

Tibial Shaft and Tibial Pilon

DR ANURAG TIWARI

Faculty, Target Ortho

- Tibia #
- Highest rate of non union and malunion
- Open # are common
- Most common surgery for an Ortho resident??

- Correct entry point for tibial nail
- A. Medial to Lateral tibial spine
- B. Lateral to Medial tibial spine
- C. In line to Medial tibial spine
- D. In line to Lateral Tibial spine





oblique

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Examination

- Skin condition- Blisters, Swelling
- Compartment syndrome
- Open # →
- Neurological examination
- Vascular examination



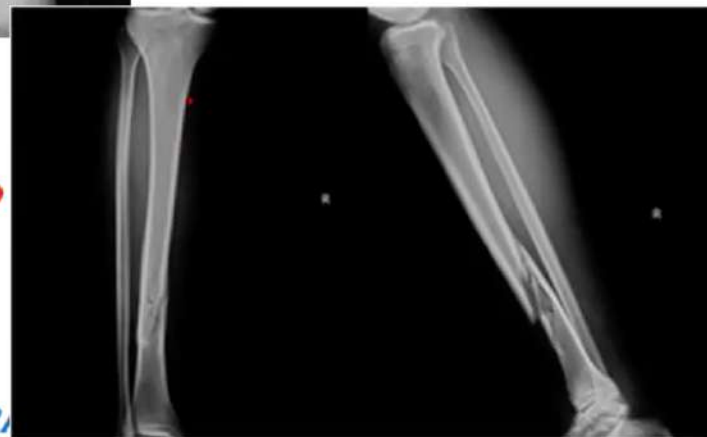
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Xray

- Include Knee and ankle
- AP and Lateral views
- Fracture pattern
- Classification
- Gas ✓
- Canal diameter
- Bone quality



*Gas
Gangrene*

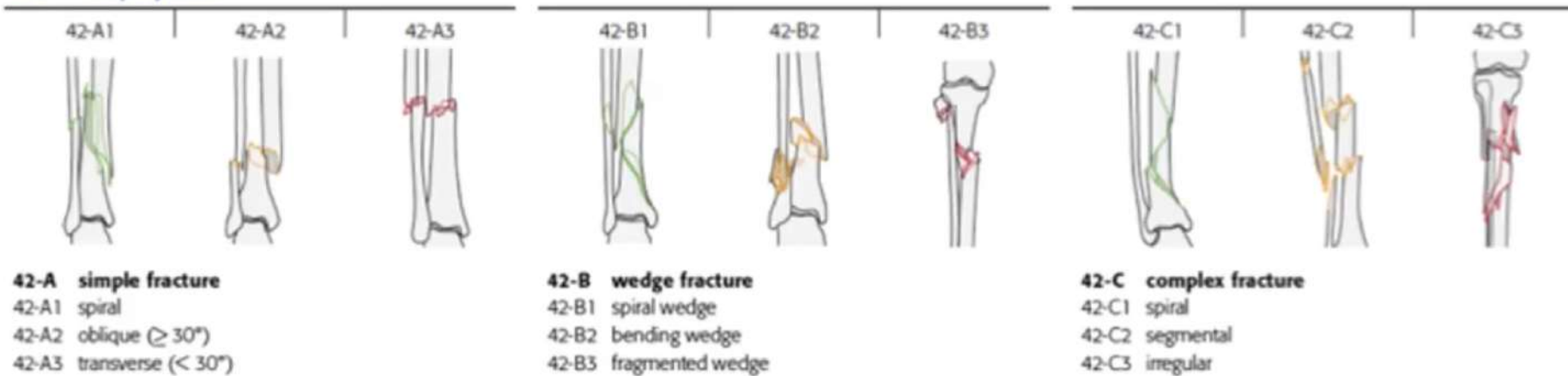


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Classification

- AO classification (42)

42 diaphyseal



Open # Classification

Gustilo and Anderson classification (Open Fracture)

Gustilo and Anderson Classification of Open Fractures

Fracture Type

Characteristics

Type I	Wounds <u>less than 1 cm</u> ; minimal contamination and soft-tissue injury; <u>simple fracture pattern</u>
Type II	Wounds <u>1 to 10 cm</u> ; moderate comminution and contamination
Type IIIA	Minimal periosteal stripping and soft-tissue coverage required
Type IIIB	Significant periosteal stripping at the fracture site; <u>soft-tissue coverage required</u>
Type IIIC	Indicates an associated <u>repairable vascular injury</u>

Gustilo and Anderson. (JBJS 1976)
Gustilo, Mendoza and Williams. (J. Trauma 1984)

- Wound of < 1cm, Distal pulses absent,
Capillary refill good, temperature warm.
No motor or sensory loss.

Classify

A. Grade I

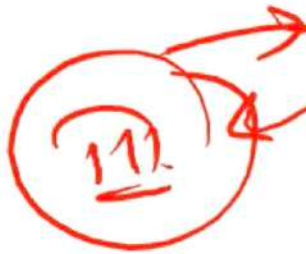
B. Grade II

☒ C. Grade III

D. Grade III B ←

E. Grade III C ←

(vascular inj. req. repair)



MESS Score for amputation

<u>Skeletal / soft-tissue injury</u>	score
Low energy (stab; simple fracture; pistol gunshot wound)	1
Medium energy (open or multiple fractures, dislocation)	2
High energy (high speed MVA or rifle GSW)	3
Very high energy (high speed trauma + gross contamination)	4
<u>Limb ischemia</u>	
Pulse reduced or absent but <u>perfusion normal</u>	1*
Pulseless; paresthesias, diminished capillary refill	2*
Cool, paralyzed, insensate, numb:	3*
<u>Shock</u>	
Systolic BP always > 90 mm Hg	0
Hypotensive <u>transiently</u>	1
Persistent hypotension	2
<u>Age (years)</u>	
< 30	0
30-50	1
> 50	2
* Double the score in cases of <u>ischemia >6 hours</u>	

14

> 7 → Amp.
< 7 - salvage

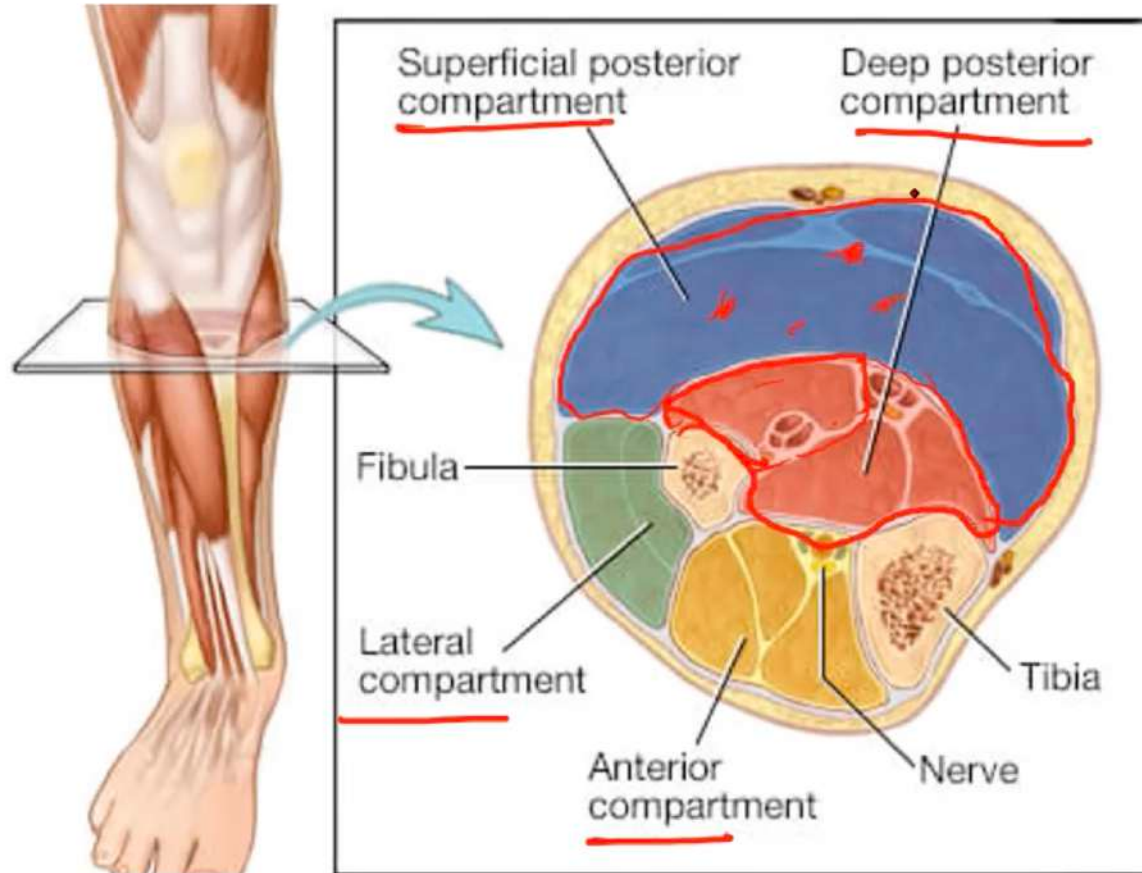


*MESS score: A score above 7 increases the chance of amputation.

Compartments

- Number of compartments in leg ?
- A. 1
- B. 2
- C. 3
- D. 4

Compartments



osseofasial

"Anatomical structure"

Treatment

- Tibial Nail.

Monop.
operative

- Non operative-

- Acceptability Criteria-

- Varus / Valgus angulation < 5 degree

- Anterior/ Posterior angulation < 10 degree

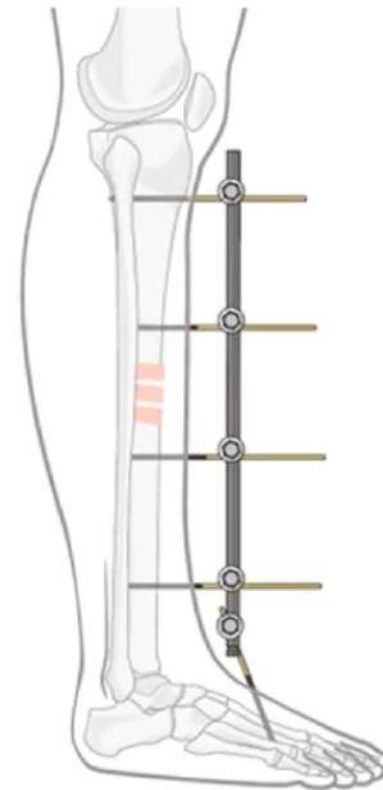
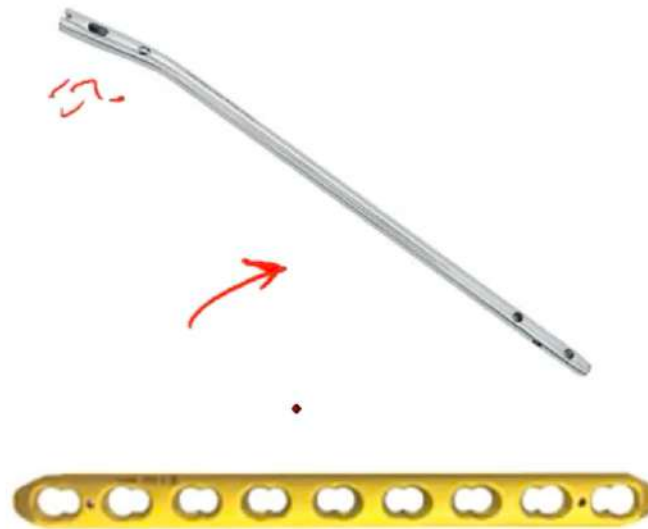
- Rotation < 10 degree

- Shortening < 10 mm

Operative treatment

- Indications-
- Open #
- Vascular injury
- Failure to obtain a close reduction
- Compartment syndrome

- Implant choice
- Nail
- Plate
- External Fixator



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Nail

- Approach - ? Infra vs Suprapatellar approach
- Entry Point ?
- Reduction methods?
- Use of tourniquet?
- Reamed or Unreamed nail ??

