PLEASE CLICK ON THE FOLLOWING LINK TO WATCH THE LECTURE ONLINE:-

https://www.youtube.com/live/JDab6-Mpq_0

Tibial plateau fractures

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MD

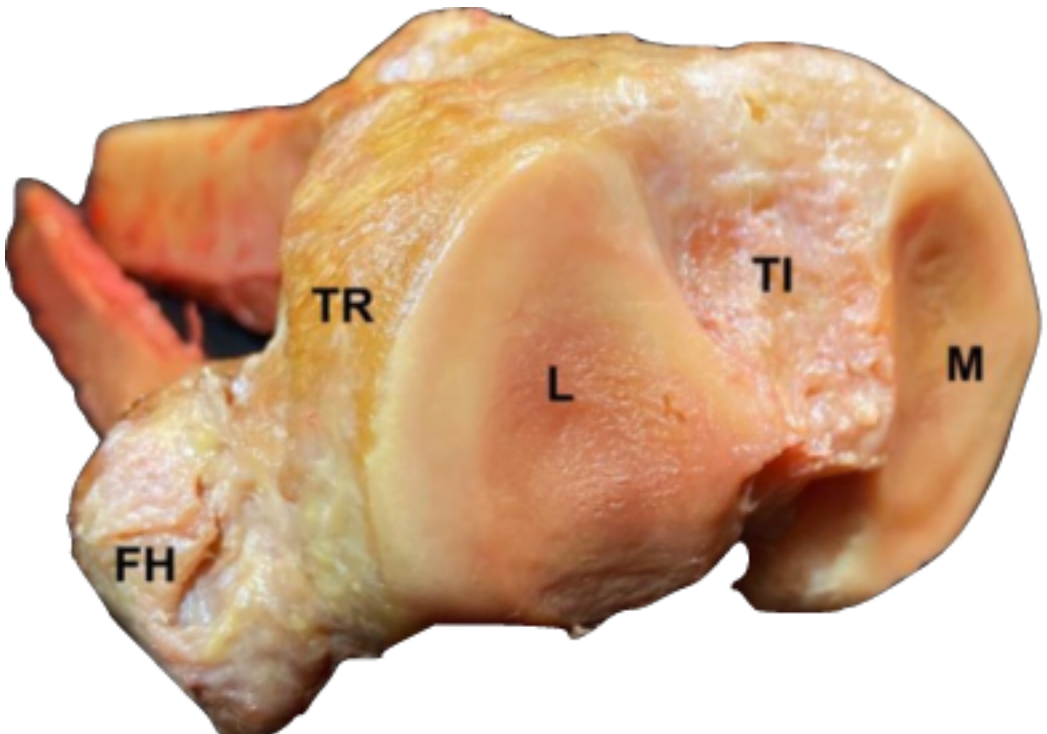
Disclosure

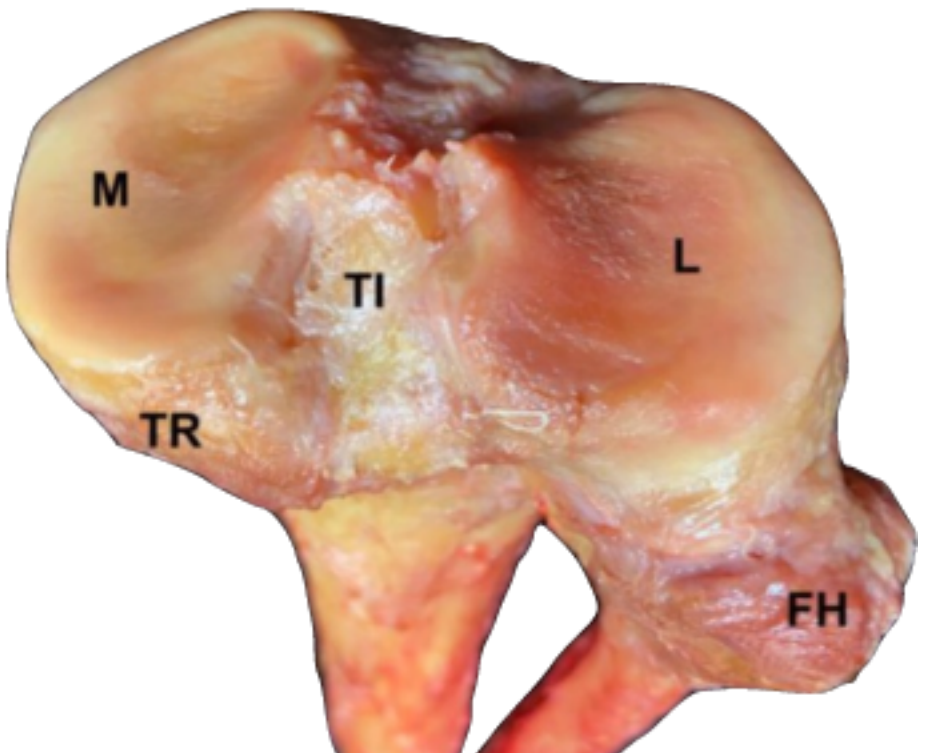
I have no financial relationships with commercial entities that produce health-care related products.

