are most commonly seen in the feet, the result of stress to a bone from repeated injuries that would not cause fractures if they occurred only once. Stress fractures of long bones are usually simple, nondisplaced fractures (Fig. 14.85). They are common in the metatarsals and in the calcaneus as a result of running, jogging, or marching. They also occur in the tibia, fibula, femoral shaft, femoral neck, ischium, and pubis.

Sufficient force to cause a fracture of the tibia places a great strain on the fibula, often resulting in a fibular fracture as well. The associated fibular fracture may be in the same general region as the tibial fracture. One example is the bimalleolar fracture (Fig. 14.86). On the other hand, a distal tibia fracture may be associated with a fracture of the fibula at its weakest point, the proximal shaft, just distal to the head. When the shaft of the tibia is fractured with a twisting injury (common among skiers), the result is often a spiral fracture (Fig. 14.87).

Knee fractures in healthy individuals are relatively uncommon because the bones of the knee are very strong. When excessive force is applied to the knee joint, the result is more likely an injury to the meniscus cartilage and/or to one or more of the ligaments that connect the tibia to the femur. These soft tissue injuries are not visible on routine radiographs. Special imaging techniques, such as arthrography (joint studies involving injection of contrast media into the joint capsule) and magnetic resonance imaging studies, are used to evaluate soft tissue injuries to the knee.

The common fractures of the femur occur in the shaft, the neck, or the intertrochanteric region (between the trochanters). Fractures of the proximal femur (head, neck, and intertrochanteric region) are generally referred to as *hip fractures* (Fig. 14.88). Hip fractures associated with

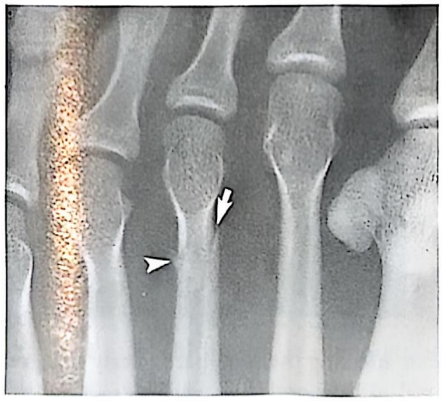


Fig. 14.85 Stress fracture of third metatarsal *(arrows)*.

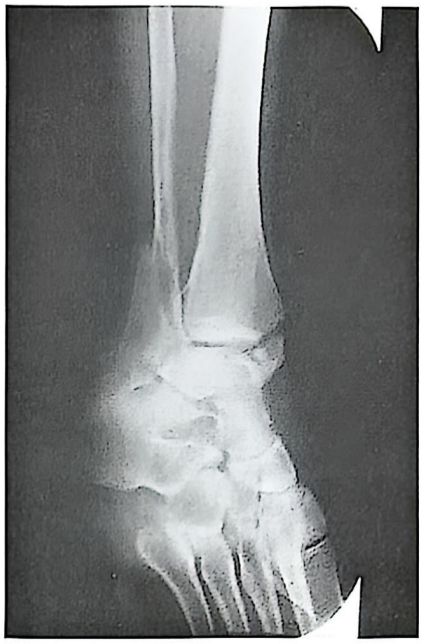


Fig. 14.86 Bimalleolar fracture.

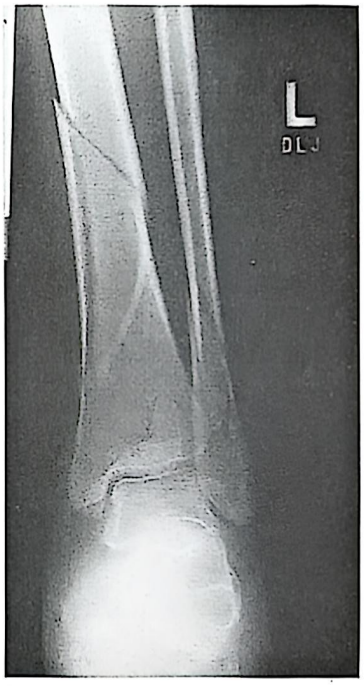


Fig. 14.87 Spiral fracture of tibia.