- Infrapatellar app- preferred

If patellofemoral joint arthritis +

knee extension is limited

Floating knee

- Suprapatellar app – preferred

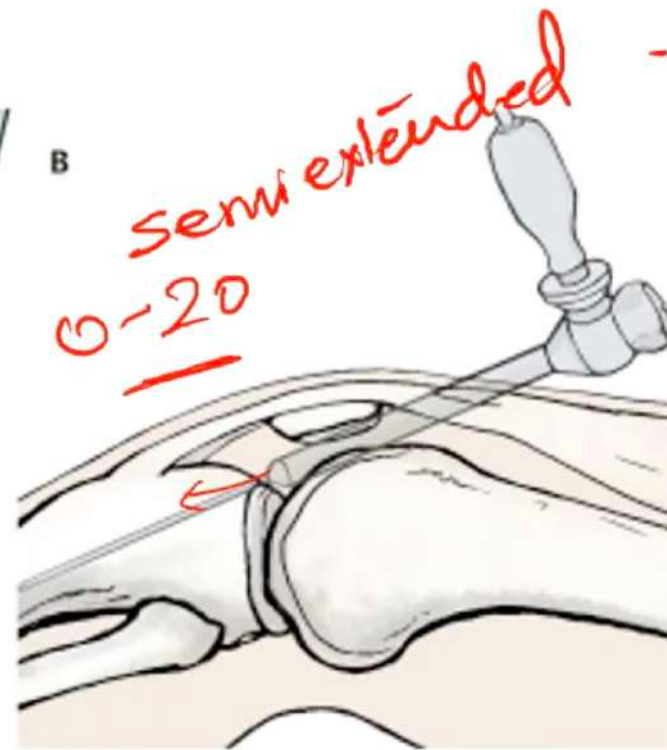
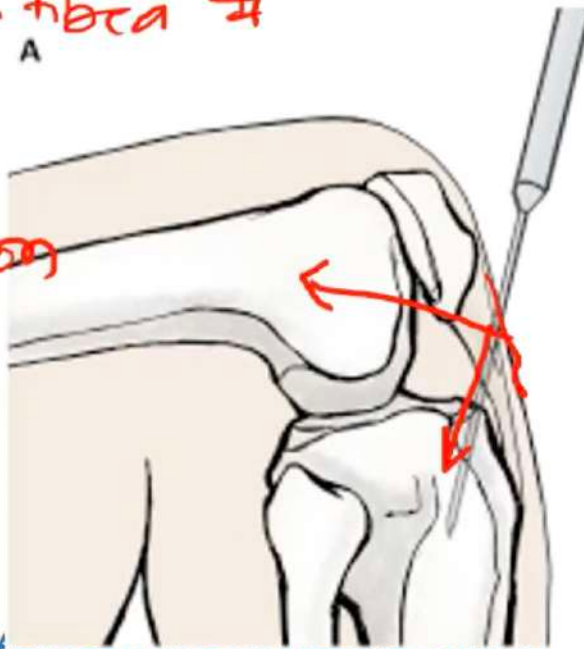
- If knee flexion is restricted

~~Prox. tibia #~~

A

B

Knee flexion
70-90° ✓

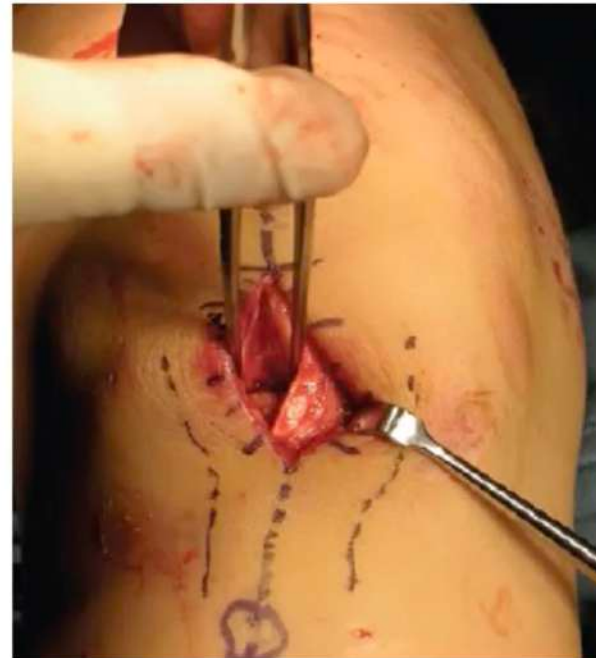


TIBIAL SHAFT AND TIBIAL



(C) www.targetortho.com

- Infrapatellar approach –
- Tendon Splitting
- Medial paratendinous
- Lateral paratendinous



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Entry point

- Correct entry point –
- Medial to Lateral tibial spine on True AP view of knee
- And on anterior edge of tibia plateau on lateral view
- True AP view ??

