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Surgical approaches in Proximal Tibial Fractures

F. Benazzo

Epidemiology

- **Tibial plateau fractures represents 55-70% of proximal tibial fractures**
- **Bimodal distribution:**
  - Young adults: high-energy trauma (sport injuries/car accidents)
  - Elderly (>70 years): often osteoporotic

Schatzker classification

Schatzker 1 → Lateral tibial plateau fracture without depression

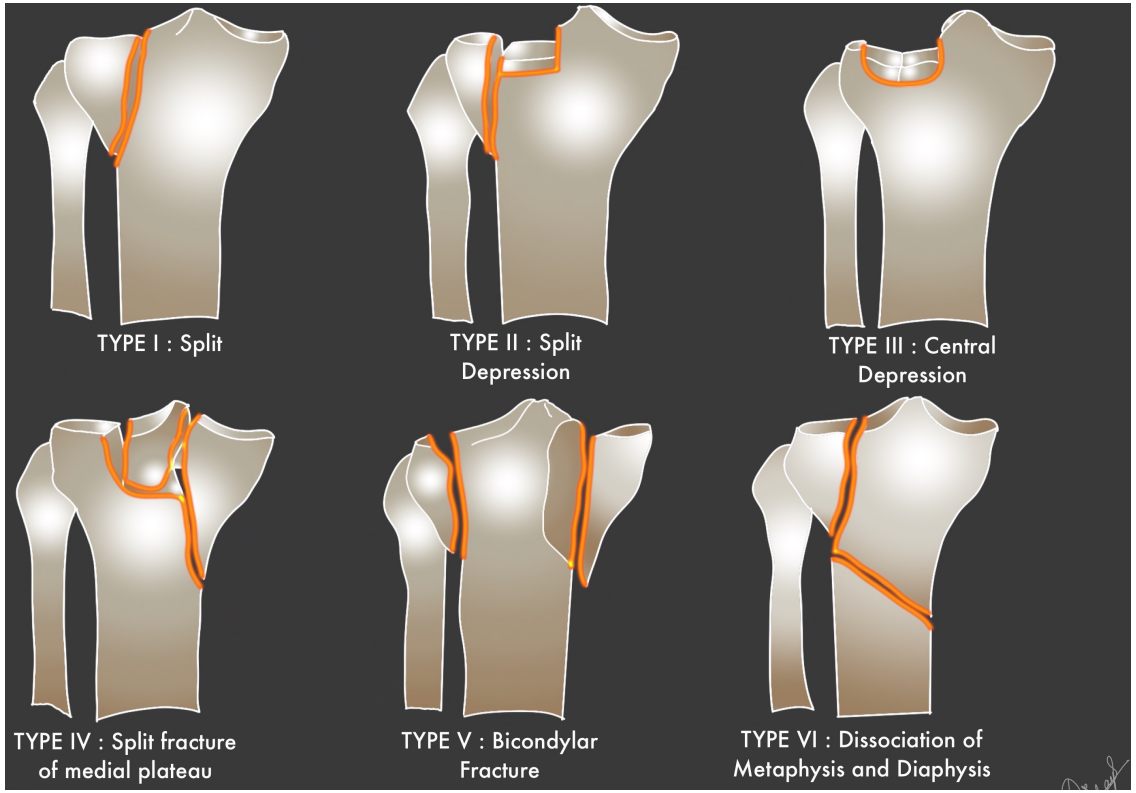
Schatzker 2 → Lateral tibial plateau fracture, with depression (most frequent)

Schatzker 3 → Lateral/central depression fracture

Schatzker 4 → Medial tibial plateau fracture

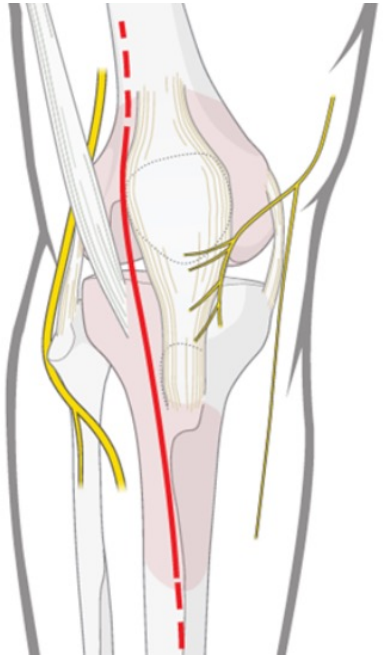
Schatzker 5 → Medial and lateral tibial plateau fracture

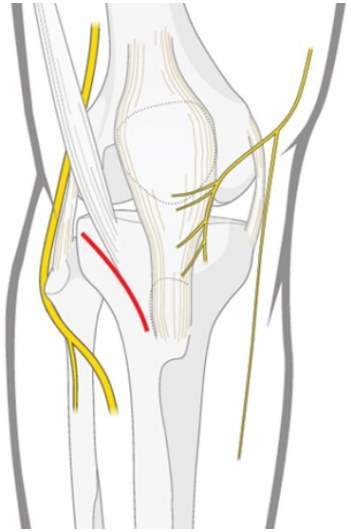
Schatzker 6 → Tibial plateau fracture with metaphysis separation from diaphysis

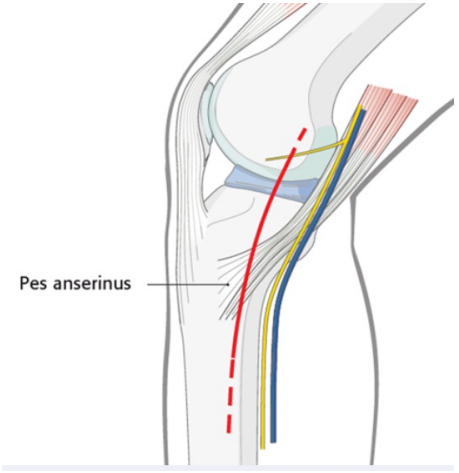


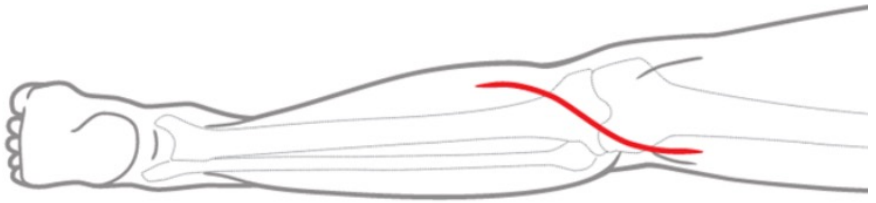
Which is the best surgical approach?

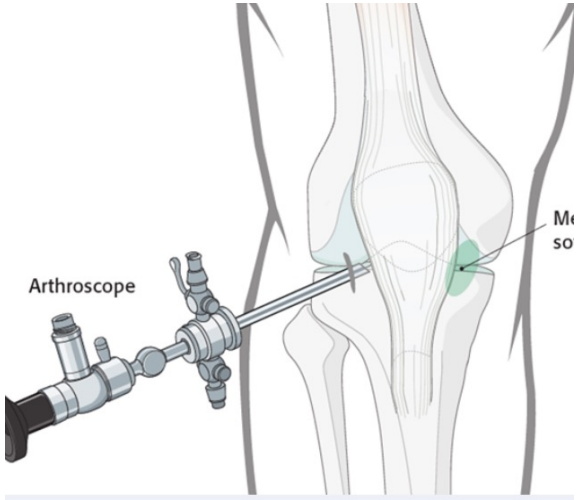
It depends on fracture type !! (medial, lateral, both…)











