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Imaging of the Proximal Tibia

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Abstract

A proximal tibia fracture is a break or fracture of the shinbone directly below the knee. The higher part of the bone where it spreads to assist form the knee joint is known as the proximal tibia.

Soft tissues (skin, muscle, nerves, blood vessels, and ligaments) may also be wounded at the time of the fracture in addition to the broken bone. Any soft tissue injuries must be treated concurrently with the shattered bone. To regain the leg's strength, range of motion, and stability as well as lower the chance of developing arthritis, surgery is frequently necessary.

The greatest weight-bearing joint in the human body is the knee. The femur and tibia come together to form the knee joint. For some support, the patella rests in front of the joint.

Keywords: Knee Joint, Broken Bone, Surgery, Femur, Tibia

Introduction

The weight-bearing and non-weight-bearing portions of the tibial plateau. The medial and lateral tibial plateaus or condyles, which articulate with the medial and lateral femoral condyles, respectively, make up the weight-bearing component of the tibial plateau. In contrast to the lateral tibial plateau, which is convex, is anteriorly flattened, and contains fewer trabeculae than the medial plateau, the medial tibial plateau is bigger, concave, and somewhat more distal. The cruciate ligament and meniscus root attachment points are located in the central intercondylar region, which supports no weight. The elevated intercondylar eminence, together with the medial and lateral tibial spines, is located in the middle of the intercondylar area.

There are various anatomic issues that are relevant to modern surgical methods for dorsal plating, even if it is outside the scope of this article to cover in detail the muscular, ligamentous, and meniscal attachments of the tibial plateau. Due to the existence of the overlaying lateral collateral ligament complex and the popliteus tendon, the typical surgical exposure of the anterolateral tibial plateau provides a constrained window for the treatment of injuries involving the posterolateral tibia. Similar to this, until it is removed, the superficial medial collateral ligament prevents the posteromedial plateau from being exposed.

Only 25% of tibial plateau fractures are caused by collisions with automobile bumpers, which is why they were initially referred to as bumper or fender fractures.

Axial loading, such as that caused by a fall, is the most frequent type of injury mechanism. Other injury patterns are caused by twisting injuries or laterally directed forces. In every instance, fracture occurs as a result of force being applied from the femoral condyles to the medial and lateral parts of the tibial plateau. Splitting fractures are more common in younger people, whereas depression fractures are more common in older, more osteoporotic patients.

It is essential to do a thorough radiographic evaluation of tibial plateau fractures in order to ascertain the degree and nature of the damage. Oblique and horizontal beam lateral views should be added to standard antero-posterior and lateral radiographs.

The following images can greatly aid fluoroscopic vision of anatomical fracture reduction and proper implant placement for the proximal tibia.

Standard views

1. AP view
2. Lateral view
3. AP with 10° cephalic tilt view
4. AP view with 45° external and internal rotation
5. Modified lateral views to assess the medial and lateral plateau

The following represent Ideal imaging with the patient placed in the supine position. The relation between the proximal tibia and the beam remains the same for patients in all other positions.

The orientation of the C-arm has to be adjusted accordingly.

1. AP view

Positioning for optimal view

To obtain the optimal AP view of the proximal tibia:

1. The leg is placed in full extension and neutral rotation.
2. The beam is placed perpendicular to the axis of the tibia.

AP images obtained with the knee is in 30° flexion will not be very different from those recorded with the leg in full extension.

With the knee in 90° flexion, an AP view cannot be obtained.

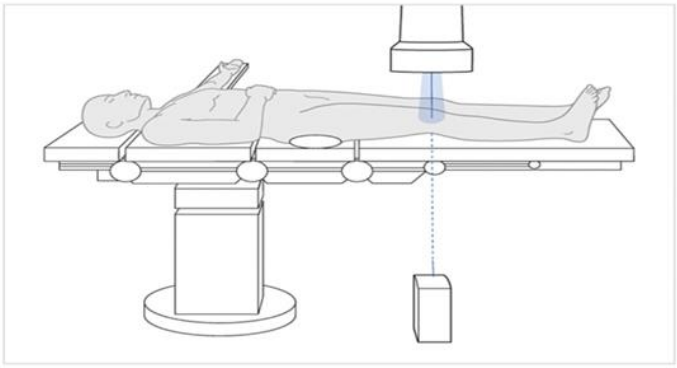

Fig 1: Positioning for optimal AP view

Verification of optimal view

The optimal AP view of the proximal tibia is obtained when:

1. The patellar apex is centred over the femoral notch.
2. There is 1/4 to 1/3 of the fibular head overlapping the lateral edge of the proximal tibia.
3. The beam is centred on the tibia plateau.