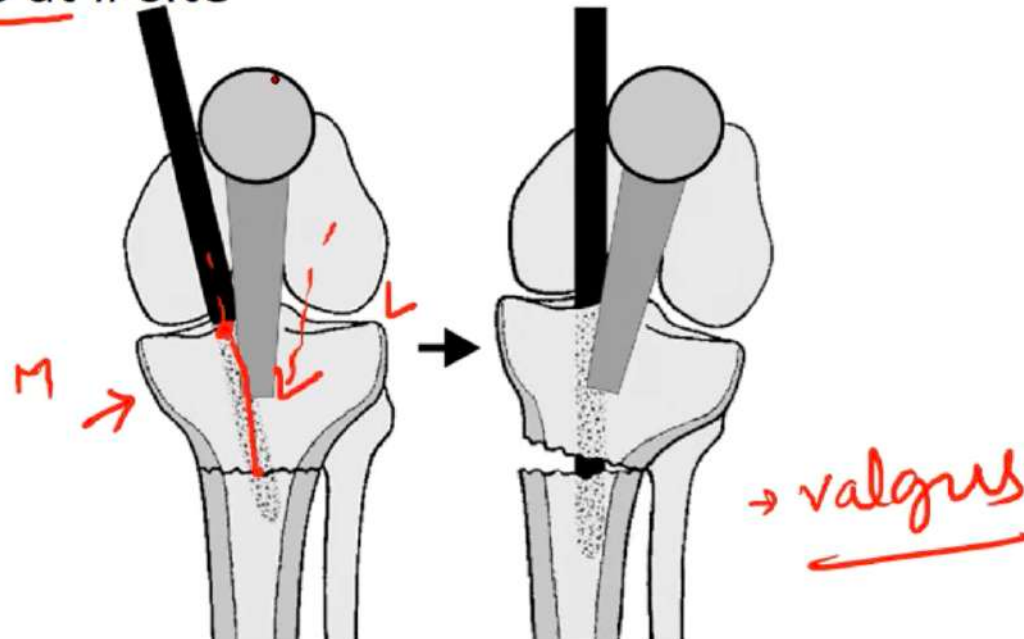


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Incorrect entry point

- If medial – will lead to valgus at # site
- If Lateral – Varus at # site

*Varus
angulation*

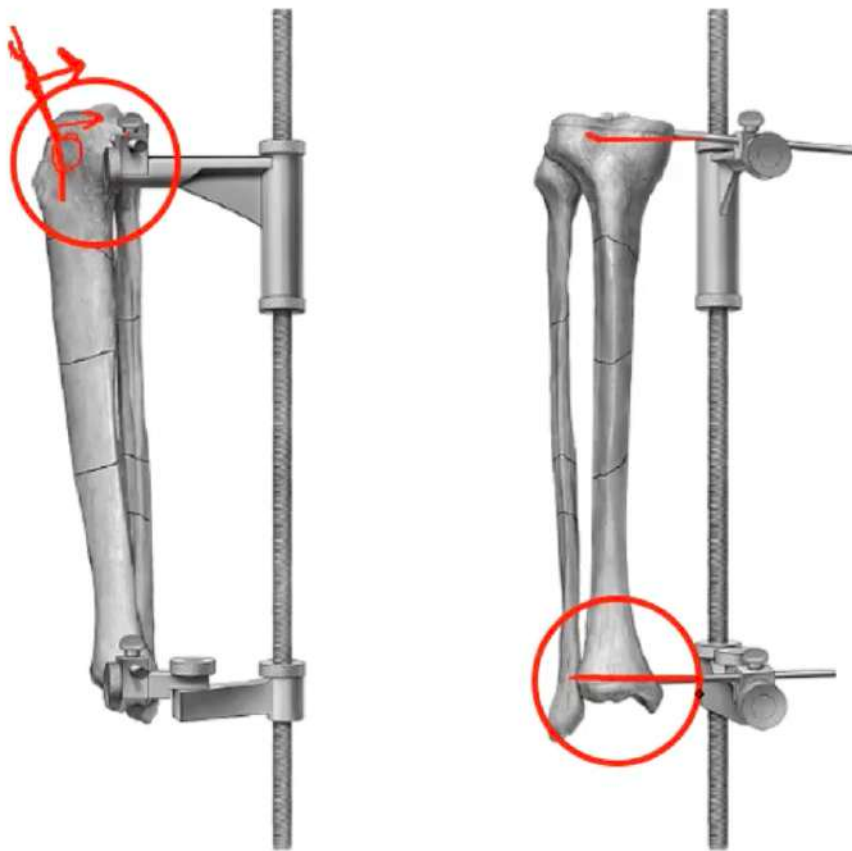


Reduction tips

- 1. Use of Esmarch bandage



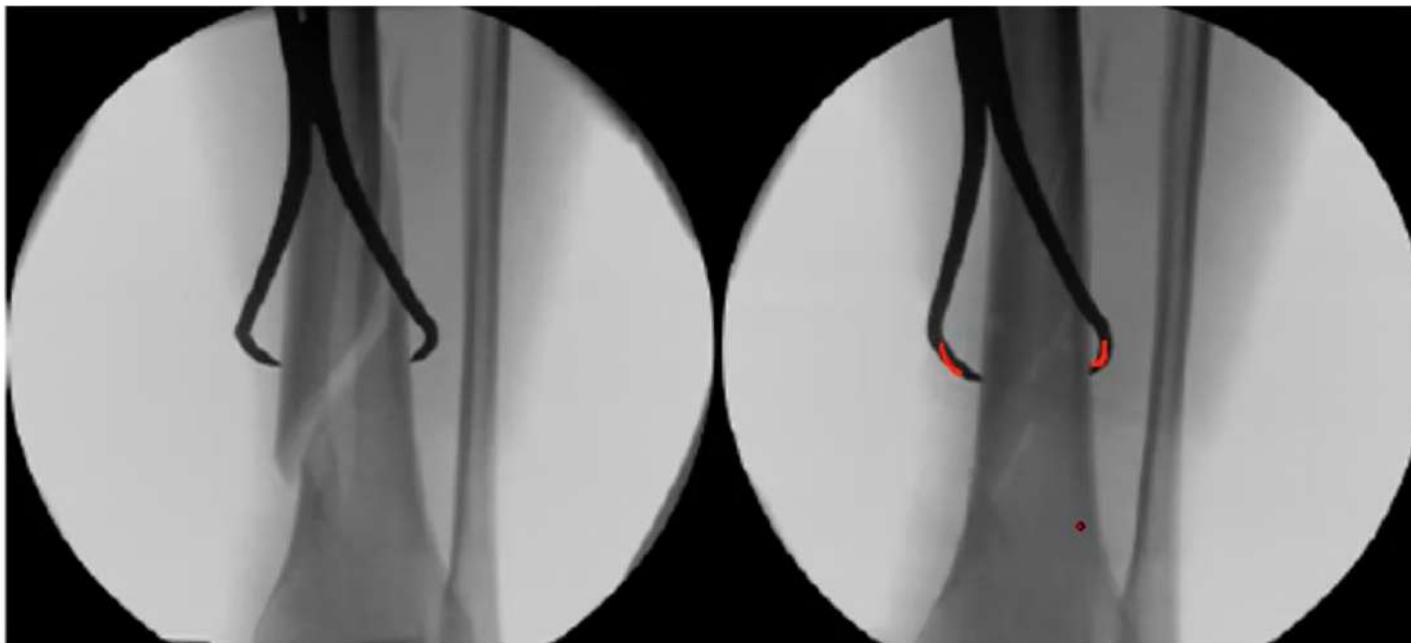
2. Use of Distractor



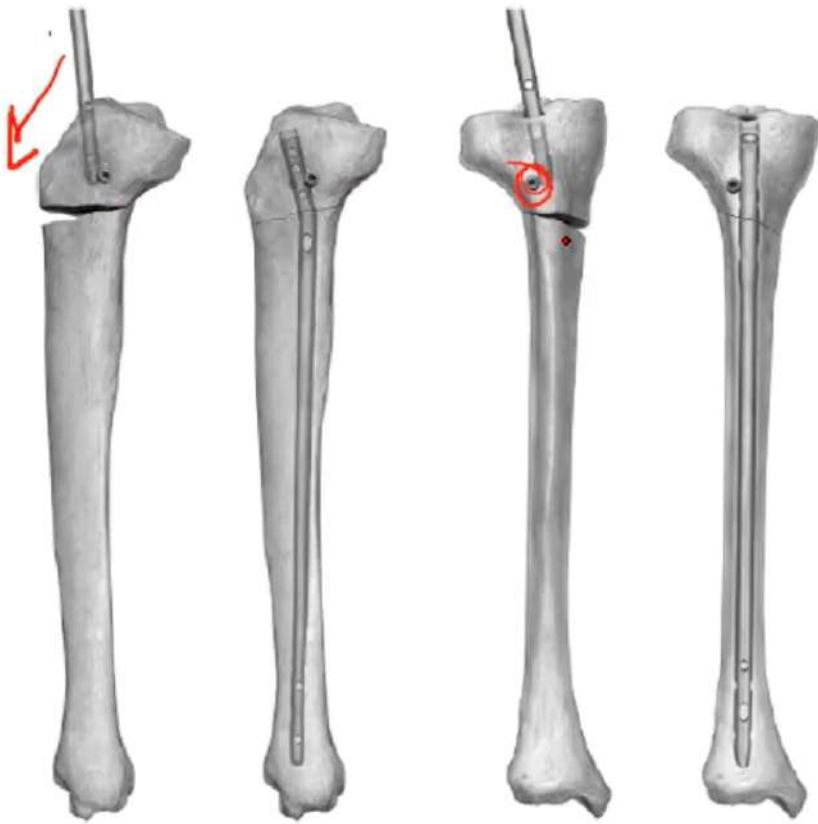
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3. Use of Pointed clamps

- Mainly for oblique and spiral fractures.

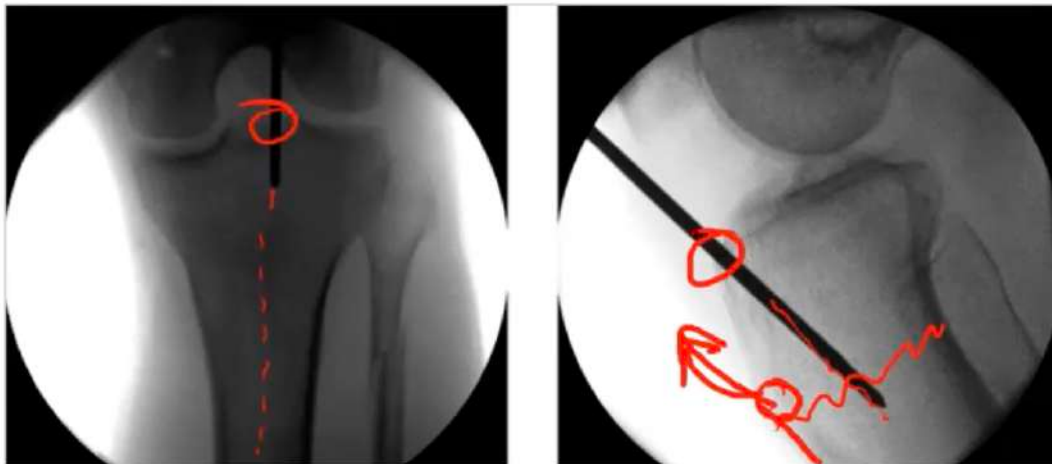


4. Use of Blocking (Poller) screws



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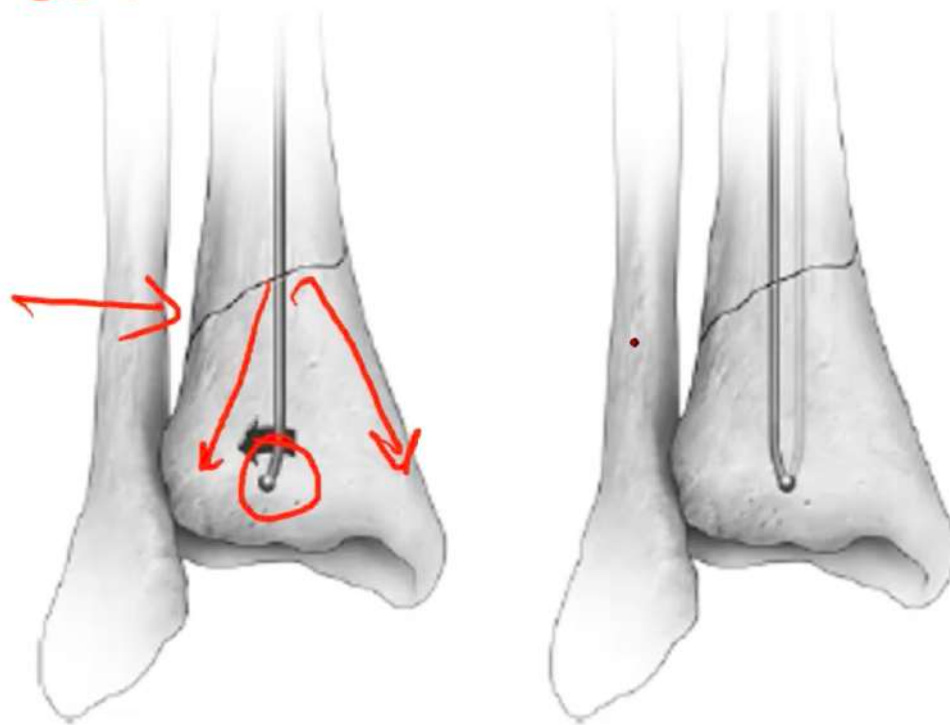
- Trajectory
- Guide wire –
 - AP view - In line with axis of tibia
 - Lateral View- Parallel to anterior tibia cortex



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Position of guide wire

Central - Centre .



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- Reaming-

- Advantages-

Canal diameter increases- Thick nail → ↑ stability]
Reamed material – Bone graft at site of # → ↑ union]

- Disadv-

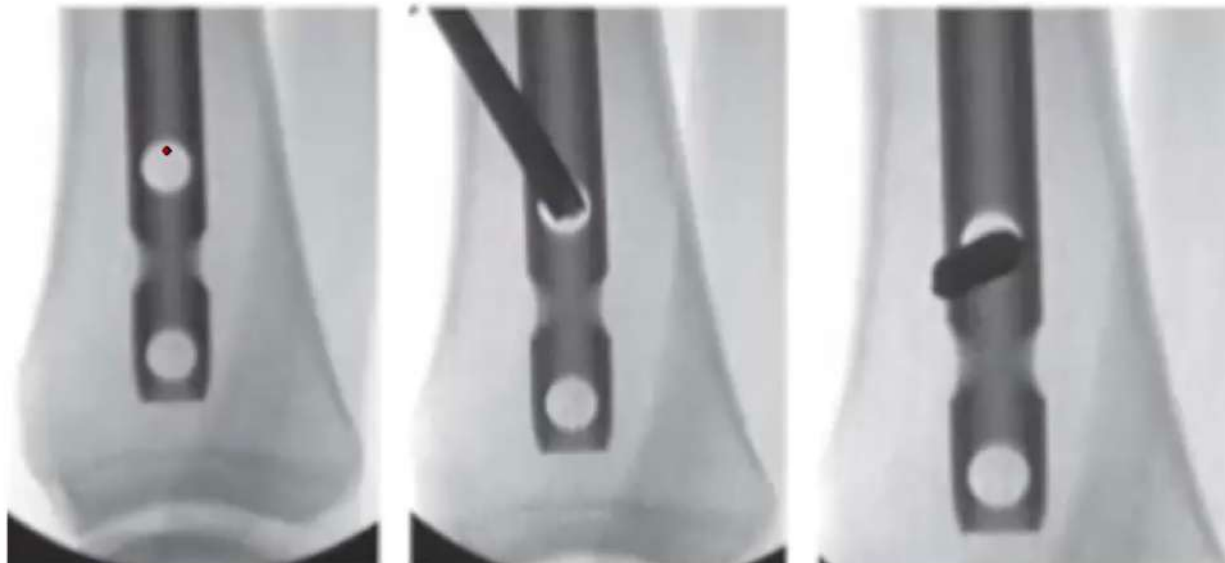
Thermal necrosis
Endosteal blood supply disrupted
Fat embolism