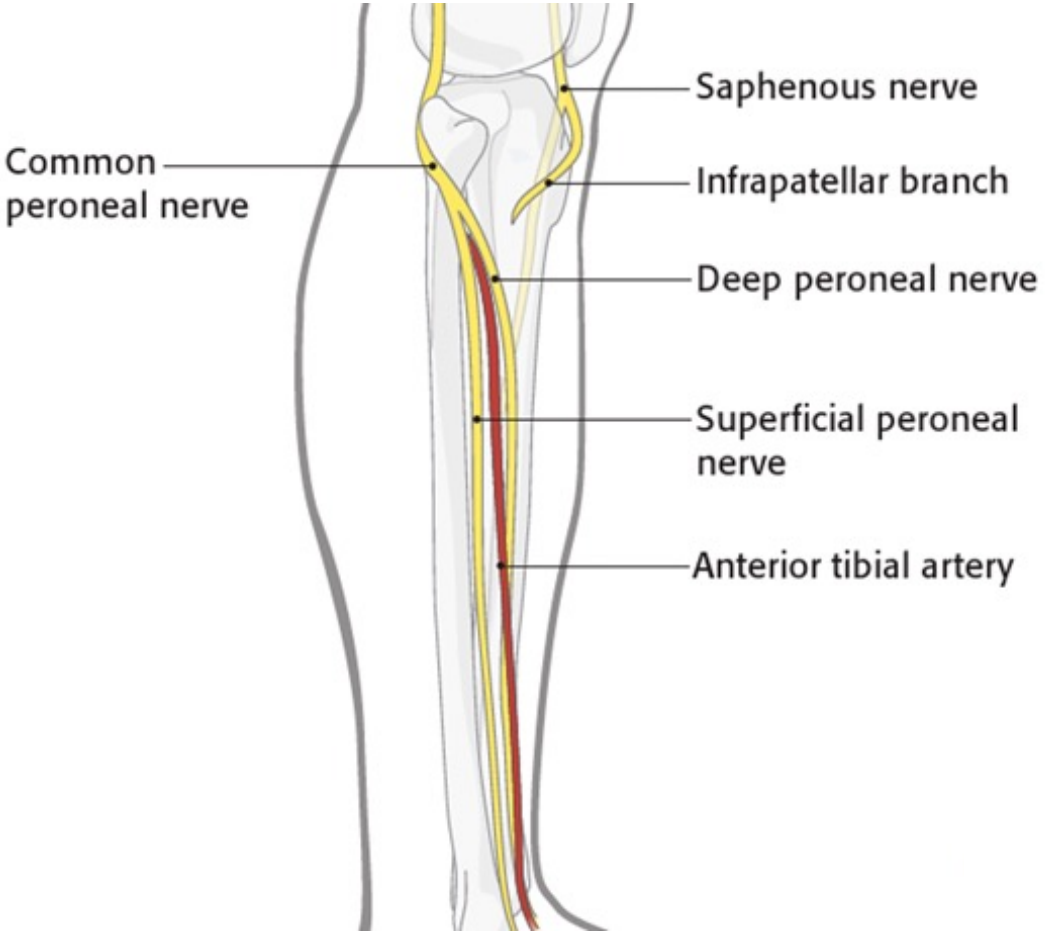
Lower leg

Common peroneal nerve

The common peroneal nerve begins posteriorly in the thigh and runs from the center of the popliteal fossa laterally and anteriorly together and below the tendon of the biceps femoris. It winds anteriorly around the neck of the fibula and then ramifies in the anterior compartment into a superficial sensory and deep motor and sensory branches. Damage to this nerve results in a severe functional deficit.

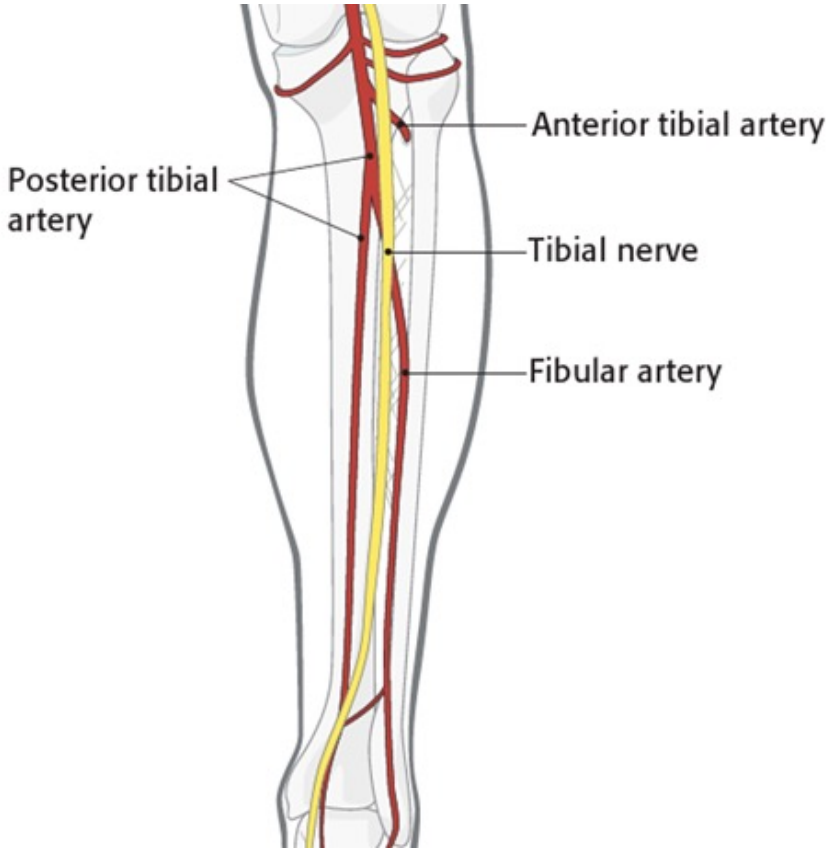
Saphenous nerve

The saphenous nerve is purely sensory. It runs distally on the anteromedial side of the thigh and passes the knee joint on the medial side of the patella where it gives off the infrapatellar branch. At the ankle it is anterior to the medial malleolus where it runs together with the long saphenous vein. Injury to this nerve will not result in functional deficit but results in a sensory loss and problems with neuroma formation.



Popliteal artery

The popliteal artery traverses the center of the popliteal fossa. It trifurcates at the level of the proximal tibial shaft into the anterior tibial artery which enters the anterior compartment just above the interroseous membrane, the fibular or peroneal artery, and into the posterior tibial artery.



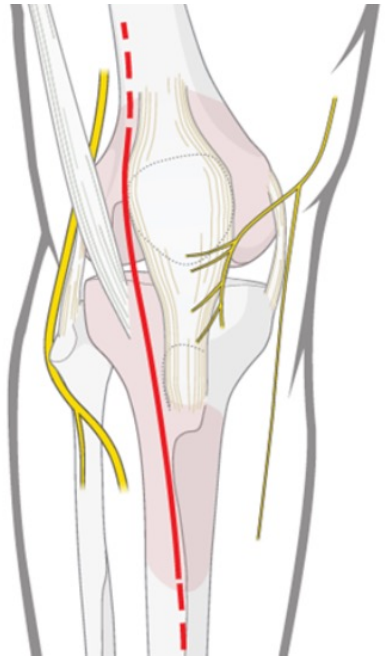
Surgical approaches

1. Anterolateral approach
2. Posterolateral approach (Frosch)
3. Medial approach
4. Direct posterior approach
5. Mini Invasive Surgery (including arthroscopy)

Anterolateral approach

Indications:

- Commonly used in Schatzker types III, V, and VI.
- Useful for posterolateral tibial plateau fractures after preoperative planning.



Technique:

- Lazy "S" incision: starts at the iliotibial (IT) band, curves around Gerdy's tubercle (GT), extends distally over the tibial crest. Interval developed between IT band and joint capsule. Tibialis anterior muscle retracted laterally to expose the tibia.
- For good joint exposure: horizontal capsulotomy between the lower edge of the meniscus and the tibia. **It is mandatory to suture the meniscus and the capsule at the end of the procedure!**

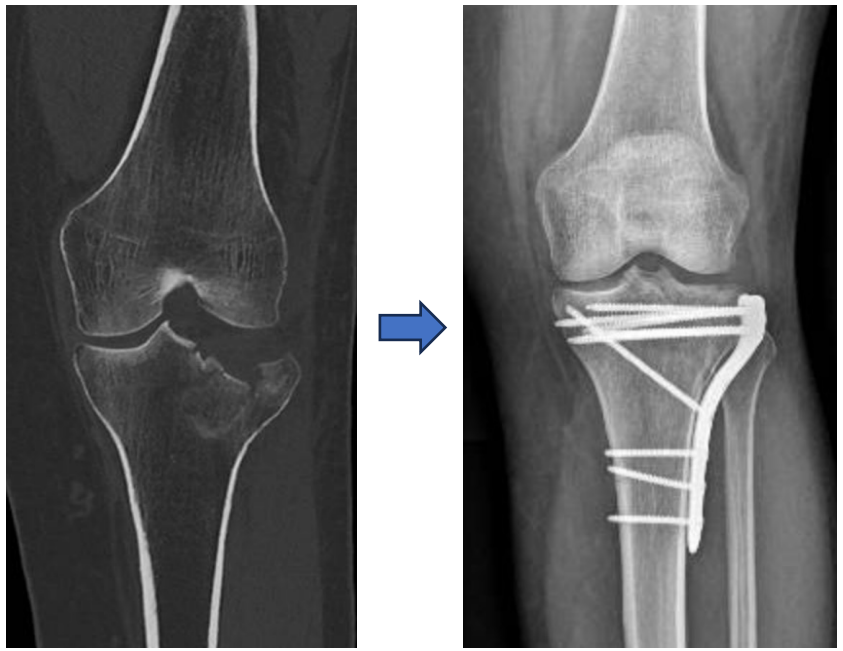
Anterolateral approach

Advantages:

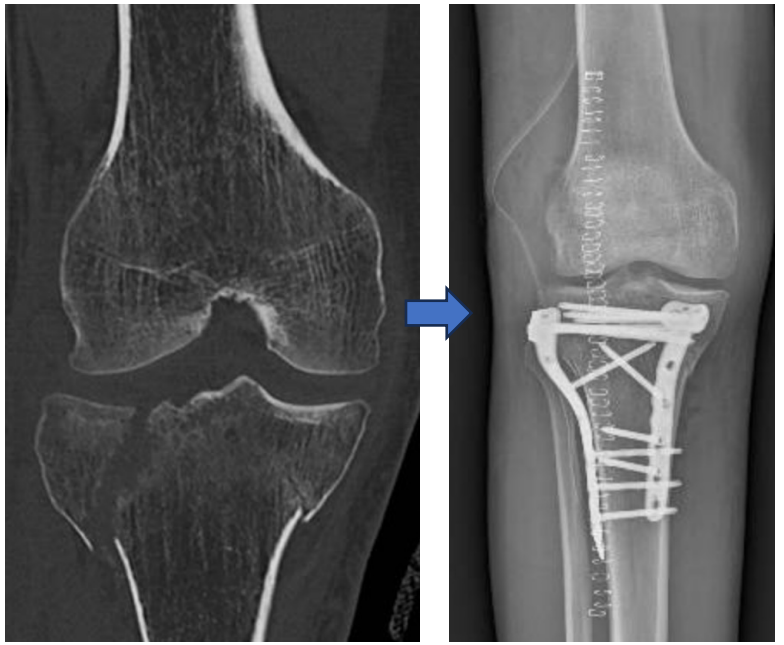
- Simple and reproducible technique
- It can be extended
- Easy positioning of the patient during surgery (support, gravity)
- Facilitates implant removal later

Where to use?

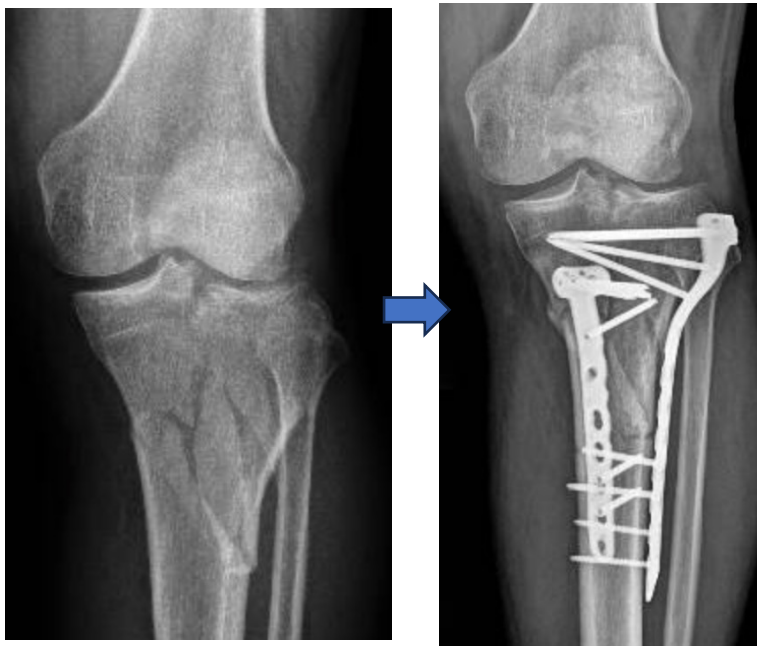
Schatzker III



Schatzker V



Schatzker VI



Posterolateral approach (Frosch)

Indications:

Coronal fractures with displaced posterolateral fragments.

Fractures not accessible via the anterolateral approach.

Patient positioning:

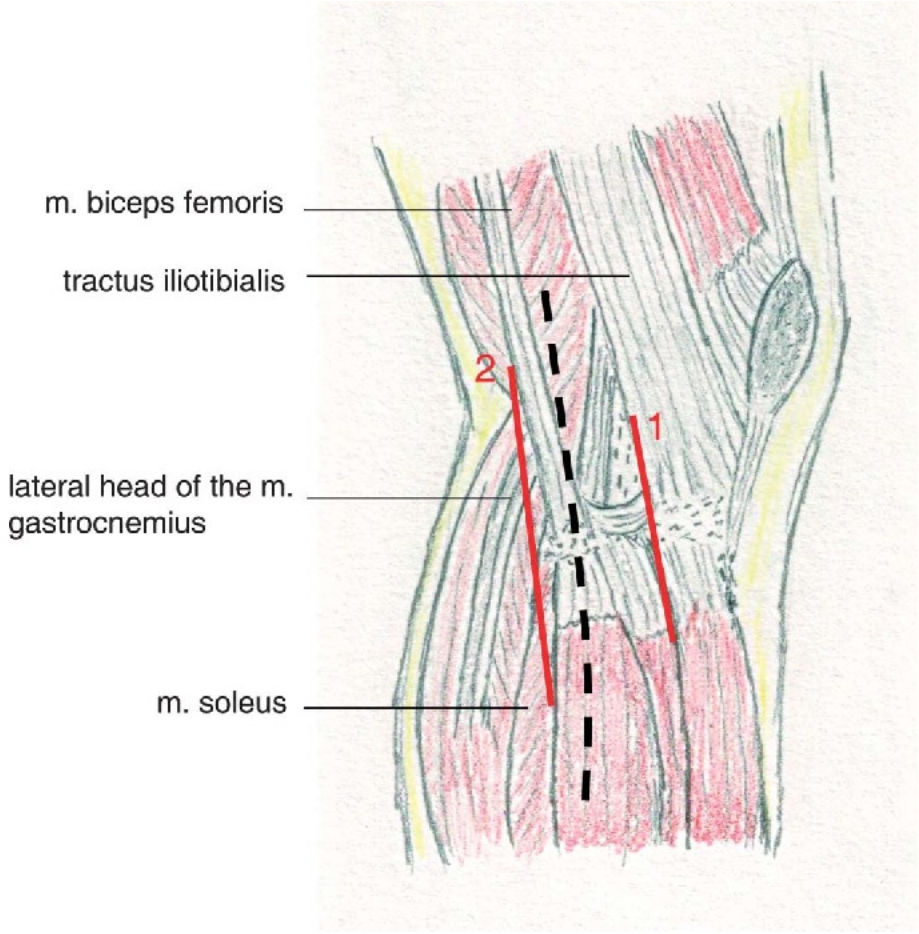
Prone, supine, or lateral position.

Incision:

Longitudinal incision (~10cm).

Starts over the medial aspect of the biceps femoris (BF) tendon.

Extends distally to the posteromedial border of the fibula.



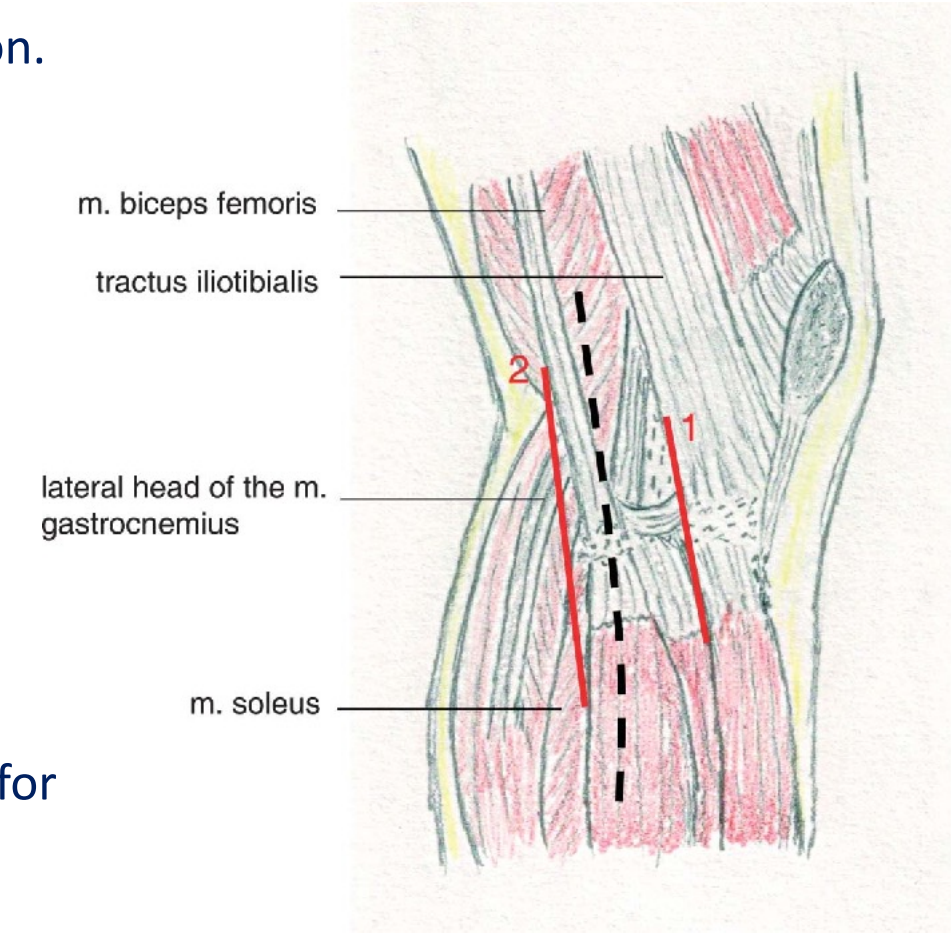
Posterolateral approach (Frosch)

Dissection:

- **Common peroneal nerve (CPN):** Identified medial to the BF tendon.
- The inferolateral genicular artery must be identified and ligated during the procedure.
- Plane of dissection between lateral gastrocnemius (LG) and BF.