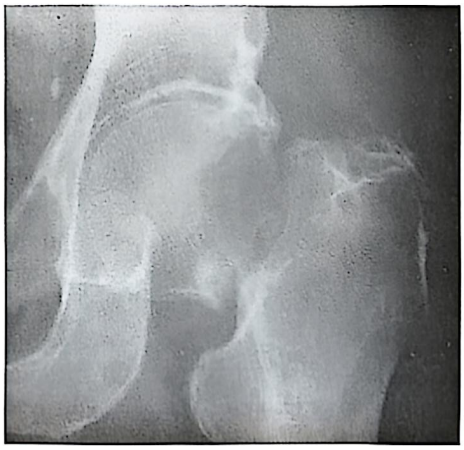


Fig. 14.88 Femoral neck fracture.

weakened bone from osteoporosis are common among the elderly, particularly women. Most fractures of the femur are treated by means of internal fixation, surgical application of hardware to hold the bones in place. Fig. 14.89 shows internal fixation of an intertrochanteric hip fracture. When there is severe degeneration of the hip joint, the treatment may be a total hip replacement (Fig. 14.90). In Fig. 14.90, the **prostheses** (anatomic replacements) for both the femoral head and the acetabulum are made of metal. It is not uncommon, however, for the acetabulum prosthesis to be made of a plastic material. Because the plastic is not visible on a radiograph, a radiopaque wire is embedded in its rim.

Because the pelvis as a whole is a rigid ringlike structure, fractures of the pelvis often occur in pairs. The reason for this is apparent if you consider how unlikely it would be to break a Life Savers candy in only one place

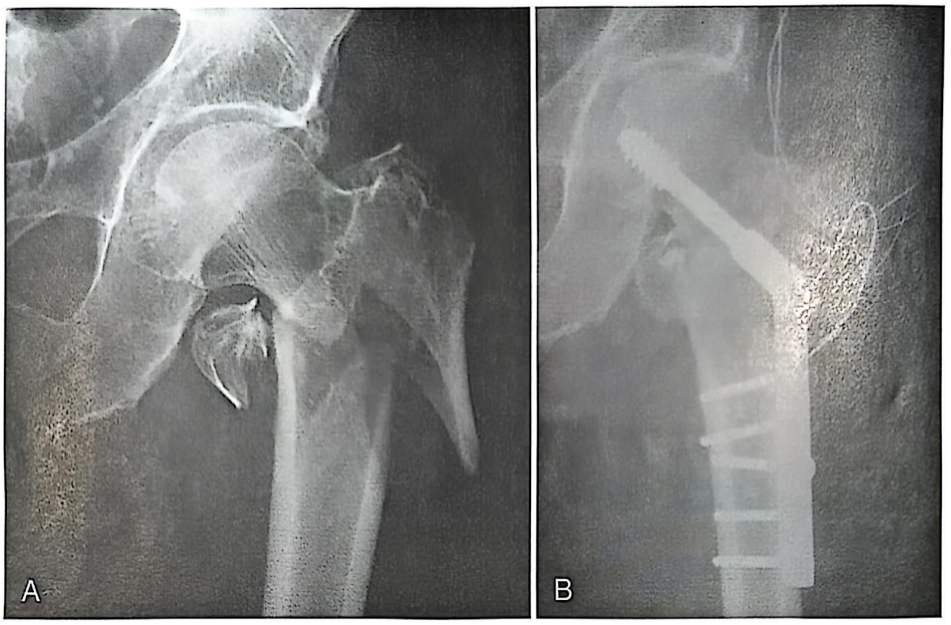


Fig. 14.89 (A) Intertrochanteric hip fracture. (B) Internal fixation of intertrochanteric fracture.

Fig. 14.90 Total hip replacement.

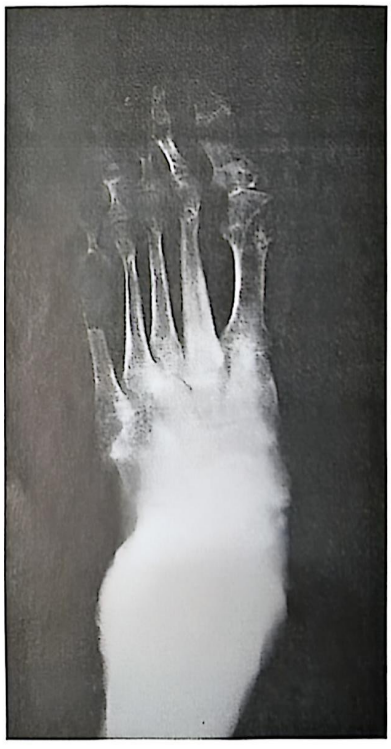


Fig. 14.91 Gout affecting the foot, particularly the great toe and first metatarsal.