Fig 2: Optimal AP view

Anatomical landmarks and lines

The following lines and landmarks can be observed in the AP view of the proximal tibia:

1. Lateral tibial plateau

2. Patella
3. Fibula head
4. Medial tibial plateau
5. Lateral tibial spine
6. Medial tibial spine

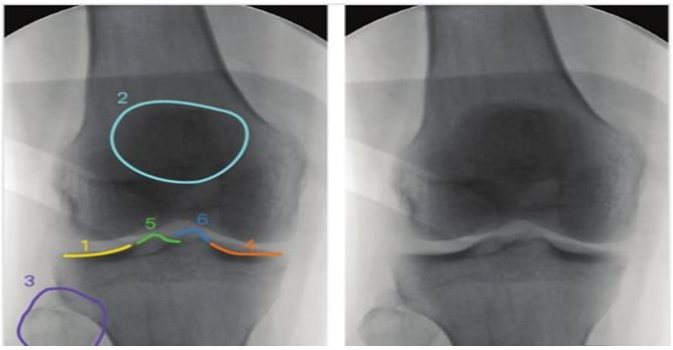

Fig 3: Anatomical landmarks and lines in AP view (Right side)

What can be observed?

This view is particularly useful to identify:

1. Malreduction of Intra-articular fractures (articular steps)
2. Intra-articular hardware
3. Opening of the joint space under varus or valgus stress (indication of collateral ligament injury)
4. Avulsions fractures of the tibial spine (indication of cruciate ligament injury)

The correct angle between the joint line and the tibial axis (85-90°)

Images of the contralateral side is beneficial as a reference.

2. Lateral view

Positioning for optimal view

To obtain the optimal lateral view of the distal femur:

1. The leg is flexed to elevate the knee.
2. The leg is placed in neutral rotation.

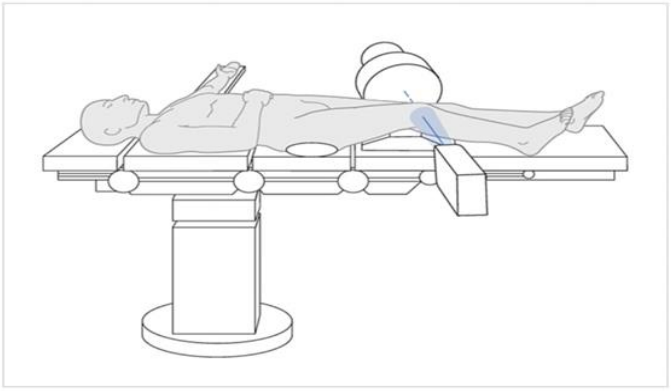

Fig 4: Positioning for optimal lateral view of the proximal tibia

Verification of optimal view

The optimal lateral view to the proximal tibia is obtained when:

1. The beam is placed parallel to the tibial joint plane (or perpendicular to the tibial axis).
2. The femoral condyles are superimposed in anterior, distal and posterior aspects

The femoral condyles are centered on the screen

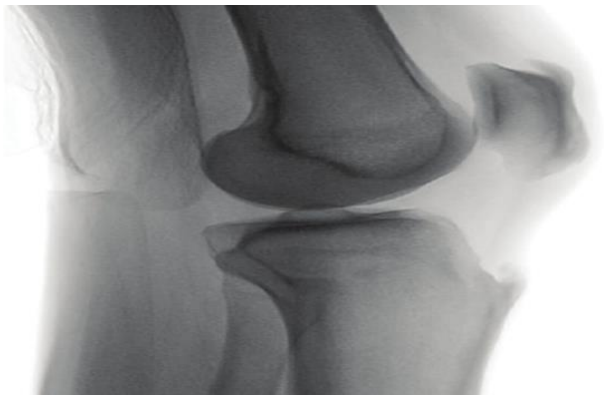

Fig 5: Imaging of the proximal tibia

Anatomical landmarks and lines

The following lines and landmarks are seen in the lateral view of the proximal tibia:

1. Lateral tibial plateau (convex line)
2. Medial tibial plateau (concave line)
3. Tibial spine
4. Tibial tuberosity
5. Epiphyseal scar

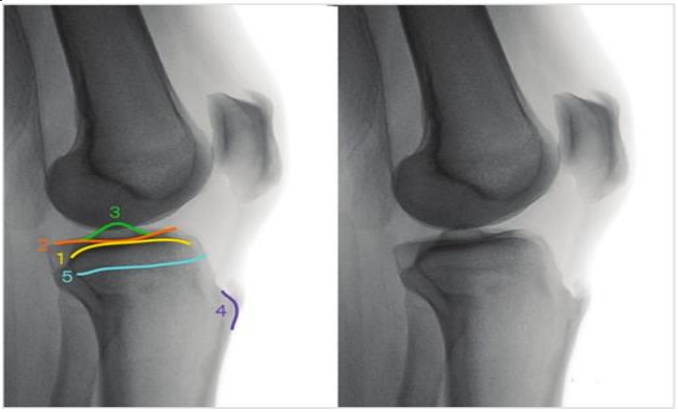

Fig 6: Anatomical landmarks and lines in the optimal lateral view of the proximal tibia

What can be observed?

The lateral view of the proximal tibia is particularly useful to identify:

1. Malreduction of the medial and lateral plateau
2. Malreduction of the tibial spine
3. Anterior or posterior subluxation of the tibial plateau relative to the femur (indicative of cruciate ligament injury)
4. Intra-articular hardware

3. AP view of the proximal tibia with 10° cephalic tilt

Positioning for optimal view

To obtain the optimal view, start from the optimal AP view and tilt the C-arm caudally until the AP view of the true tibial joint line is obtained (10°).

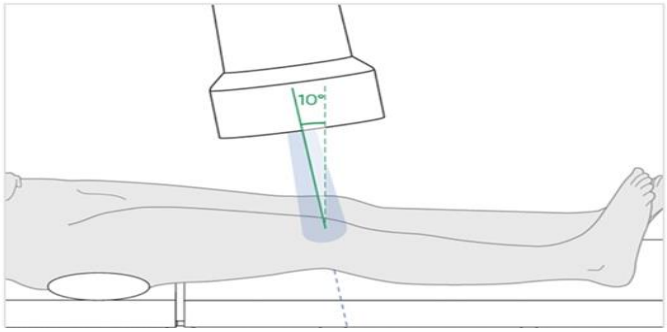

Fig 7: Positioning for optimal AP view of the proximal tibia with 10° cephalic tilt

Verification of optimal view

The optimal view of the true tibial joint line is achieved when:

1. The tibia joint line is cantered on the screen
2. The medial and lateral joint lines appears as one thick line.

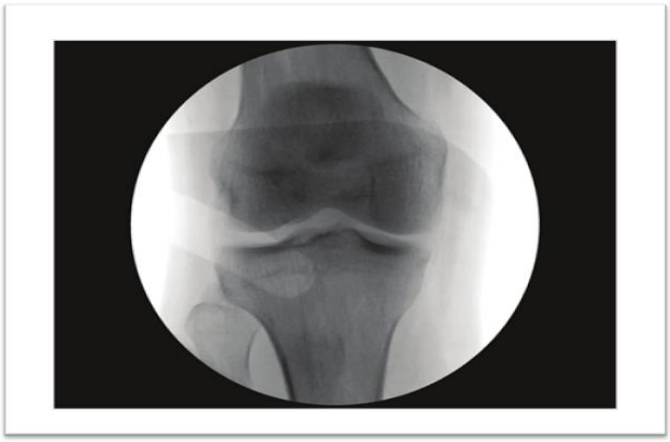

Fig 8: Verification of optimal AP view of the proximal tibia with 10° cephalic tilt

Anatomical landmarks and lines

The following lines and landmarks can be seen

1. Lateral tibial plateau (convex line)
2. Medial tibial plateau (concave line)
3. Medial and lateral tibial spine
4. Epiphyseal scar