Distally:

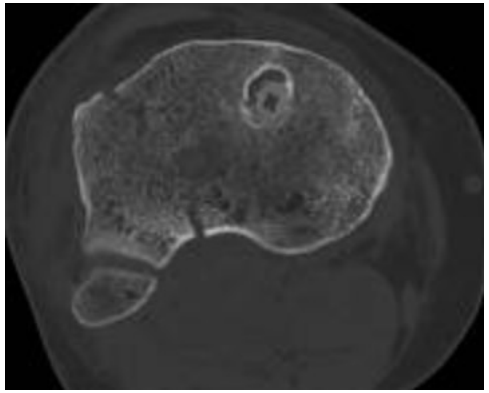
- Soleus bluntly dissected for proximal tibia and posterolateral ligament exposure.
- Popliteus and lateral horn of the arcuate ligament may be incised for better exposure.



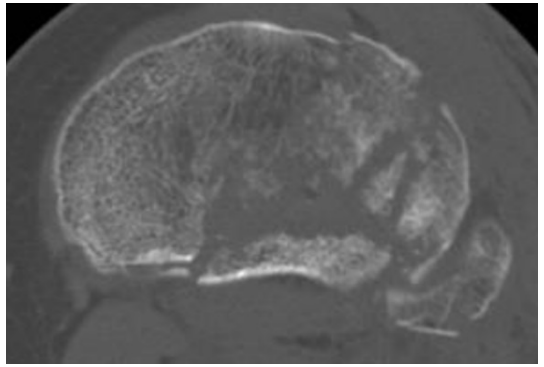
Fibular Osteotomy: Advantage: Excellent exposure of the joint line. Disadvantage: Increases patient morbidity.

Where to use?

Schatzker I



Schatzker II



Displaced posterolateral fragments

A modified Frosch approach for posterior tibial plateau fractures: Technical note and case series

N. Mancini , D. Salvato , E. Delmastro , A. Belluati , V. Salini , G. Placella

Injury, March 2023

Highlights

•Joint congruity in tibial plateau fractures are fundamental, but a good posterior reduction is not achievable with standard approaches.

•Frosch approach provides a good view of the back of the joint but is burdened by a large skin incision and not expose the lateral tibia.

•Our modification of the Frosch approach provides an “S-shaped” incision that allows to better expose and control the CPN and the fracture.

Medial approach

Indications:

Commonly used for Schatzker type IV fractures.

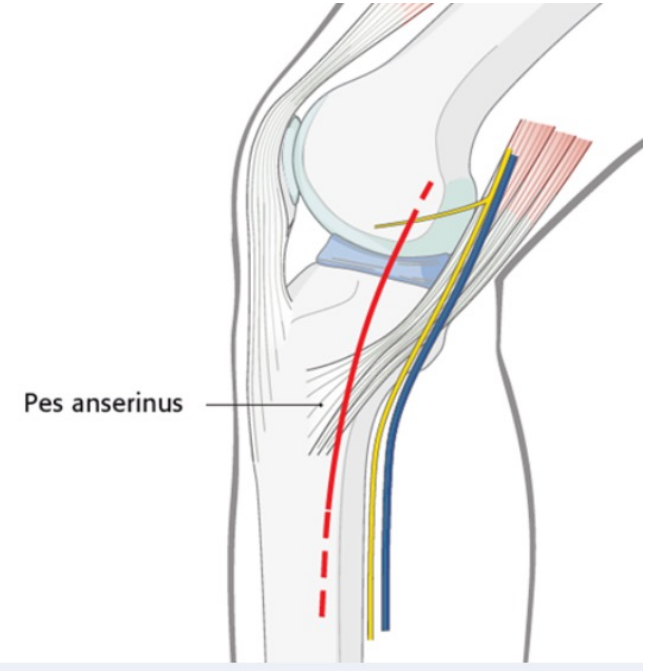
Increasingly used for Schatzker type V fractures with dual plating techniq**ues.**

Incision:

Starts at the medial femoral epicondyle.

Extends over the pes anserinus.

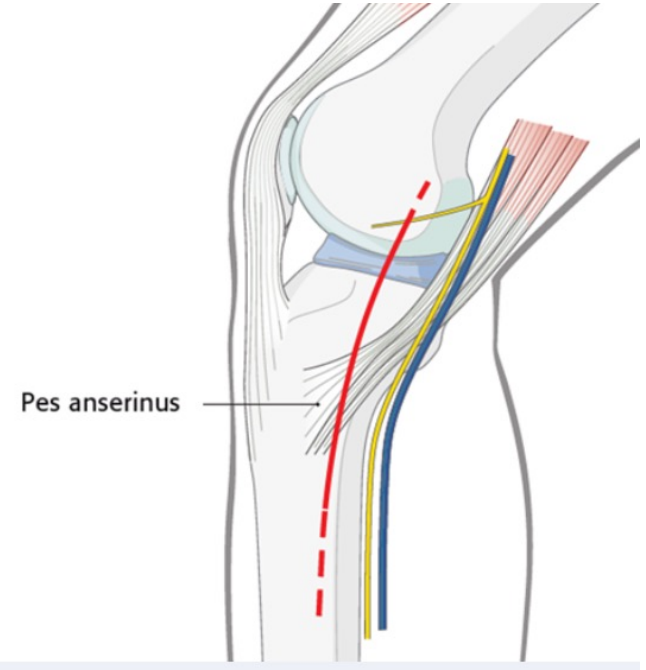
Length: ~10 cm, straight incision with knee flexed at 15 degrees.



Medial approach

Key Considerations:

- Ensure proper identification of **neurovascular structures**
  - Saphenous nerve and vein located posterior to the incision)
- Sequential dissection of **layers** for optimal exposure
  - First layer: Sartorius fascia and pes anserinus tendons
  - Second layer: Superficial medial collateral ligament (MCL)
  - Third layer: Deep medial collateral ligament (MCL)



Where to use?

Schatzker IV

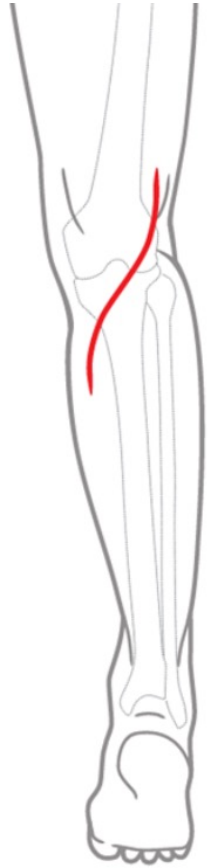
Direct posterior approach

Indications:

- Shear fractures of the posterior plateau
- Avulsion fractures of the posterior cruciate ligament (PCL)
- Used in the three-column fixation concept to address posterior column fractures

Incision:

- “S”-shaped incision: starts proximally over the biceps femoris (BF), curves over the popliteal fossa and extends distally along the medial head of the gastrocnemius.