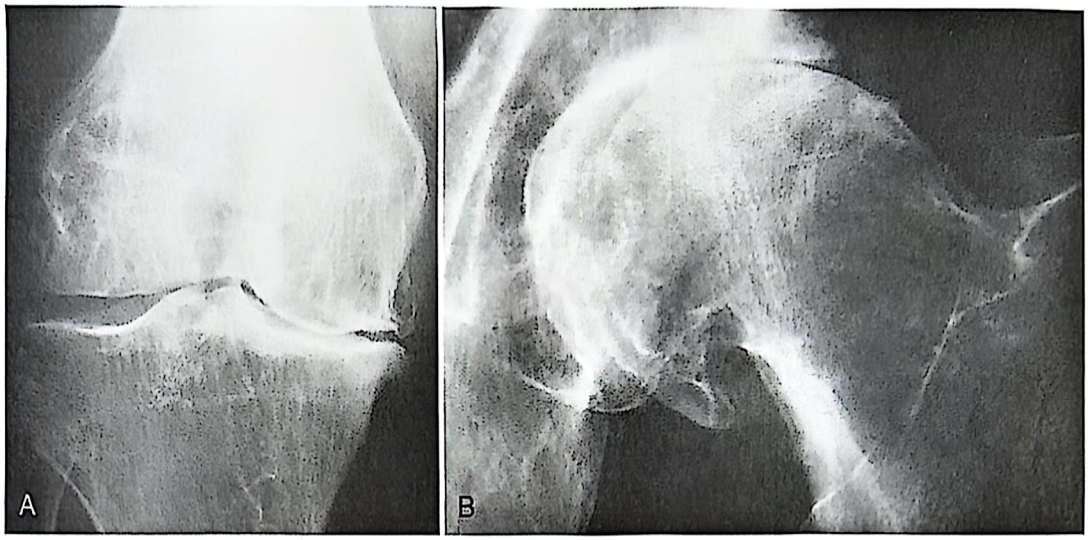


Fig. 14.92 Osteoarthritis. (A) Knee. (B) Hip.

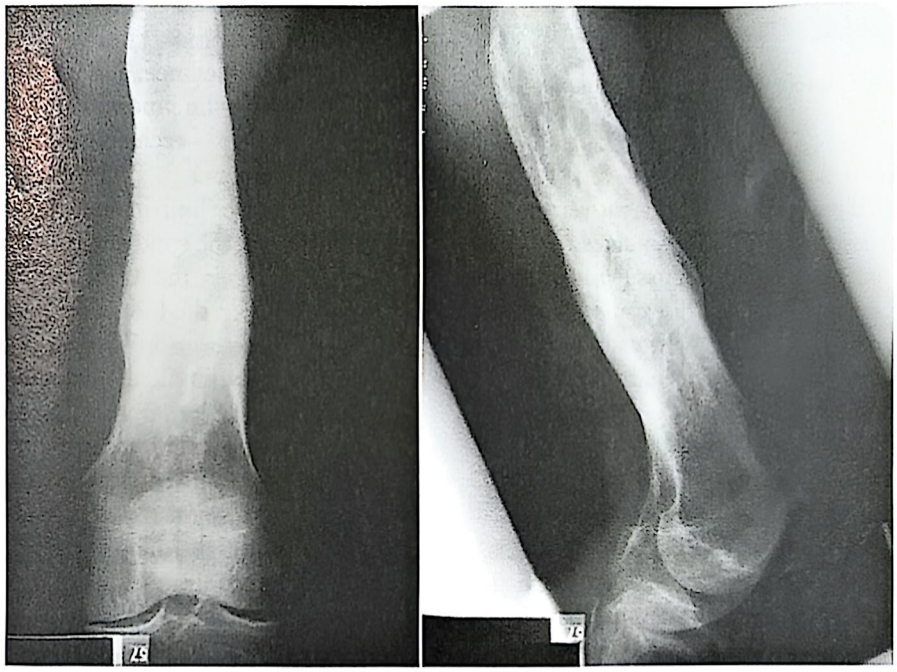


Fig. 14.93 Healed osteomyelitis of distal femur.

The stress that causes one fracture creates an opposing stress, and two fractures result.

Nontraumatic Conditions

As previously mentioned, arthritis may affect any joint of the body, and there are a number of different types. Rheumatoid arthritis, discussed in Chapters 12 and 13, may also affect the joints of the feet. Gouty arthritis is a joint condition caused by gout, a systemic disorder that increases the uric acid content of the blood. Gouty arthritis commonly affects the feet, particularly the joints of the great toe (Fig. 14.91), although it may also involve the hands. Osteoarthritis may cause degeneration of any of the joints of the lower limb but is most common in the knee and the hip (Fig. 14.92). This condition is often associated with osteoporosis. Note the irregular contours of the articular surfaces and the bony hypertrophy at the margins of the joints.