→ Reaming > Unreamed

Reaming – 1 mm greater than the nail size (if flexible reamers are used)

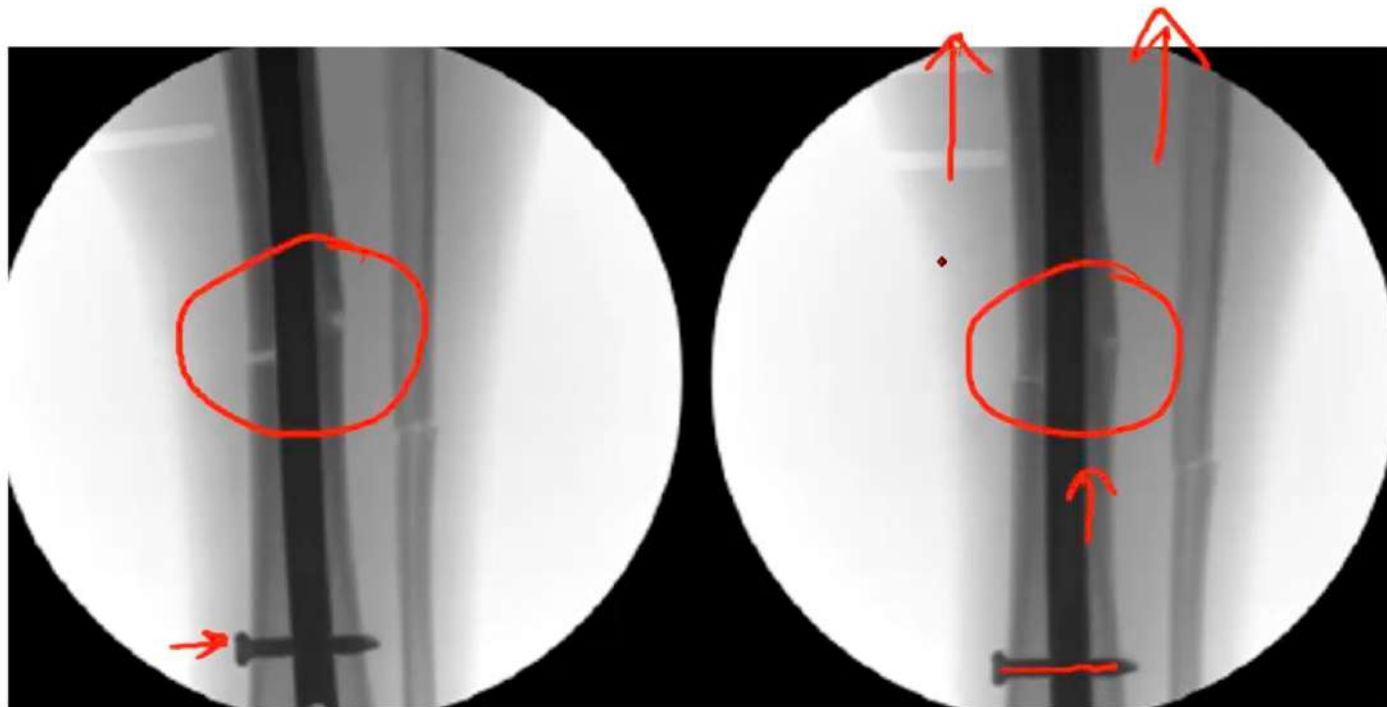
Distal locking

- Free Hand technique (Perfect circles technique)



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Back Slapping



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Plate Construct

- Indications-
- Periprosthetic #
- Narrow canal diameter
- Deformed Bone (due to previous #)



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External Fixator

- Definitive or Temporary?
- Indications-
- Poor soft tissue envelope ✓
- Open fractures ✓
- Damage control ✓
- Post fasciotomy
- Post vascular repair



How to increase the stability of fixator

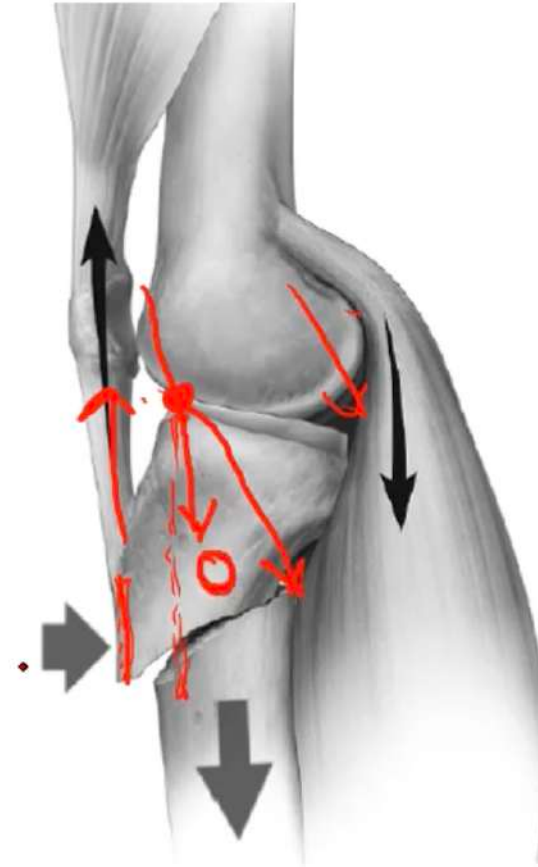
- Increasing the fixator stability
- Rods closer to bone
- Widespreading the pins
- Reducing the interpin distance
- Increasing the number of rods
- Increasing the diameter of pins

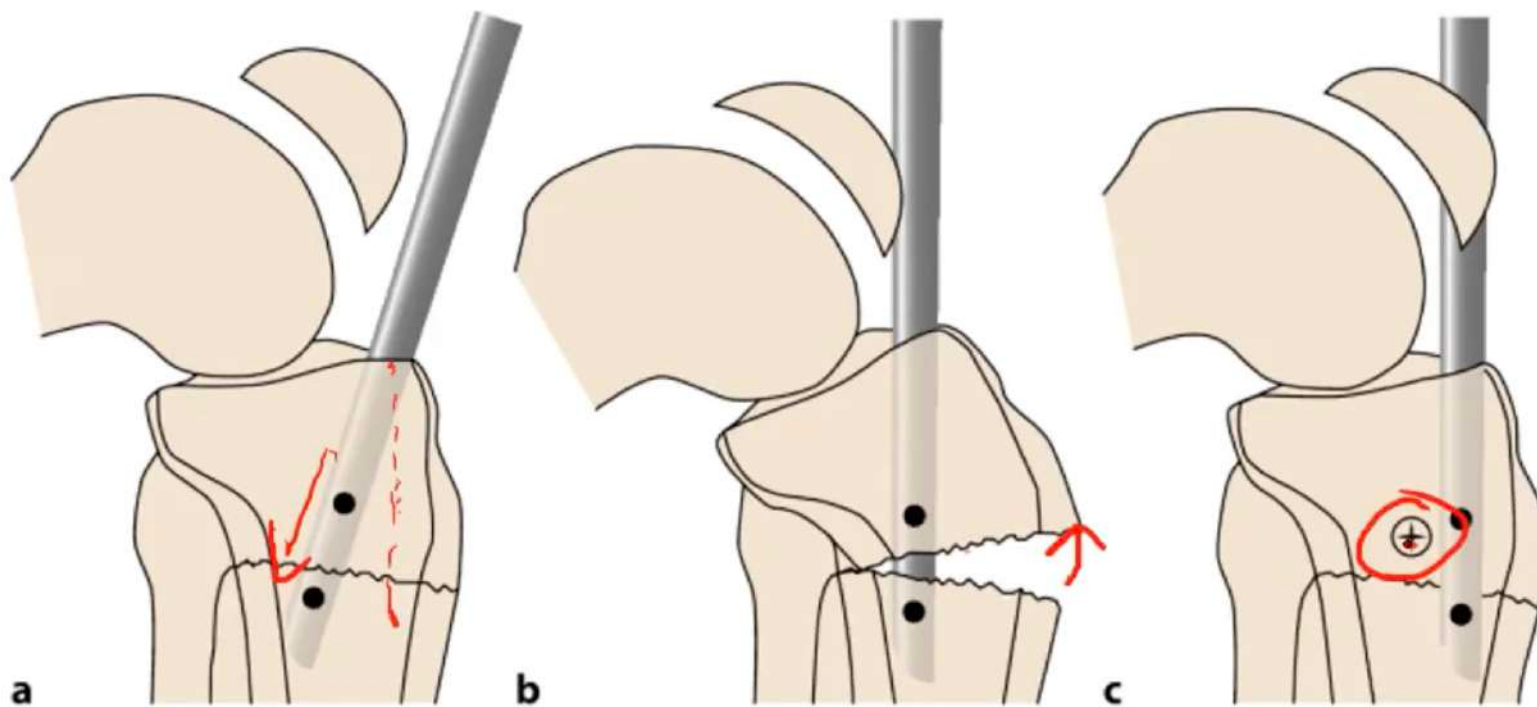


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Special considerations

- Proximal Tibia Fractures
- Infrapatellar nailing – valgus and Apex anterior angulation
- To solve –
- Prefer Suprapatellar nailing
- And Use Lateral entry point and guide wire should be parallel to anterior tibia cortex
- 2nd option- Poller screw