Learning objectives

- Describe the principles to treat tibial plateau fractures
- Assess and treat soft tissue injuries
- Describe staged management of tibial plateau
- Select surgical approaches, reduction and fixation techniques

TT





Patterns of fractures

- Shearing and compression: articular fractures
- Shearing produces a split wedge
- Force continues and depress the split wedge and widening of the metaphysis
- Femoral condyle follows displaced split wedge because of soft tissue attachment: joint subluxation and instability
- Torsion: fracture diaphysis and torn ligaments

Patterns of fractures

Principles for management

- Staged treatment of a tibial plateau fracture is better than an infected one

- A malunited tibial plateau fracture is easier to manage than a stiff knee

Assess

Imaging

Lateral convex

Medial concave

Impaction

Alignment

Congruency

Imaging

- CT

  Articular surface, comminution, characteristics

- MRI

  Soft tissues / Fracture dislocations

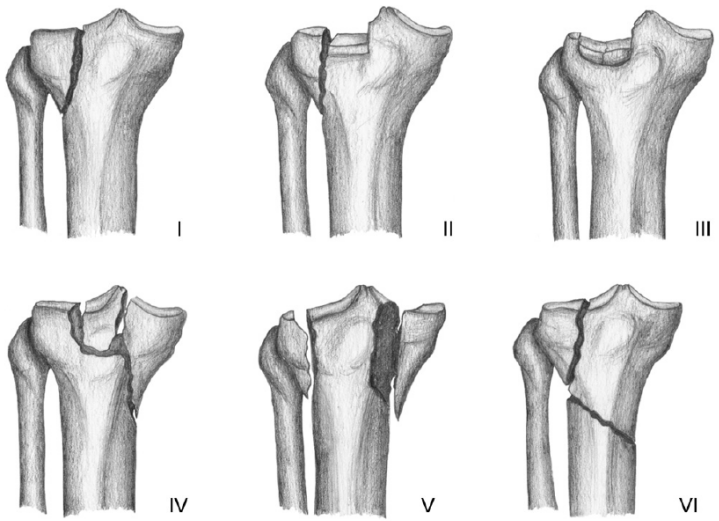
How much articular displacement can be detected using fluoroscopy for tibial plateau fractures?