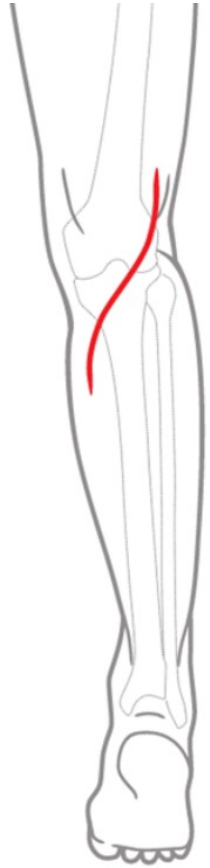


Direct posterior approach

Anatomy and Dissection

Neurovascular structures:

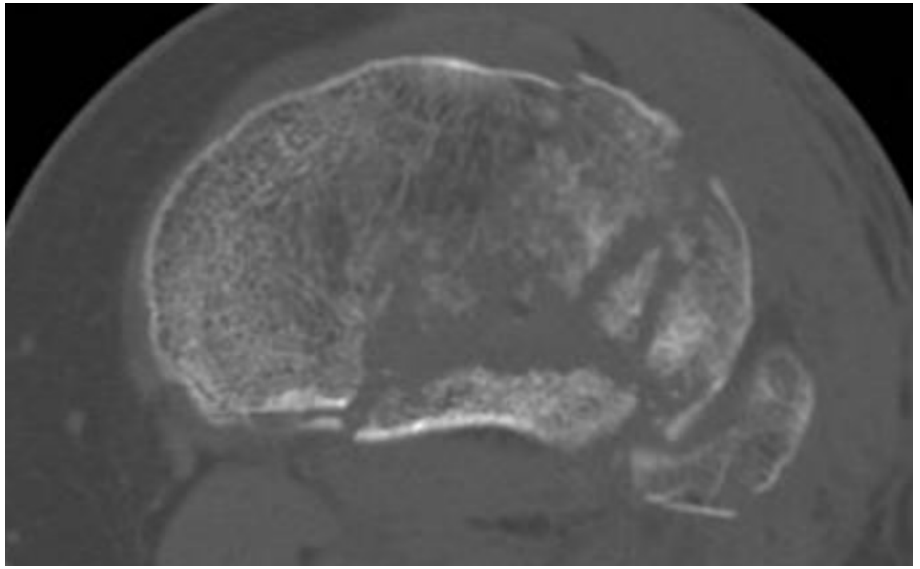
- Lesser saphenous vein and sural nerve near the joint line
- Tibial nerve: Followed proximally to the junction of semimembranosus (SM) and BF
- Popliteal artery: Medial to the tibial nerve
- Popliteal vein: Lateral to the artery proximally, crossing medial to it distally
- Common peroneal nerve (CPN): Located medial to the BF. Dissected and retracted laterally



Where to use?

Posterior cruciate ligament avulsion fracture

Posterior fragment tibial plateau fracture



Why address posterior tibial plateau fractures?

J.D. Van den Berg , L. Quintens , Y. Zhan , H. Hoekstra

Injury, December 2020,

- Posterior tibial plateau fracture are associated with high energy trauma and specific soft-tissue injuries depending on the diagonal injury pattern and addressing these concomitant soft-tissue injuries simultaneously seems obvious.

- Plate osteosynthesis of the posterior malleolus fractures is safe and should be considered routinely in coronal fractures of the posterior tibial plateau.

Comparative Analysis of Posterior Approach Versus Anterior Approach for Posterior Tibial Plateau Fractures

A Systematic Review and Meta-analysis

JBJS Reviews 11(7):e23.00030, July 2023.

Sung Huang Laurent Tsai, et al

Background: Posterior tibial plateau fractures can lead to significant posttraumatic instability if not treated properly. It remains unclear which surgical approach achieves better patient outcomes. The objective of this systematic review and meta-analysis was to assess postoperative outcomes in patients undergoing anterior, posterior, or combined approach for posterior tibial plateau fractures.

29 studies with a total of 747 patients were included for quantitative and qualitative analysis. Compared with other approaches, the posterior approach for posterior tibial plateau fractures was associated with a better ROM and shorter operative time.

The complication rates, infection rates, union time, and hospital for special surgery (HSS) scores were not significantly different between surgical approaches.

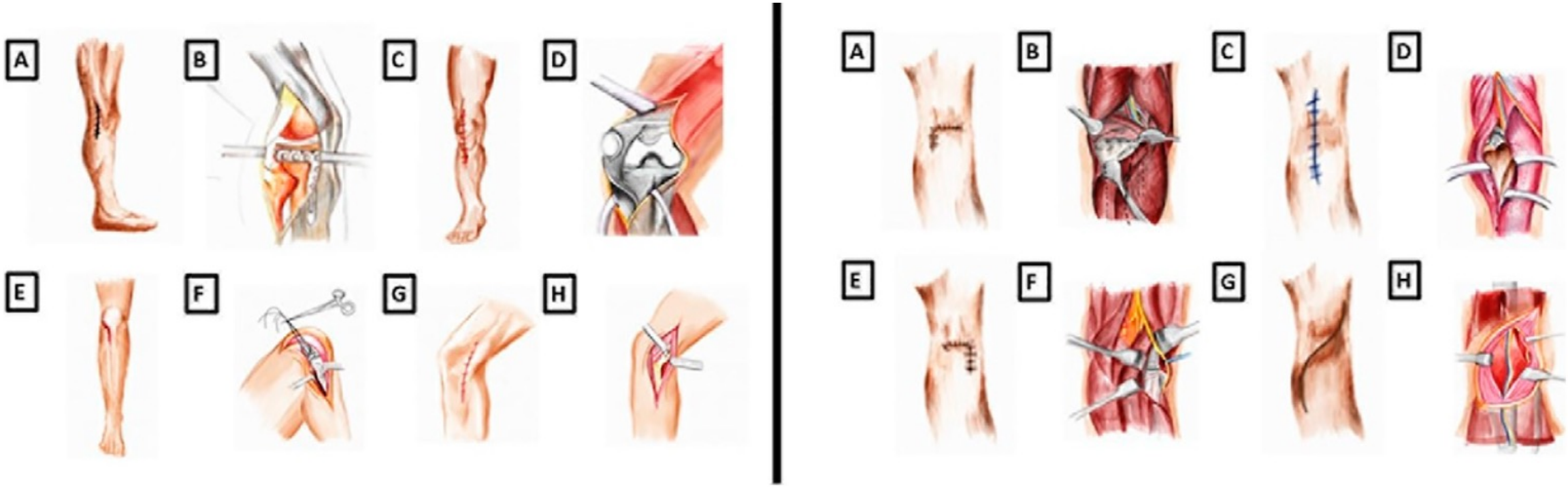


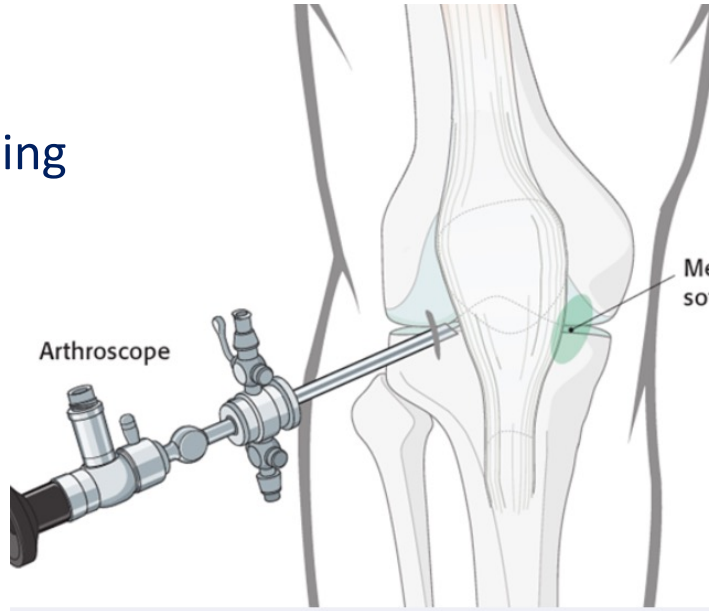
Fig. 2

The approaches for posterior tibial plateau fractures: Left section. **Figs. 2-A and 2-B** Posterolateral incision was made. The common peroneal nerve should be safely protected. This approach can be combined with the fibular head or Gerdy tubercle osteotomies followed by a submeniscal arthrotomy to expose the lateral plateau. **Figs. 2-C and 2-D** Anterior midline incision was made medial to the patella. Dissection to the medial parapatellar area was made to gain access to the medial spike of the fracture. **Figs. 2-E through 2-H** Anterolateral combined with posteromedial incision can be made to allow visualization of hyperextension 3-column fractures. The incision of anterolateral starts from the anterior edge of biceps femoris, approximately 5 cm above the crease of the knee joint and extend down to the level of the fibular head, approximately 3 cm outside the tibial tubercle. Arthroscopic inspection of a joint can be used to remove debris, examine structures, and assess lesions. A tool is used to elevate the joint while the surgeon observes: Right section. **Figs. 2-A and 2-B** Reverse L-shaped incisions for the posteromedial approach of the posterior column. The medial gastrocnemius was retracted laterally with the popliteal neurovascular bundle retracted and protected. **Figs. 2-C and 2-D** Direct posterior midline approach can be made just below the joint line. When the incision is extended across the joint line, it should be curved. The 2 heads of the gastrocnemius can be split. **Figs. 2-E and 2-F** Reverse L-shaped incisions for the posterolateral approach of the posterior column. The lateral gastrocnemius was retracted medially. It is crucial to identify the common peroneal nerve and protect with a loop. Figure 2 was drawn by Lo Ching.