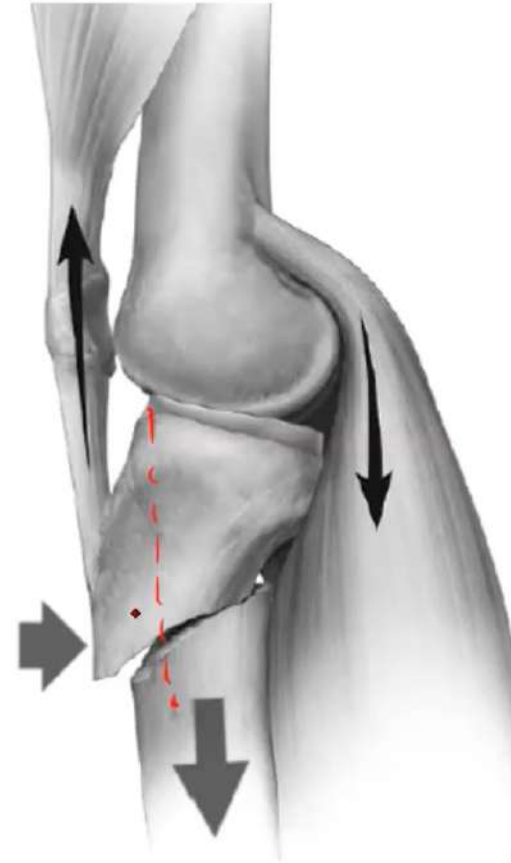




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Complications

- Compartment syndrome
- Non union
- Malunion
- Infection

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Tibial Pilon

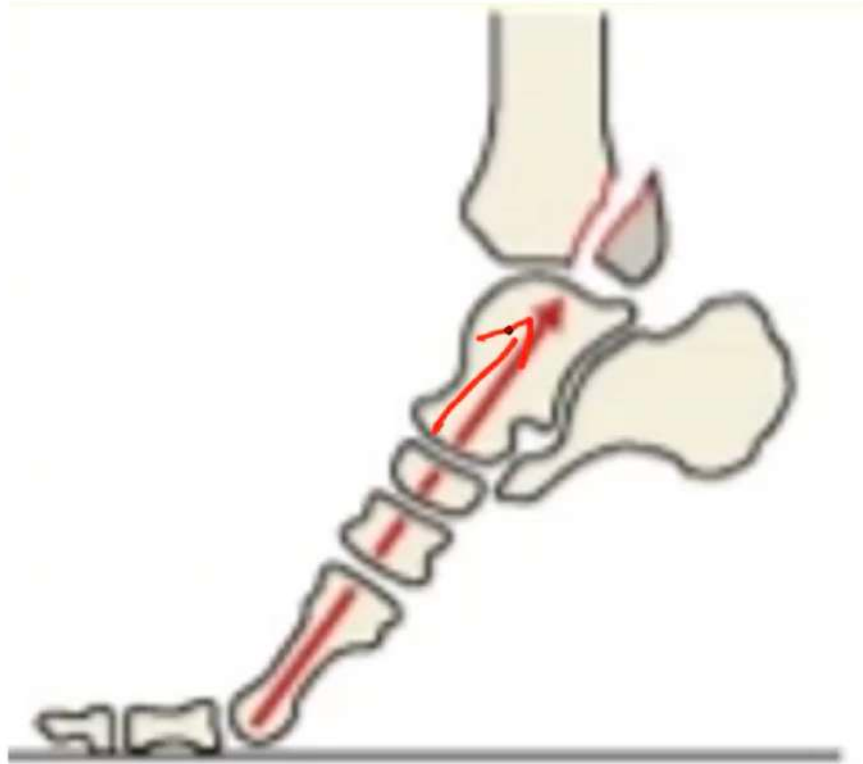
WHAT IS PILON

- Pilon- French word, meaning “pestle”
- Pilon- Distal tibia # involving articular surface with metaphyseal impaction.



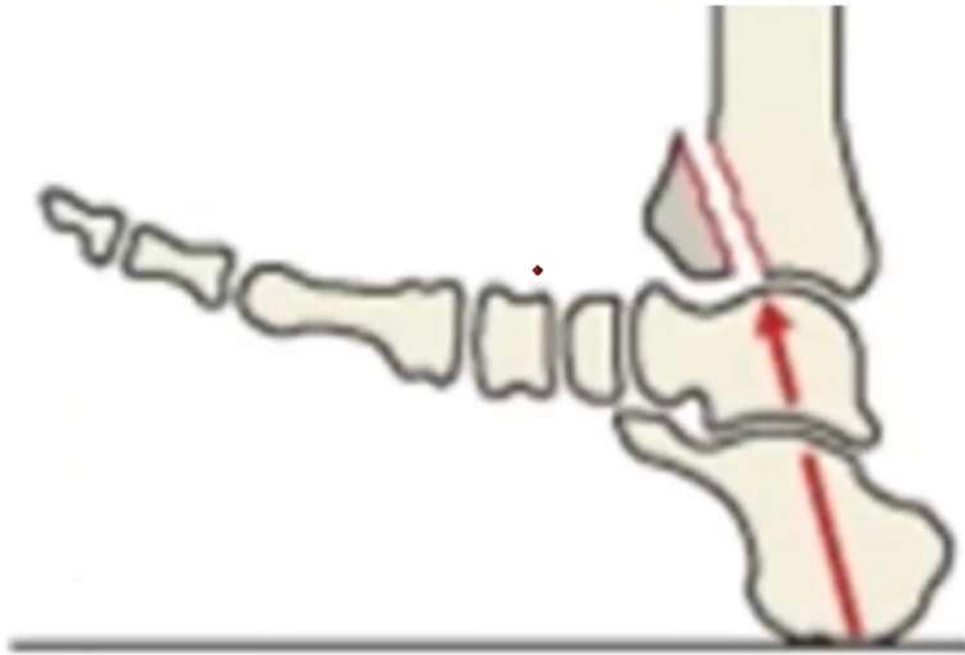
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Mechanism of injury



- Impact to Plantar flexed foot – Posterior pilon # with posterior subluxation

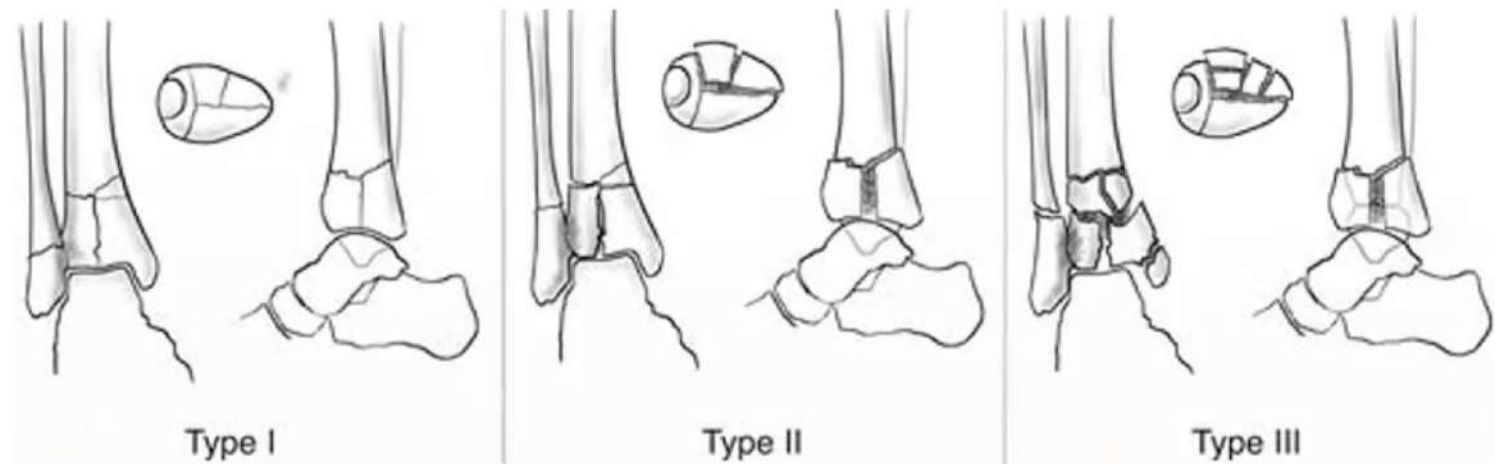
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- Impact on dorsiflexed foot- Anterior pilon # with anterior subluxation

Classification: Reudi Allgower

- I- Undisplaced intraarticular
- II- Displaced with no comminution
- III- Displaced and comminuted.



Xrays

- AP – mortise (AP in 10-15° IR)
- Lateral
- Articular comminution
- Articular depression
- Knee and ankle injuries

Spectrum of Fracture



B

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Role of Traction xrays

- Traction View –
- Ligamentotaxis often pull the displaced fragments back into position → better understanding of fracture pattern



Treatment

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- 38 yr Male, H/o RTA, 2 days old trauma.
- Plan ??
- A. ORIF with Plate
- B. Non operative (CR and Slab)
- C. CR and Tibial Nail
- D. Ankle spanning External Fixator
- E. None of the above



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Rule No 1:

“Always examine the patient before OT”



- Pilon # - A potential soft tissue disaster
- Don't hesitate to remove the slab and examine the skin condition before shifting to OT.
- Always check the distal pulses and neurological deficit.

Spectrum of soft tissue injury

- Blisters- Two types-
- Blood filled
- Clear/serous fluid filled



“Blood filled blisters indicate more extensive cutaneous damage”

- 50 yr male,
- 3 days old trauma, Swelling + , No blisters. Plan ?

A. CT then Ex Fix then ORIF

B. ORIF.

C. Ex Fix then CT then plan

D. Wait and watch



Rule No 2: Ex Fix +/- Fibula → CT → Plan

Span → Scan → Plan
Exfix - CT - Definitive



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Span → *Scan* → *Plan Approach*



External Fixator +/- Fibula fixation (1st stage)

Fibula Fixation

Fixed always

Preferred approach for Fibula – Posterolateral app

Certain conditions where not to fix-

- Wound/ poor skin on lateral side
- If very severe comminuted and you are not planning definitive surgery

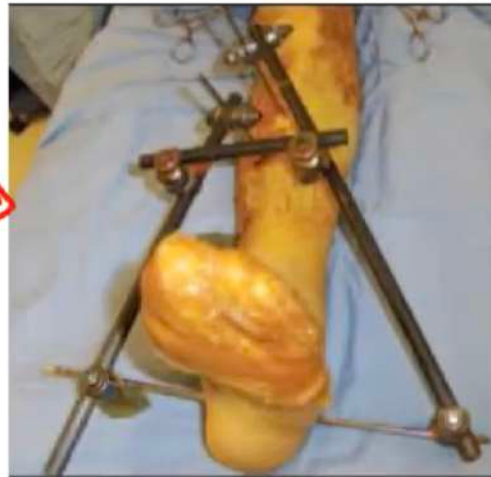


Rule No 3: How to Span

If fibula is not fixed → Delta (Triangle configuration) frame must be applied to prevent valgus

If fibula is intact or fixed → Medial side External fixator should be applied

- Pins should not be placed along the course of a possible incision site for future surgery.
- Assembly should not jeopardize the attainment of coverage flap