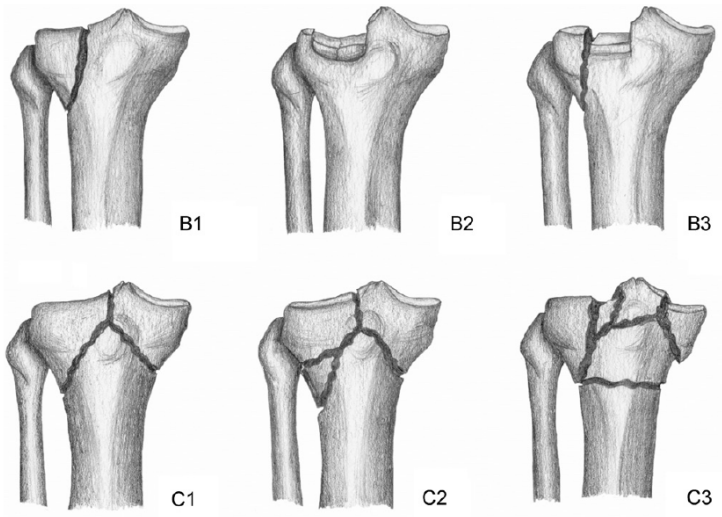
Justin M. Haller [a], Robert O'Toole [b], Matthew Graves [c], David Barei [d], Michael Gardner [e], Erik Kubiak [a], Jason Nascone [b], Sean Nork [d], Angela P. Presson [a,f], Thomas F. Higgins [a,*]

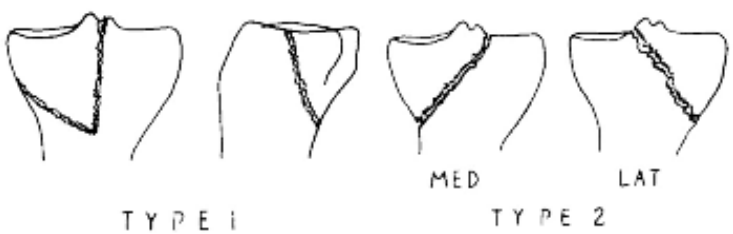
5 mm

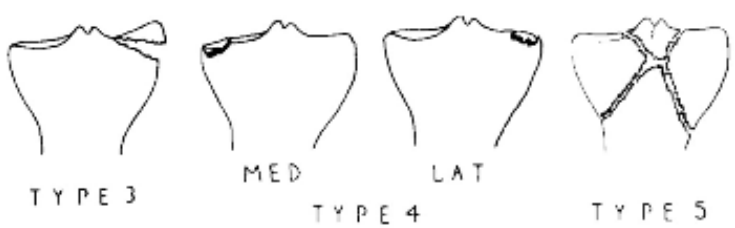
Injury 2015

Classifications





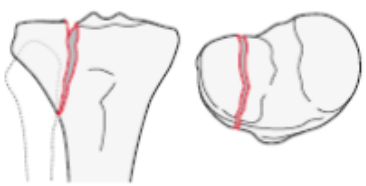




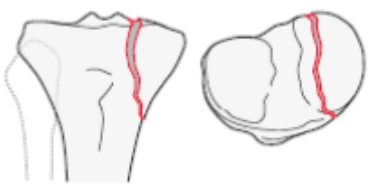
AO/OTA Classification: tibia proximal end segment 41B