Mini Invasive Surgery

Indications:

- Low-energy fractures (e.g., Schatzker I-III): Simple split or depression fractures
- Selected complex fractures where a staged approach is necessary, combining MIS with external fixation



Techniques Used in MIS:

- Percutaneous reduction: Using tools like K-wires, cannulated screws, or a joystick for manipulation
- Arthroscopy-assisted fixation: Useful for assessing joint congruency and managing intra-articular fragments

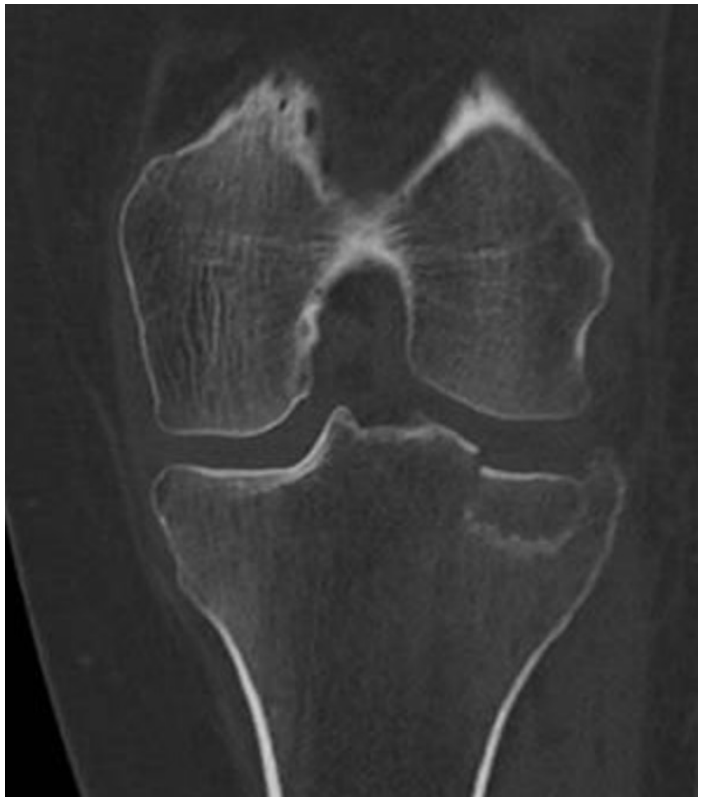
Mini Invasive Surgery

Advantages of MIS:

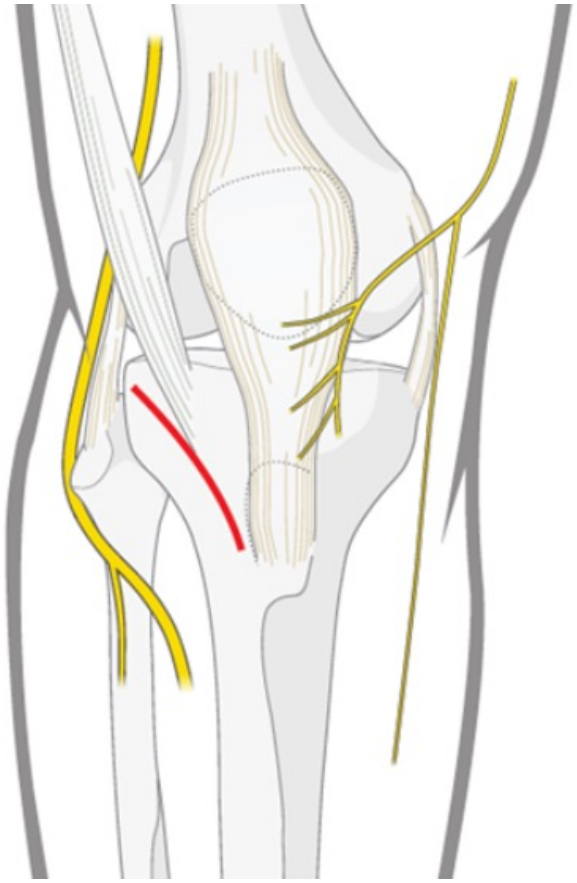
- Lower rates of infection and soft tissue complications.
- Reduced blood loss and shorter operative time.
- Quicker postoperative recovery with reduced pain and faster rehabilitation.

Where to use?

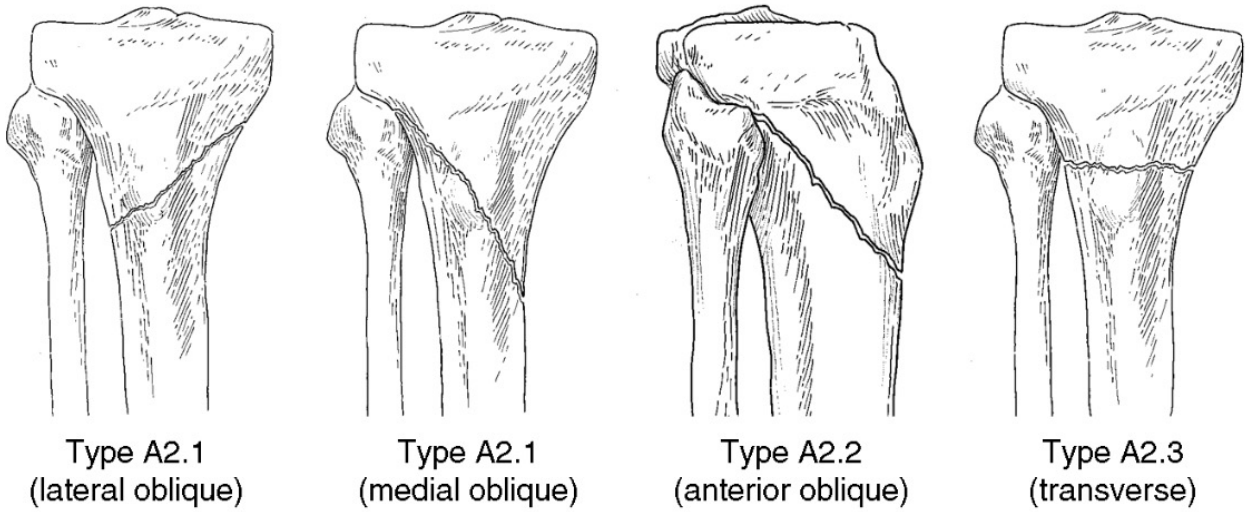
Simple split or depression fractures



Mini Invasive Surgery - MIPO



The AO/OTA classification of simple (A2) and comminuted (A3) extra-articular proximal tibia fracture patterns.

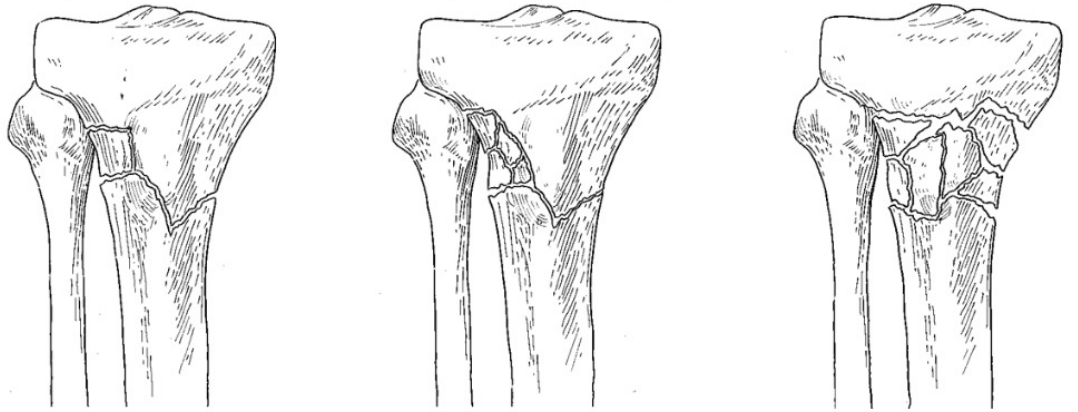


Type A2.1
(lateral oblique)

Type A2.1
(medial oblique)

Type A2.2
(anterior oblique)

Type A2.3
(transverse)



Type A3.1
(intact wedge)