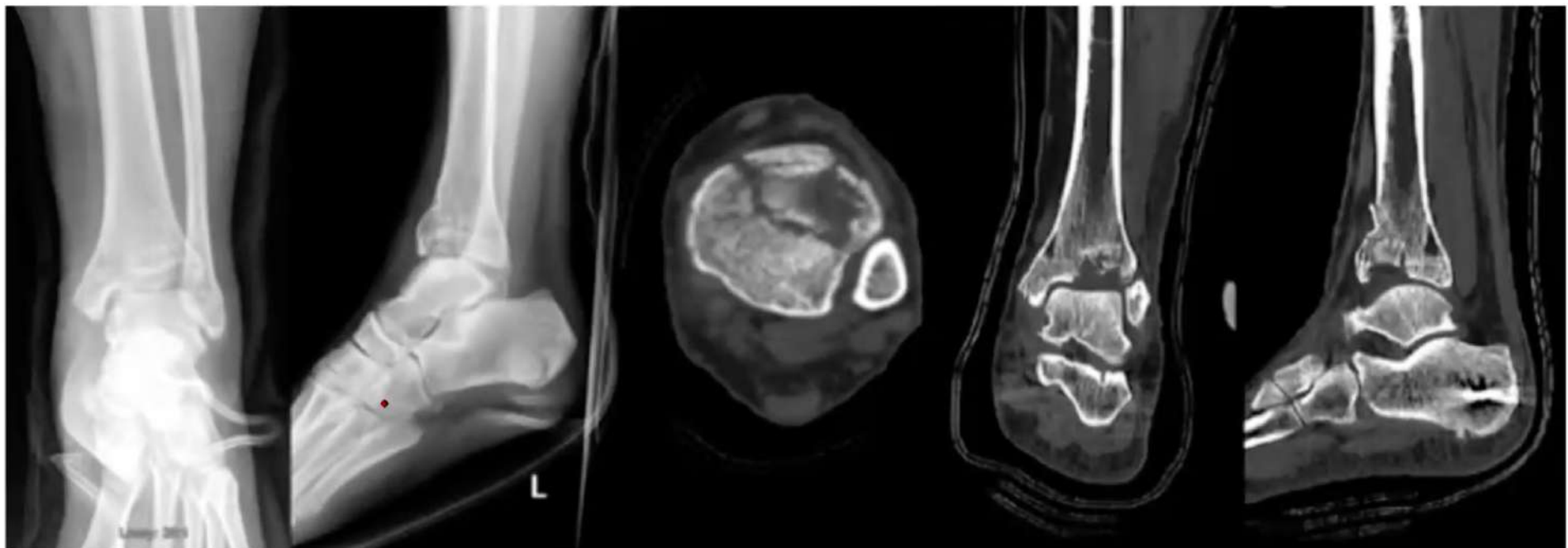
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- Fibula fixed, External Fixator applied
- Instead of Ex fix, Calcaneal pin traction is an alternative

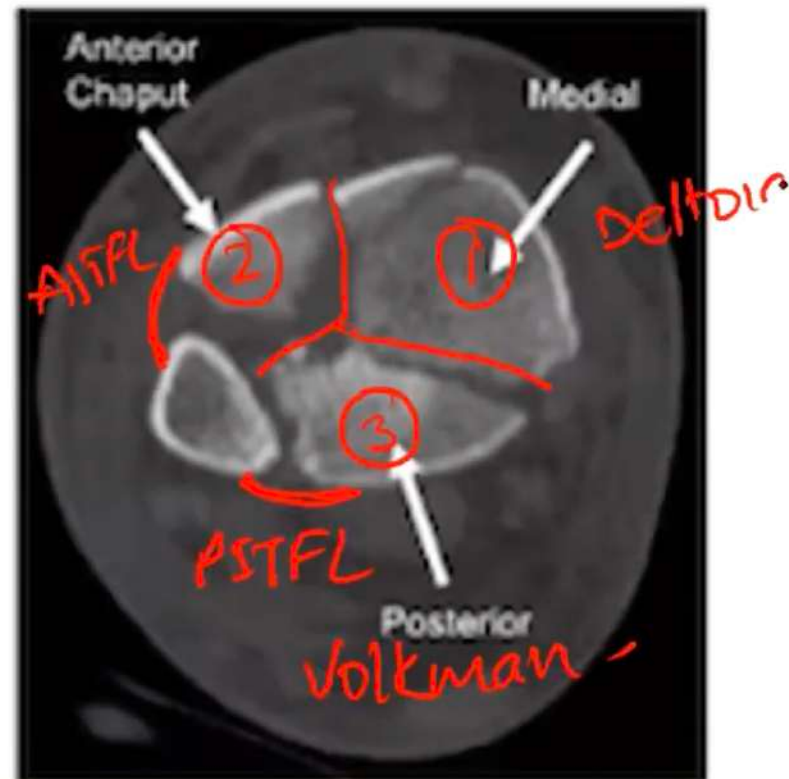
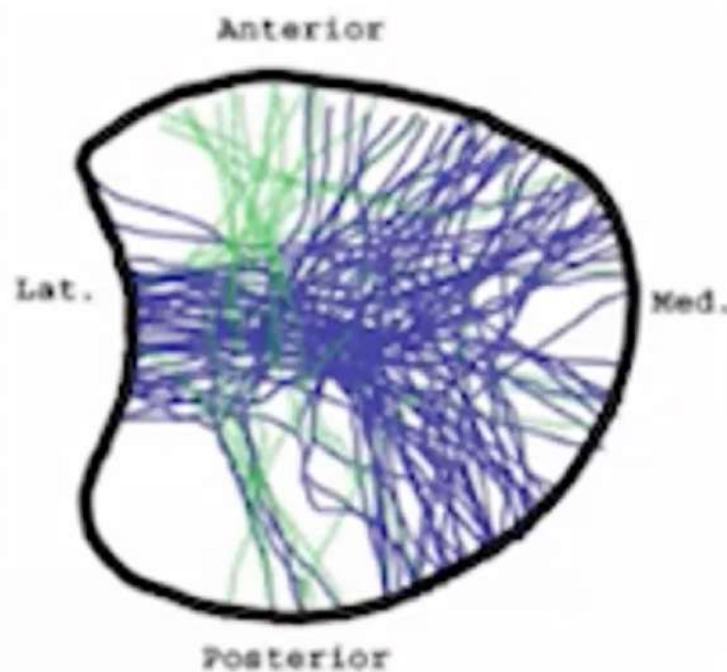
Rule no 4: Scan

- CT should be done after External fixator or calcaneal pin traction
- Provide better details of articular geometry
- Very good friend of surgeon in planning surgery



Tornetta et al. CT scan changes operative plan in 64 % of patients.

Pilon Mapping

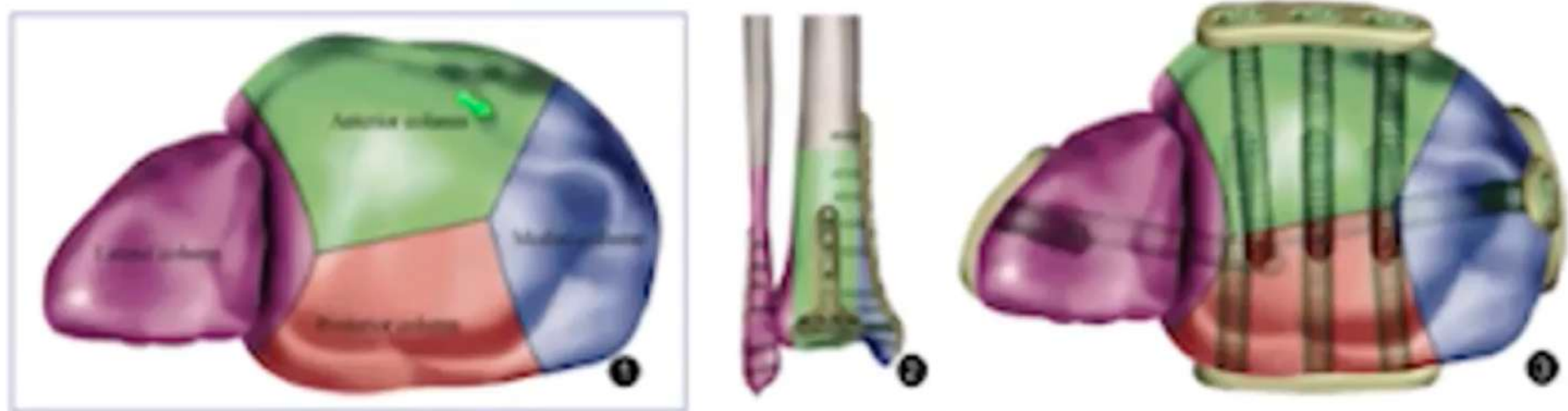


Cole PA et al. The pilon map: fracture lines and comminution zones in OTA/AO type 43C3 pilon fractures. J Orthop Trauma. 2013 ;27(7): e152-6.

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Pilon Column concept

The column will dictate plate position



Tang X et al. Pilon fractures: a new classification and therapeutic strategies. Chin Med J.2012; 125(14): 2487-92.

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When to do definitive fixation?

- Ideal time to do definitive surgery
- A. 2-3 days of trauma
- B. within 7 days
- C. 2-3 weeks
- D. 3- 6 weeks of trauma

10-21 days

Rule No.5: Timing of surgery

- 2 surgical windows-

Look for-

WRINKLE TEST
BLISTERS RE-EPITHELIZATION

Within 6-8 hours of trauma
– Single stage ORIF

After 10-21 days of trauma

Wrinkle test



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Why Timing is Important?

- To avoid this-



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Span → Scan → Plan Approach



Definitive ORIF: How to proceed??