Partial articular fractures –split fractures

Subgroups:
Lateral plateau fracture
41B1.1



Medial plateau fracture
41B1.2



Oblique, involving the tibial spines and 1 of the tibial plateaus
41B1.3*

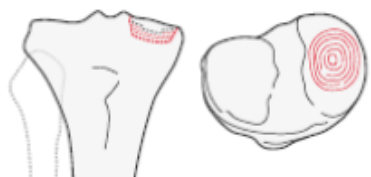
*Qualifications:
f Lateral
h **Medial**

Depression fractures

Subgroups:
Lateral plateau fracture
41B2.1*

*Qualifications:
t Anterolateral (AL)
u **Posterolateral (PL)**
x Central

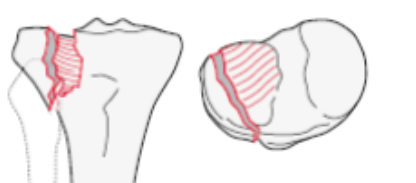
Medial plateau fracture
41B2.2



*Qualifications:
v Anteromedial (AM)
w Posteromedial (PM)
x **Central**

Split depression fractures

Subgroups:
Lateral plateau fracture
41B3.1*

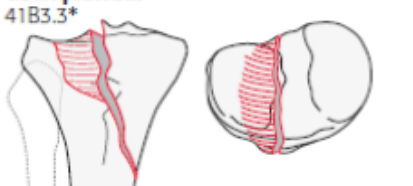


*Qualifications:
t Anterolateral (AL)
u **Posterolateral (PL)**
x Central

Medial plateau fracture
41B3.2*

*Qualifications:
v **Anteromedial (AM)**
w Posteromedial (PM)
x Central

Involving the tibial spines and 1 of the tibial plateaus
41B3.3*



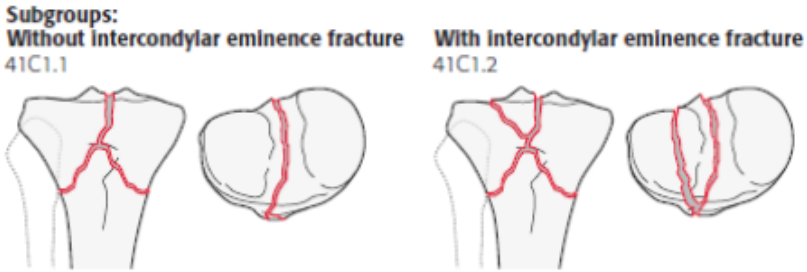
*Qualifications:
f **Lateral**
h Medial

Tibial proximal end segment

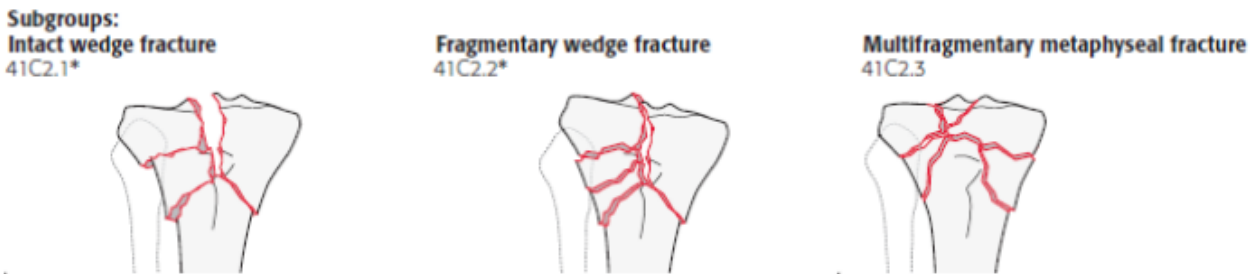
Complete articular fractures 41C

Simple articular

Simple metaphyseal 41C1

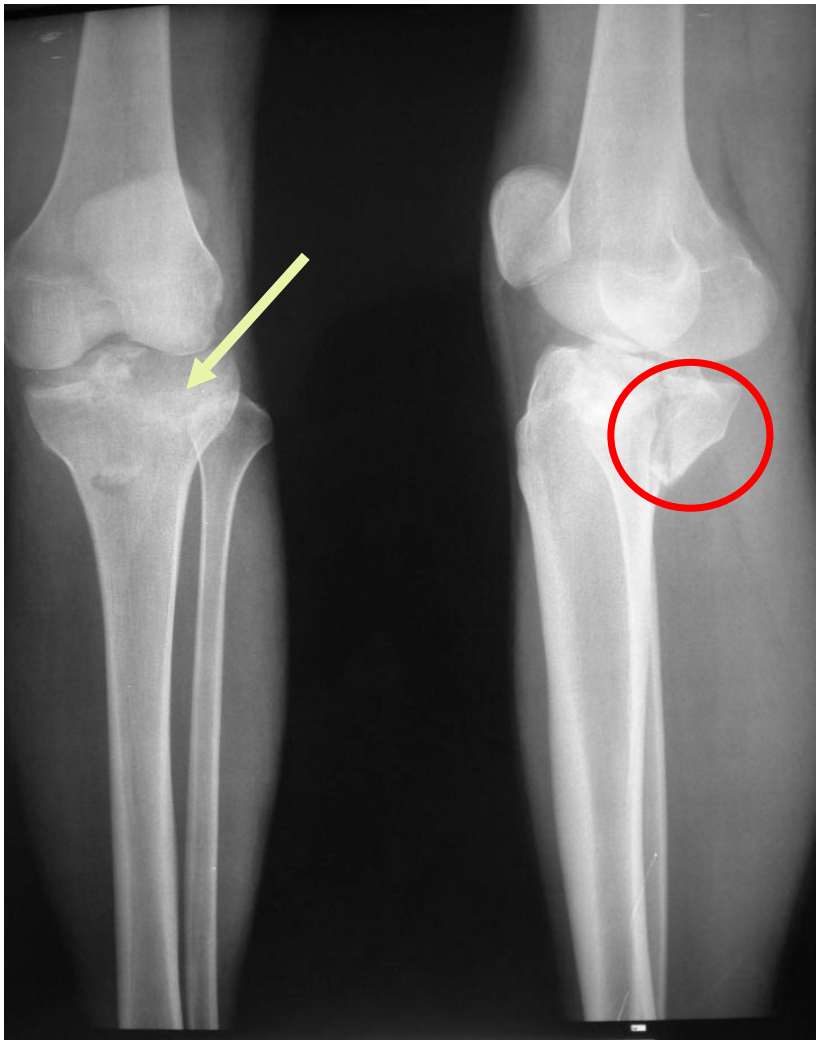


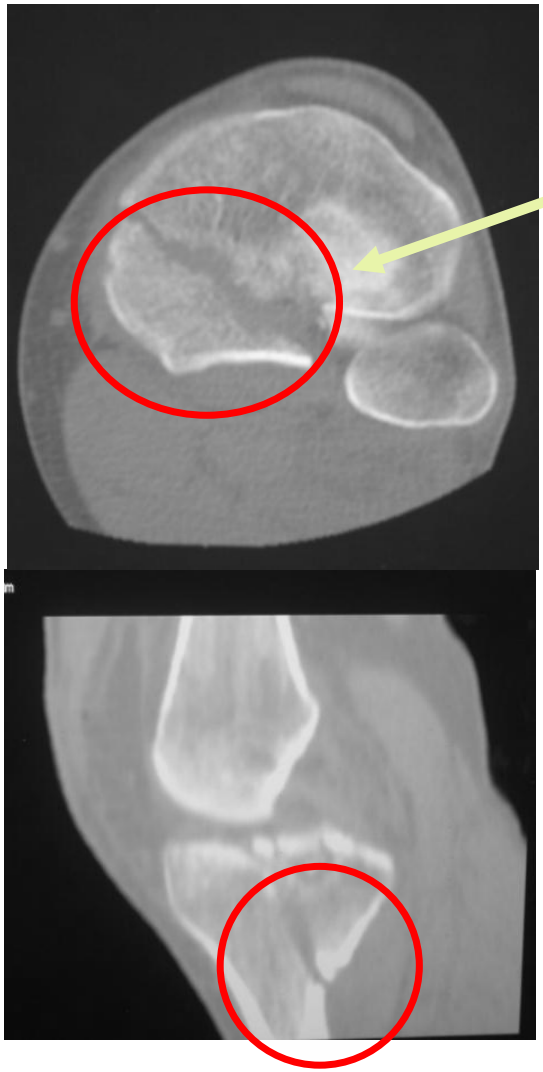
Simple articular,
wedge or multifragmentary
metaphyseal 41C2