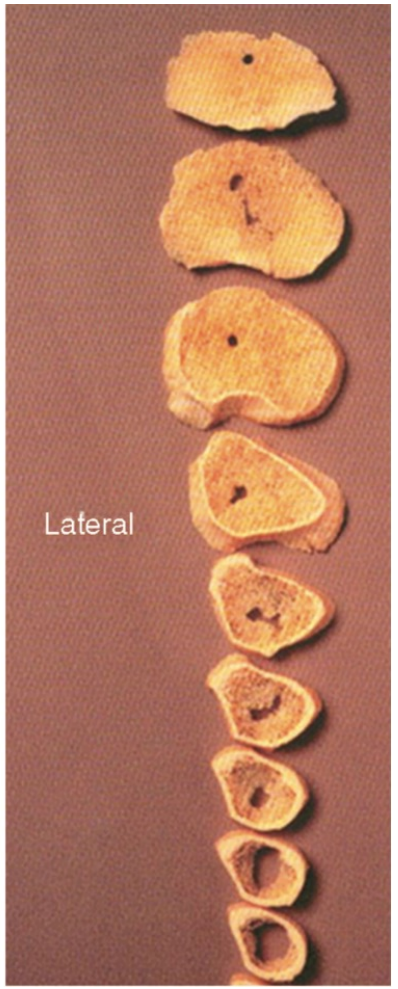
Type A3.2
(fragmented wedge)

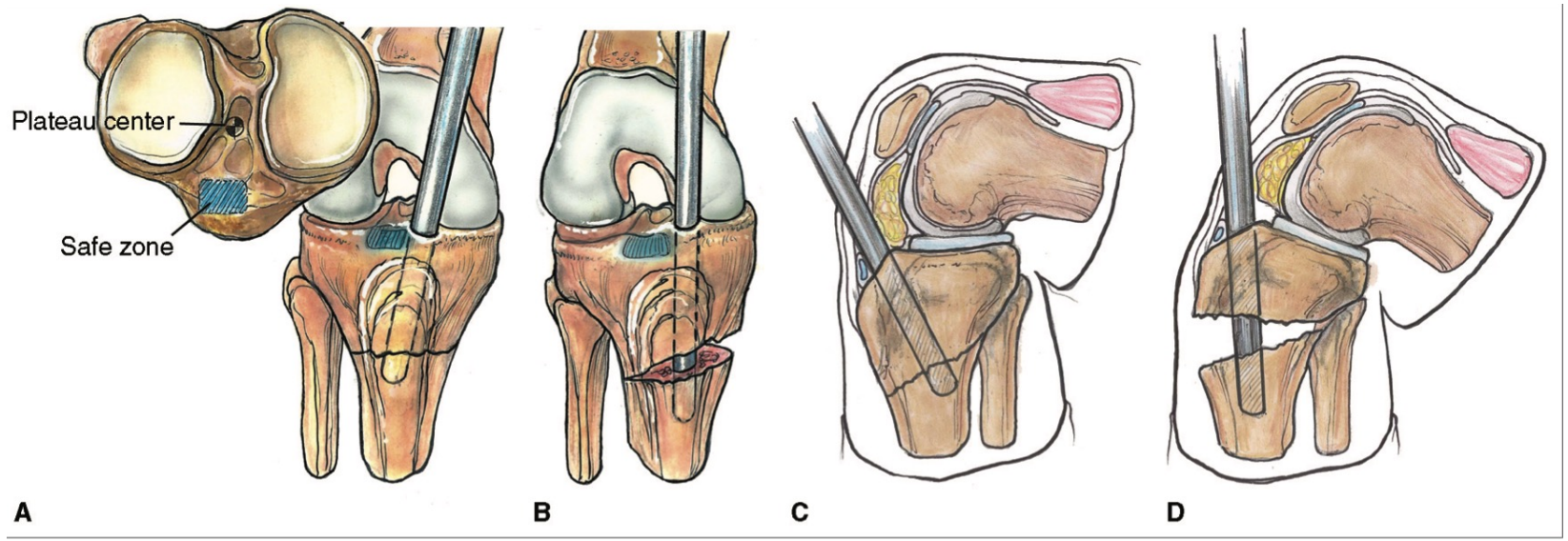
Type A3.3
(complex comminution)

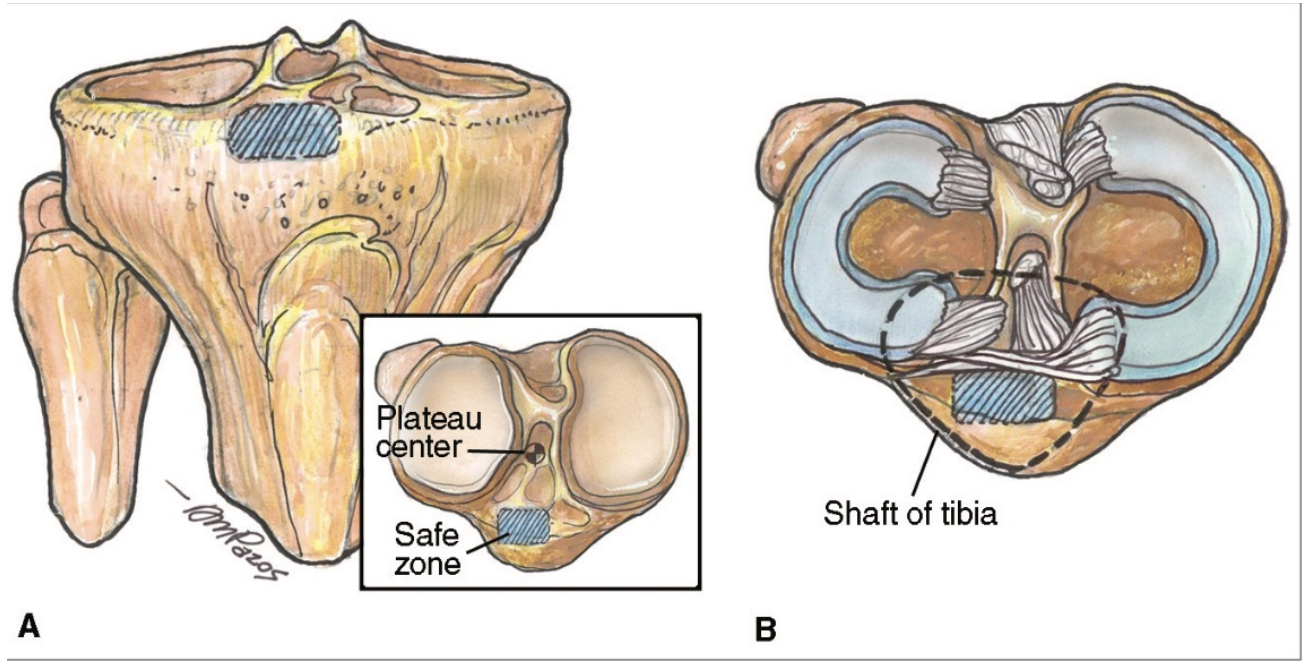
Intramedullary Nailing of Extra-articular Proximal Tibia Fractures

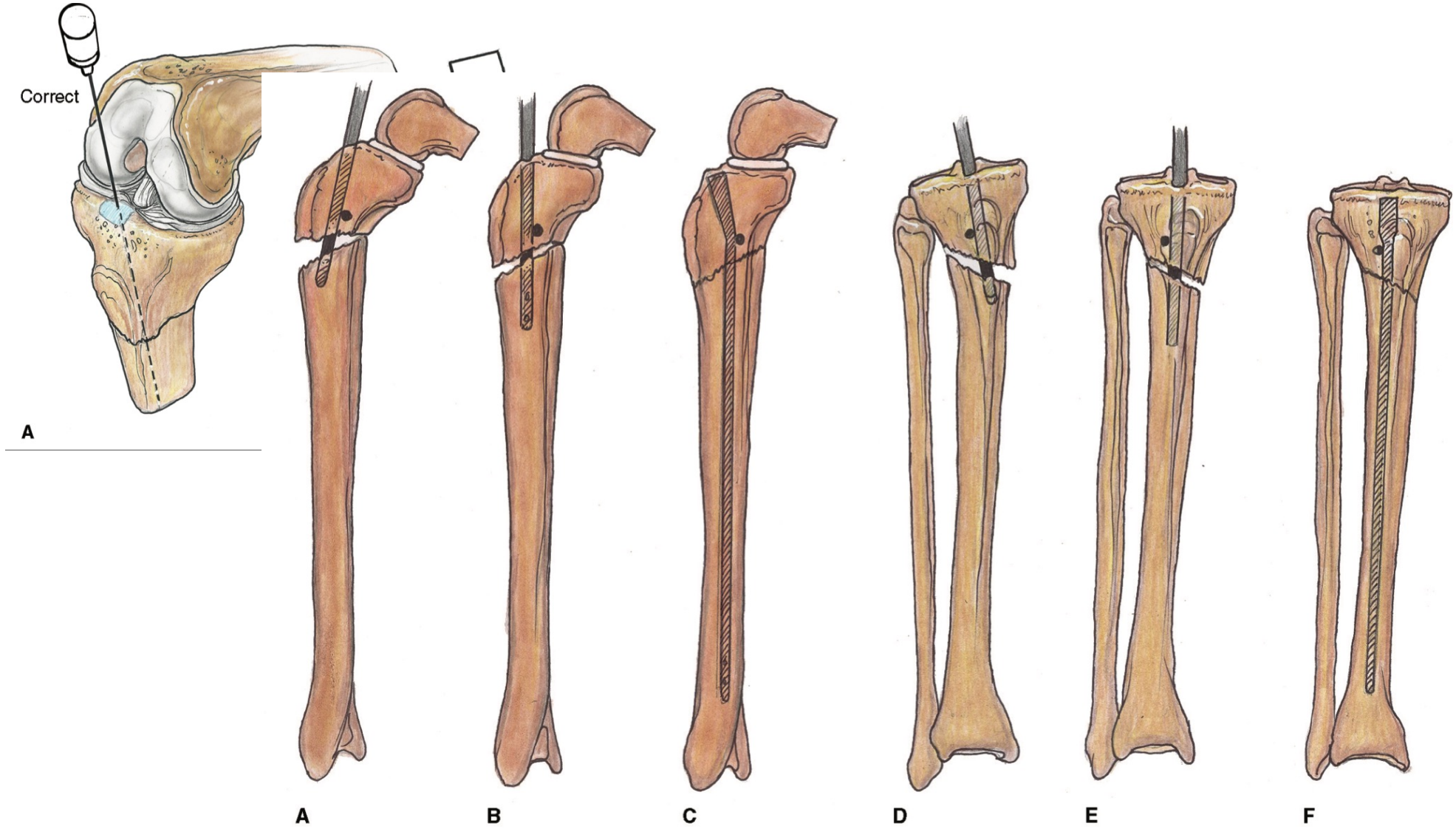
Timothy G. Hiesterman, DO
Babar X. Shafiq, MD
Peter A. Cole, MD