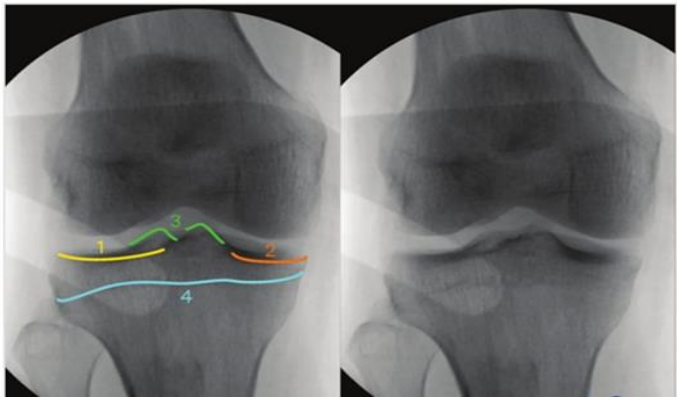

Fig 9: Anatomical landmarks and lines in the AP view of the proximal tibia with 10° cephalic tilt

What can be observed?

This view is particularly useful to identify:

1. Joint malreduction
2. Intra-articular hardware

The correct angle between the tibial joint line and the tibial axis (85-90°).

4. Modified lateral view to evaluate the lateral plateau

Positioning for optimal view

To obtain the optimal view for evaluating the lateral tibial plateau, start from the perfect lateral view and abduct the leg approximately 10-20°.

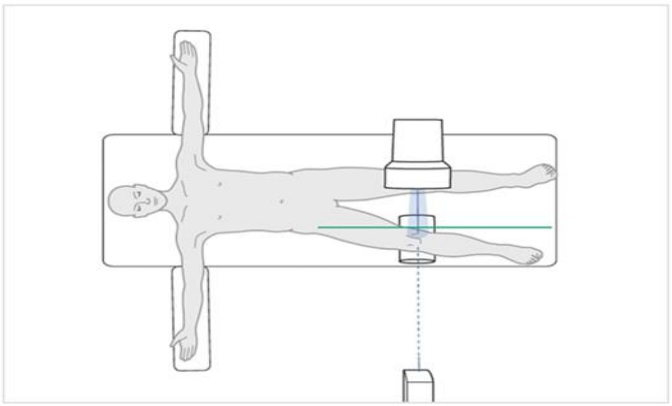

Fig 10: Positioning for optimal modified lateral view to evaluate the lateral plateau

Verification of optimal view

The optimal lateral view to assess the lateral tibial plateau is obtained when:

1. The contour of the convex lateral plateau is seen in the joint space cranially to the concave medial plateau.
2. The lateral tibial plateau is cantered on the screen.

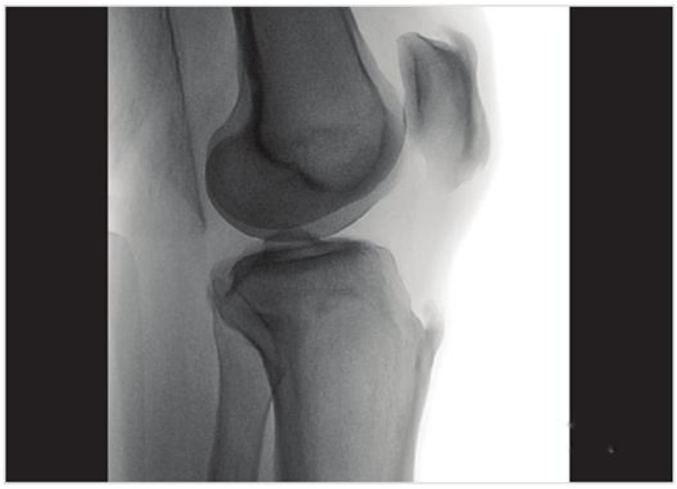

Fig 11: Verification of optimal view modified lateral view to evaluate the lateral plateau

Anatomical lines and landmarks

The following lines and landmarks can be observed:

Lateral tibial plateau.

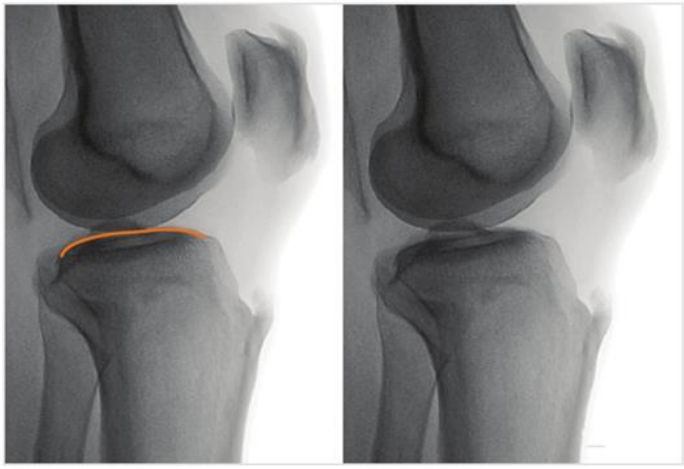

Fig 12: Anatomical landmarks and lines in the modified lateral view to evaluate the lateral plateau

What can be observed?