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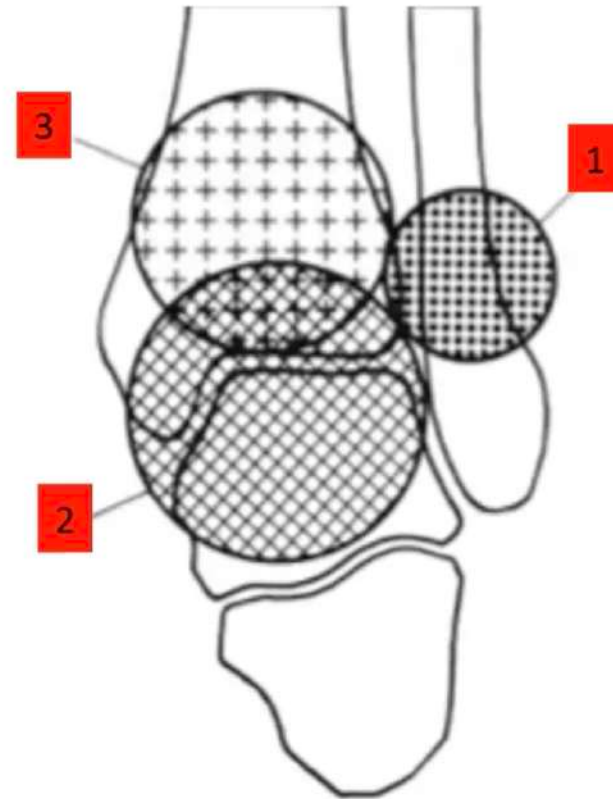
Aim of treatment



- Anatomic restoration of fibula length
- Anatomical articular reduction
- Restoration of axial alignment
- Reconstruction of plafond
- Bone grafting of metaphyseal defect
- Buttressing of distal tibia
- “No touch technique” for soft tissue dissection

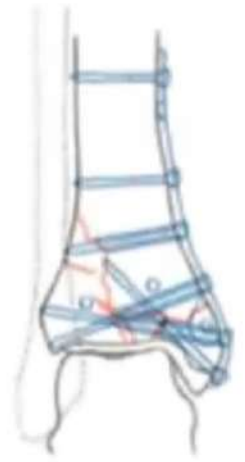
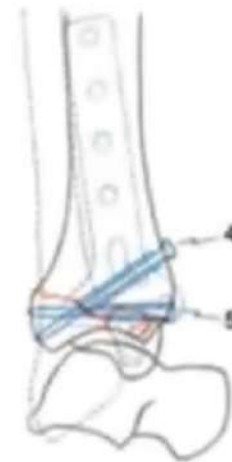
- Three important anatomical zones for decision making-

1. Fibula
2. Articular surface
3. Metaphysis



- Reudi Allgower's principles -

1. Restoring fibula length
2. Reconstruction of articular surface
3. Metaphyseal bone graft
4. Distal tibia Buttreassing



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Incision and approaches

Decided on basis of CT , according to location and number of articular fragments.

Rule of 7cm – between 2 incisions, 7cm of skin bridge should be intact.

Howard JL, Agel J, Barei DP, Benirschke SK, Nork SE. A prospective study evaluating incision placement and wound healing for tibial plafond fractures. J Orthop Trauma. 2008;22(5):299–305.

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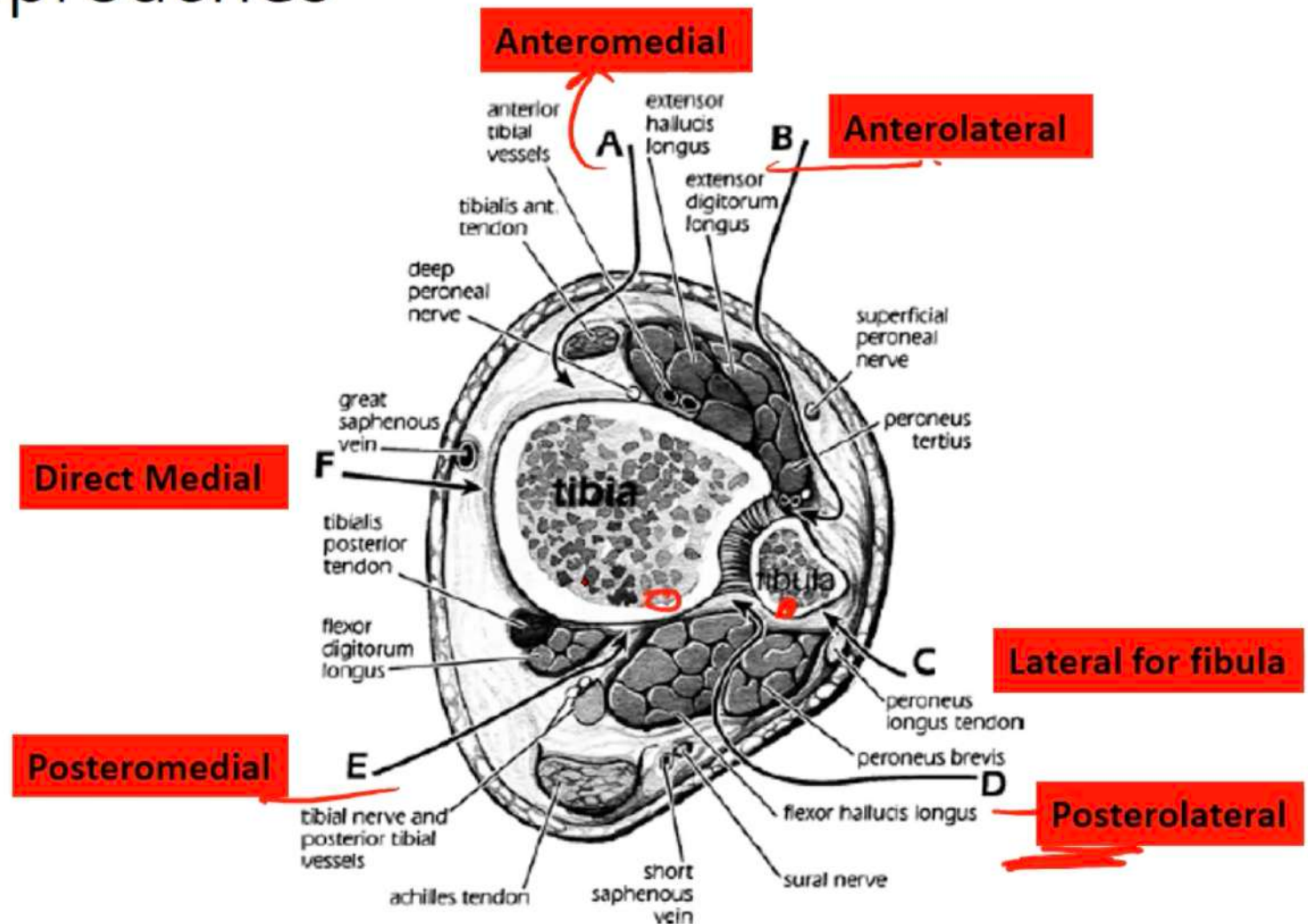
Positioning



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Different approaches-

- Anteromedial
- Anterolateral
- Posterolateral
- Posteromedial
- Medial

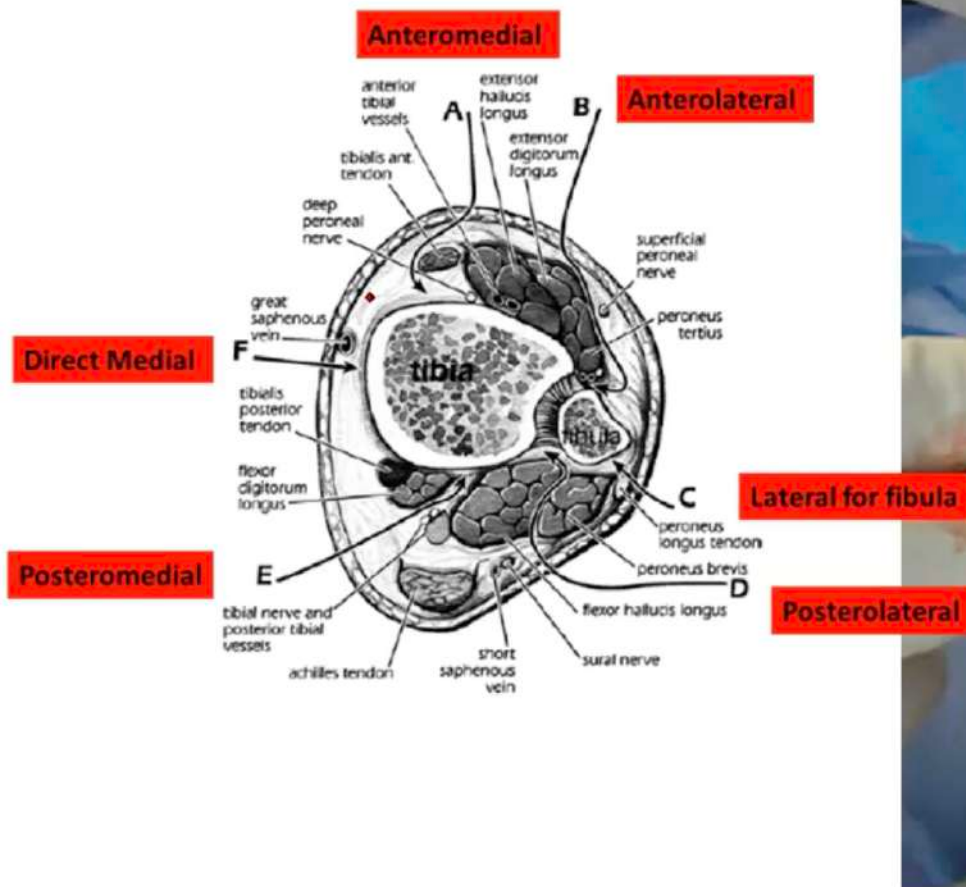


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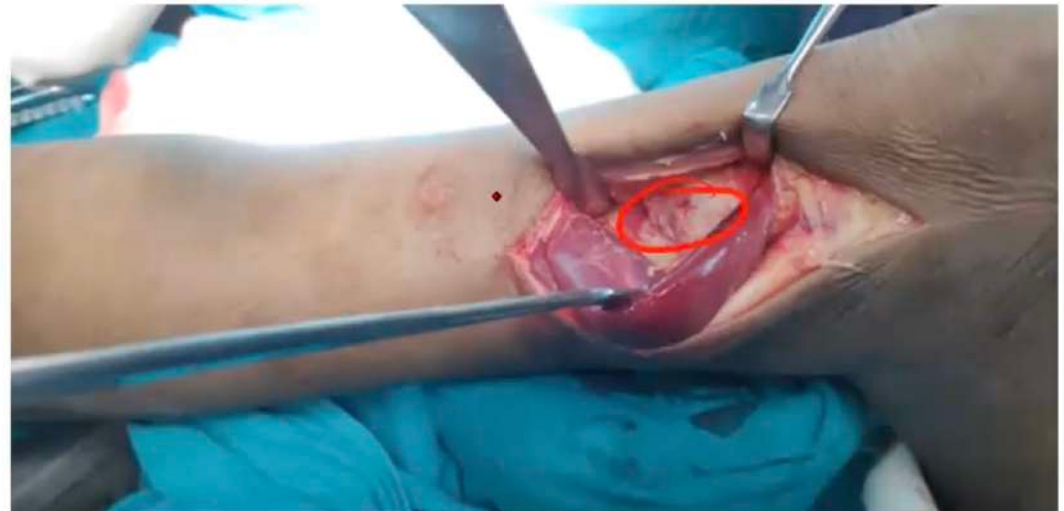


Laminar spreader can be used to distract the fracture to see the articular reduction

Posteromedial approach



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Sequence of reduction of tibial articular surface