Osteomyelitis, as introduced in Chapter 13, is an infection of the bone. In the acute phase of the disease, there is bony destruction. With healing, however, there is considerable new bone formation (Fig. 14.93).

Neoplastic and metastatic bone diseases may also affect the bones of the lower limb. Fig. 14.94 is an example of osteogenic sarcoma, one of several types of malignant bone tumors that occur in the lower limb. The typical lesions of osteogenic sarcoma occur in the distal ends of

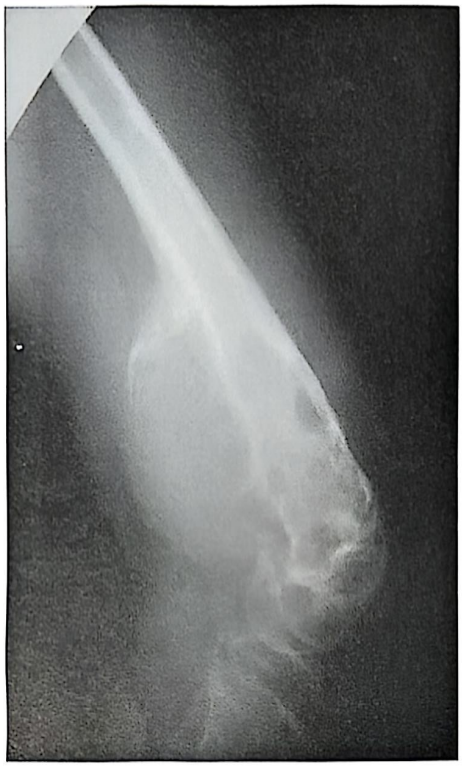


Fig. 14.94 Osteogenic sarcoma of the distal femur.

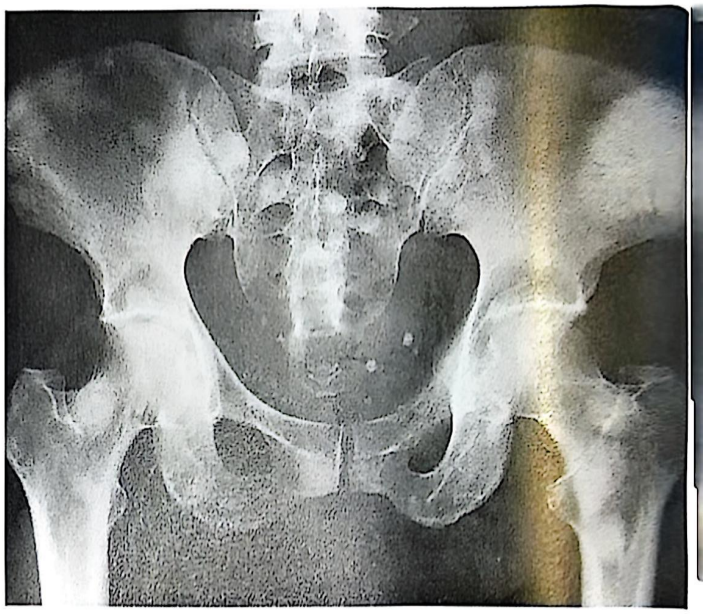


Fig. 14.95 Osteoblastic metastatic lesions of the pelvis and proximal femurs.

long bones and are both destructive and sclerotic (thickened and hardened). They are associated with a tumor mass within the soft tissues. The bony spicules (needle-like formations) that extend into the soft tissue mass create the classic sunburst pattern of this disease. Fig. 14.95 shows osteoblastic metastases of the pelvis and proximal femurs, secondary to carcinoma of the urinary bladder.

SUMMARY

The bones of the foot include the phalanges, metatarsals, and tarsals. The tibia and fibula form the lower leg, articulating at the ankle with the talus. The femur articulates with the tibia at the knee, and it forms the hip joint where it articulates with the innominate bone at the acetabulum. The two hip bones—each consisting of ilium, ischium, and pubis—form the pelvis. Important palpable bony prominences of the lower limb include the medial and lateral malleoli of the ankle, the condyles and greater trochanter of the femur, the iliac crest, the ASIS, and the pubic symphysis.

Radiography of the foot, heel, and ankle is done on the tabletop, without a grid. The patient is seated or recumbent on the radiographic table. Examinations of the femur and pelvis, on the other hand, are done using grids or Buckys with the patient recumbent. Radiography of the knee may be done either with or without a grid.

The most common radiographic pathology occurring in this portion of the anatomy involves trauma, particularly fractures. Nontraumatic conditions, such as arthritis, osteomyelitis, and neoplastic disease, are also seen.