This view is particularly useful to identify:

1. Incongruency of the joint line.
2. Joint penetration of hardware.

5. Modified lateral view to evaluate the medial plateau

Positioning for optimal view

To obtain the optimal view for evaluating the medial tibial plateau, start from the perfect lateral view and adduct the leg approximately 10-20°.

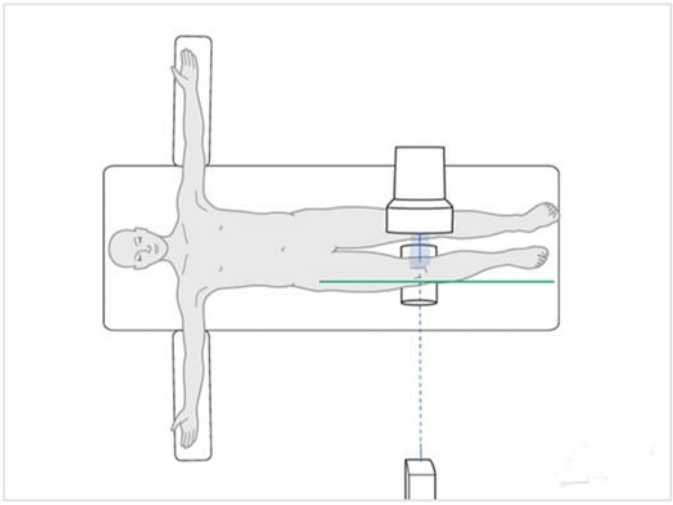

Fig 13: Positioning for optimal modified lateral view to evaluate the medial plateau

Verification of optimal view

The optimal lateral view to assess the medial tibial plateau is obtained when:

1. The contour of the concave medial plateau is seen in the joint space cranially to the convex medial plateau.
2. The medial tibial plateau is centred on the screen.

Fig 14: Verification of optimal view for optimal modified lateral view to evaluate the medial plateau

Anatomical lines and landmarks

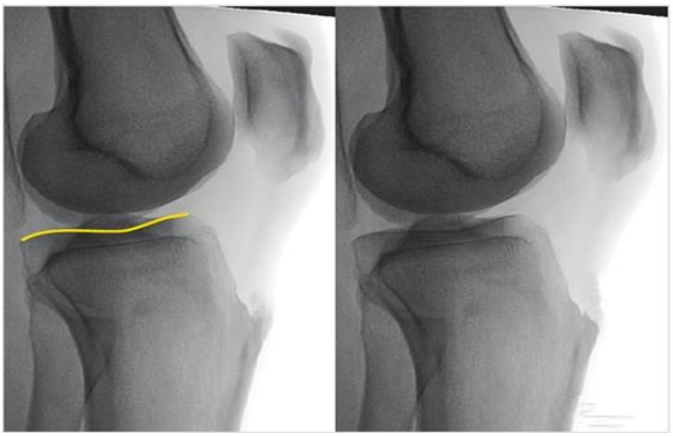

Fig 15: Imaging of the proximal tibia

What can be observed?

This view is particularly useful to identify:

- Incongruency of the joint line.
- Joint penetration of hardware.

On behalf of all authors, the corresponding author states that there is no conflict of interest.

Declarations

Informed consent

Informed consent was obtained for experimentation with human subjects. The privacy rights of human subjects must always be observed

"Institutional Ethical Committee Approval"

Taken from Institutional Ethical Approval Committee, MGM Medical College & Hospital, Navi Mumbai, Maharashtra, India.

Availability of data and materials

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- Diagnostic imaging and classification of proximal femoral and tibia fractures in adults. Josephine Berger-Grouch, Maximilian J Hartal, Miriam T Leiderer, Karl-Heinz Frosch. PMID: 32405746, DOI: 10.1007/s00117-020-00691-5

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