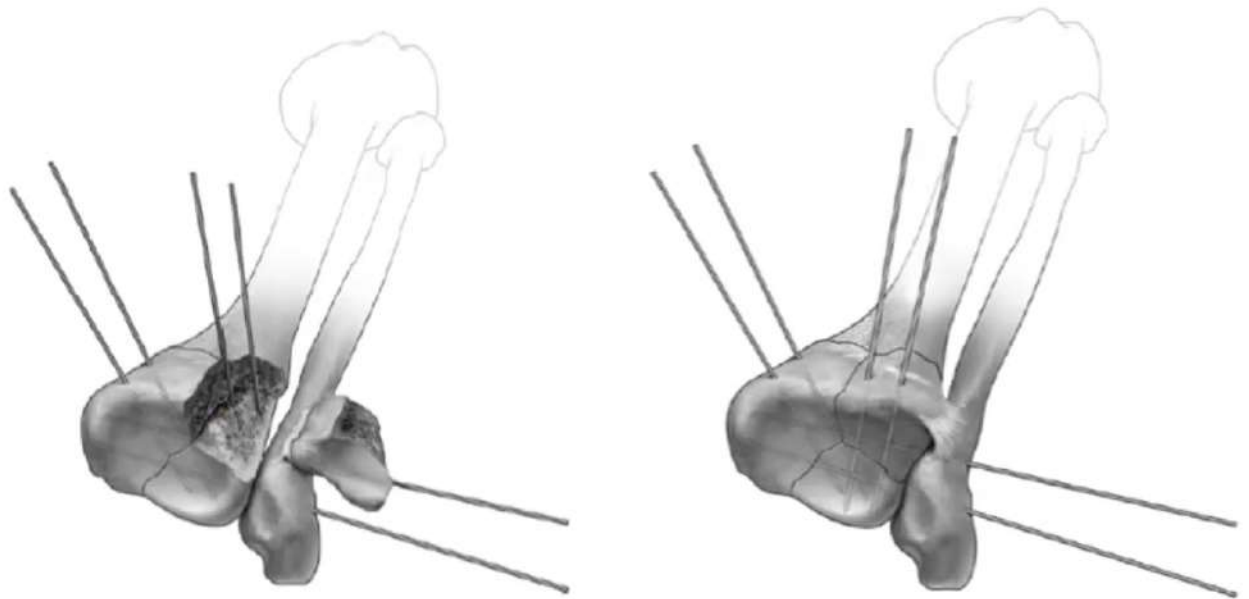
- Posterolateral



- Medial



- Anterolateral



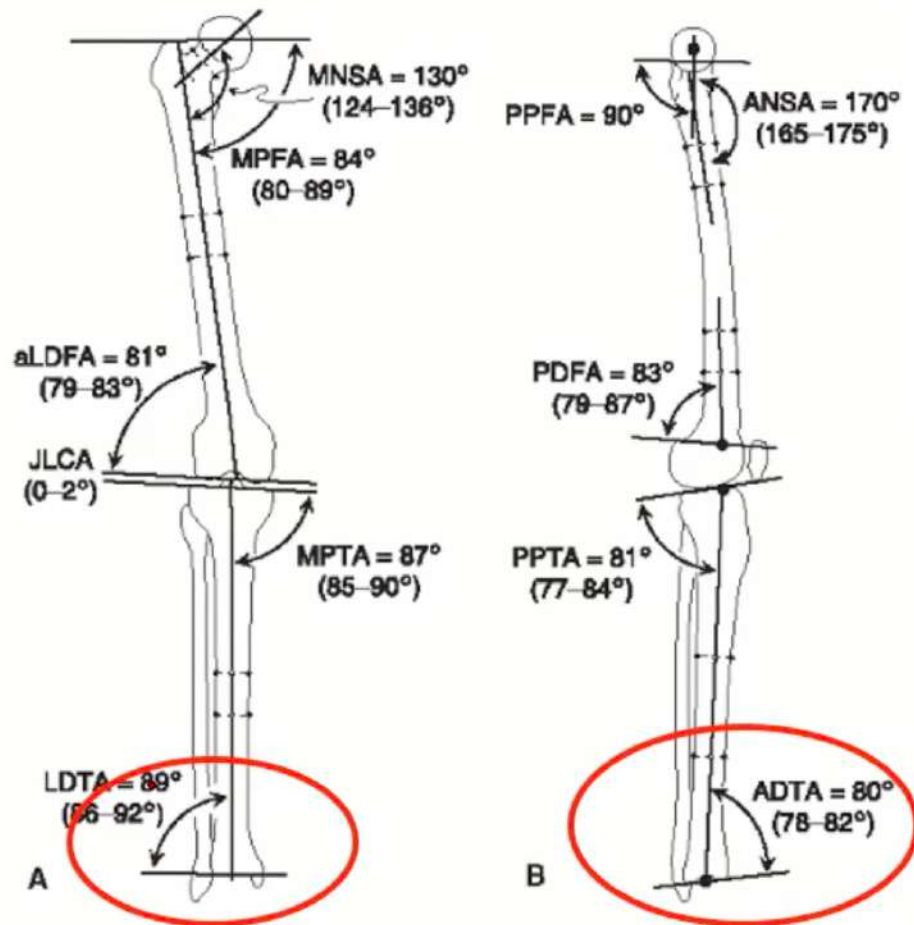
No Touch technique for soft tissues

- Full thickness flap
- Retracted with k wire

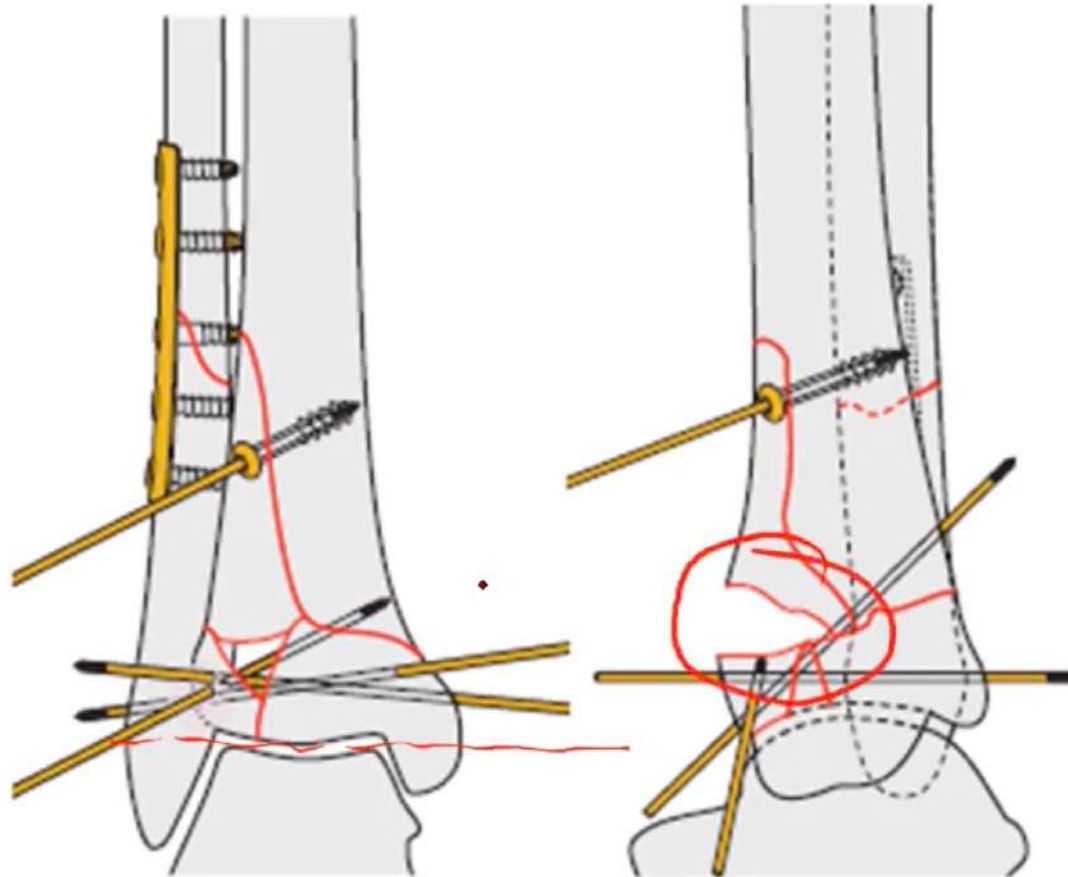


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Reconstruction of articular surface

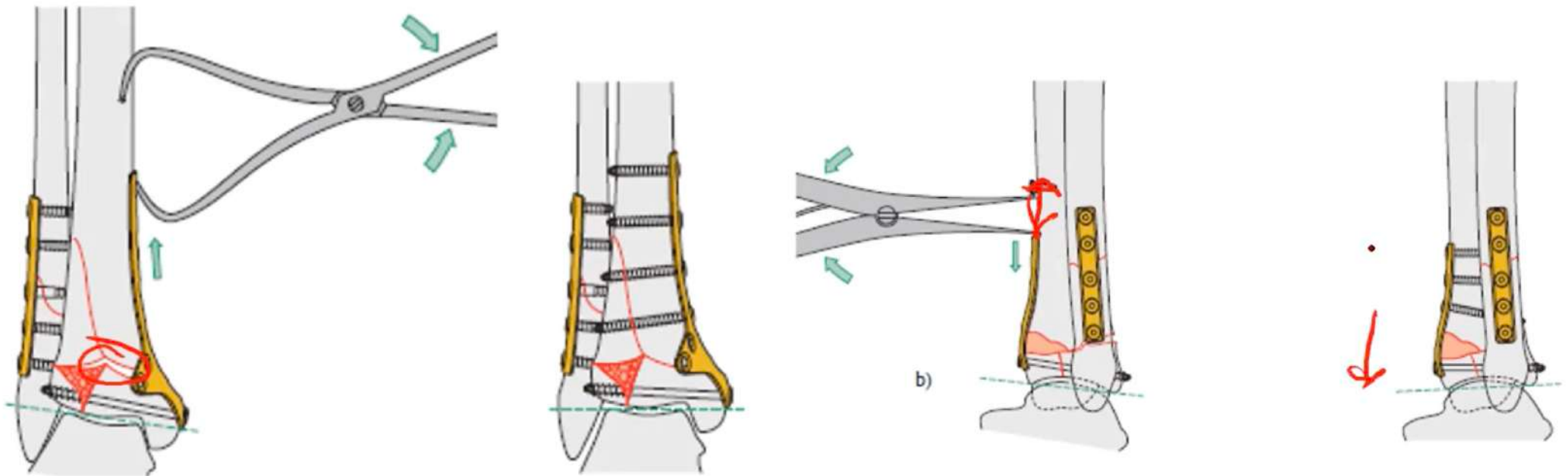


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Push Pull reduction technique for minor adjustment



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Buttressing



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Role of Primary Arthrodesis

- No Role
- Seldom performed acutely
- Reserved for severe articular comminution, not otherwise reconstructable
- Best if done after comminution have consolidated and soft tissues have recovered