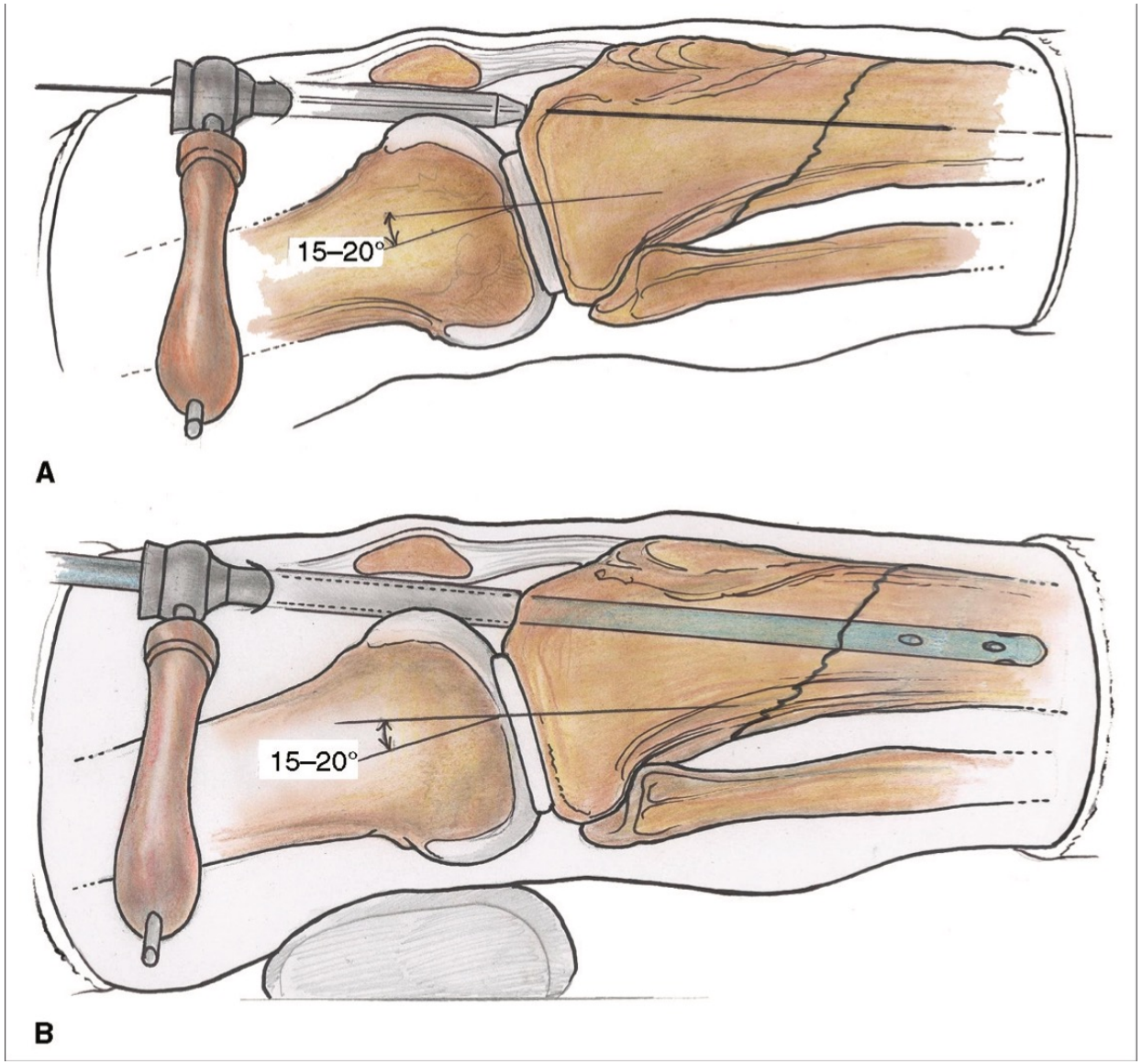
J Am Acad Orthop Surg 2011

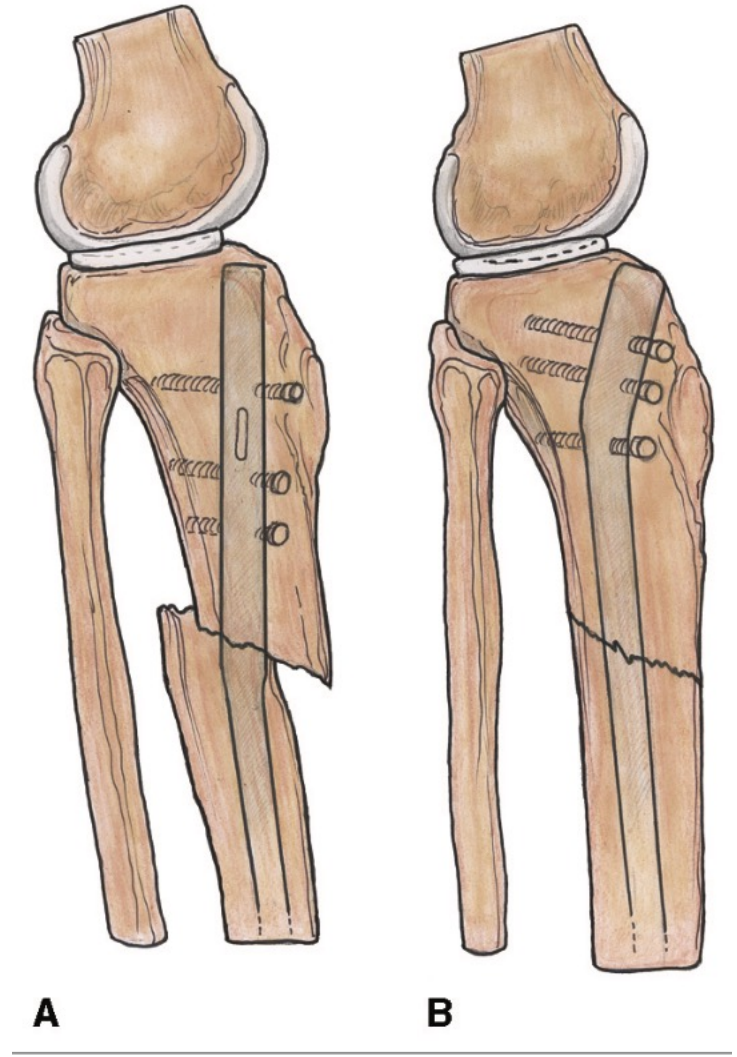



Plateau center
Safe zone
A
B
C
D


Plateau center
Safe zone
Shaft of tibia
A
B


Correct
A
A
B
C
D
E
F


15–20°
A
15–20°
B


A
B

Conclusions

- Diagnosis first (location, extension of the fracture : CT scan mandatory)
- Approach according to the type of fracture
- Knowledge of anatomy , and literature
- Surgery characterized by tips and tricks, skill and expertise mandatory