Qualifications Lateral f, Medial h

Fragmentary or
multifragmentary
metaphyseal fractures
41C3



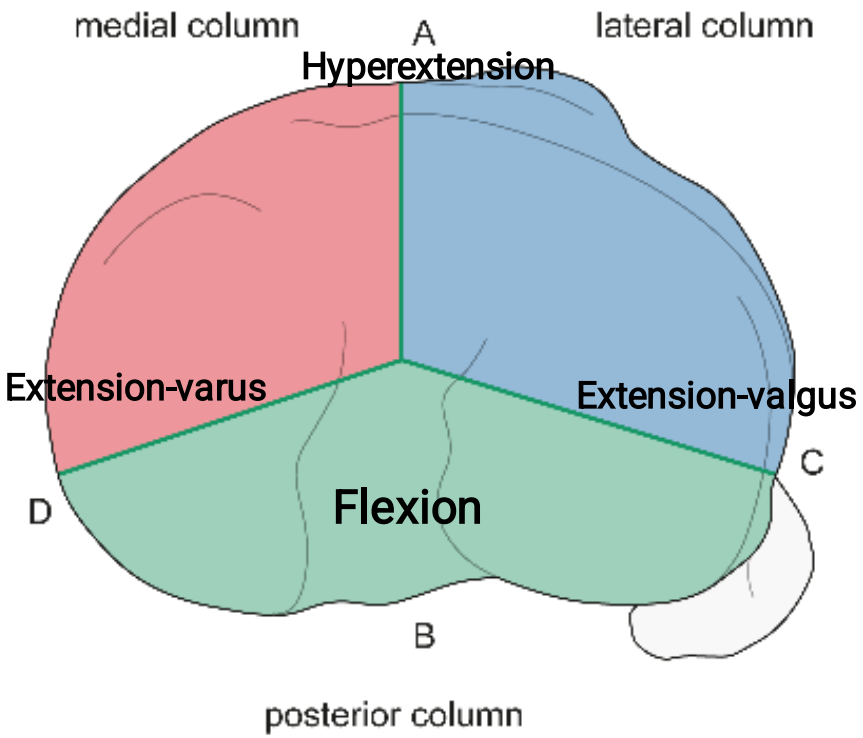


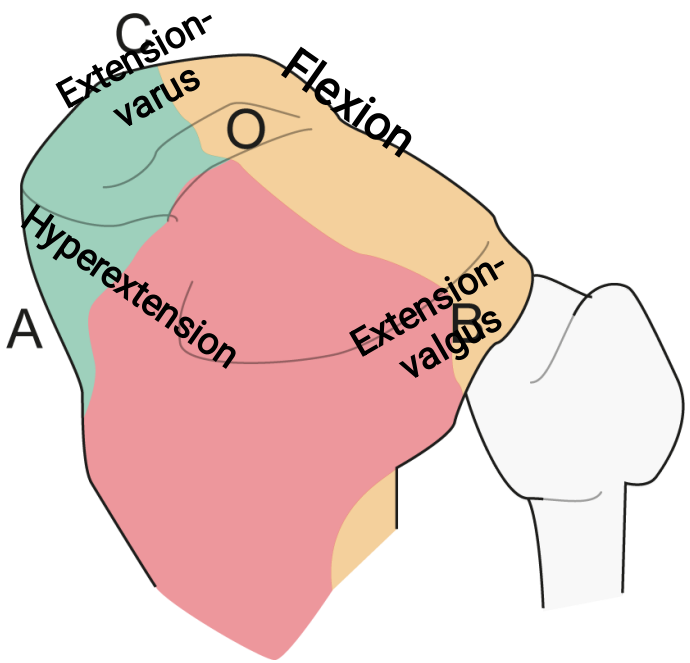
“Rather than trying to fit fractures into a specific fracture classification, the morphological visualization of the fracture via CT or radiographs should result in establishing a sufficient surgical strategy”

Krause M et al, Injury 2016

A new way of thinking

3D morphology and injury mechanism





Timing

- Soft tissues
- Patient conditions
- Staged management
  - Trans articular x-fix
- Primary definitive fixation

Back to basics

- Reduce anatomically and compress the joint
- Restore condylar width
- Restore axial alignment
- Restore joint stability
  - Key element: split wedge fragment

Steps

- Identify the split wedge fragment/s responsible for joint stability
  - Patient position
  - Surgical approach
- Open split wedge as a book to reduce articular surface
- Fill the bone defect

Steps

- Reduce split wedge fragment anatomically
  - Restore rim
  - Restore joint stability
  - Restore axial alignment (unless diaphysial extension)
- Buttress with plate (containment)

Key to restore joint stability

- Anatomical reduction of the split wedge fragment

- Restoration of continuity of the articular rim

Principles for approach selection

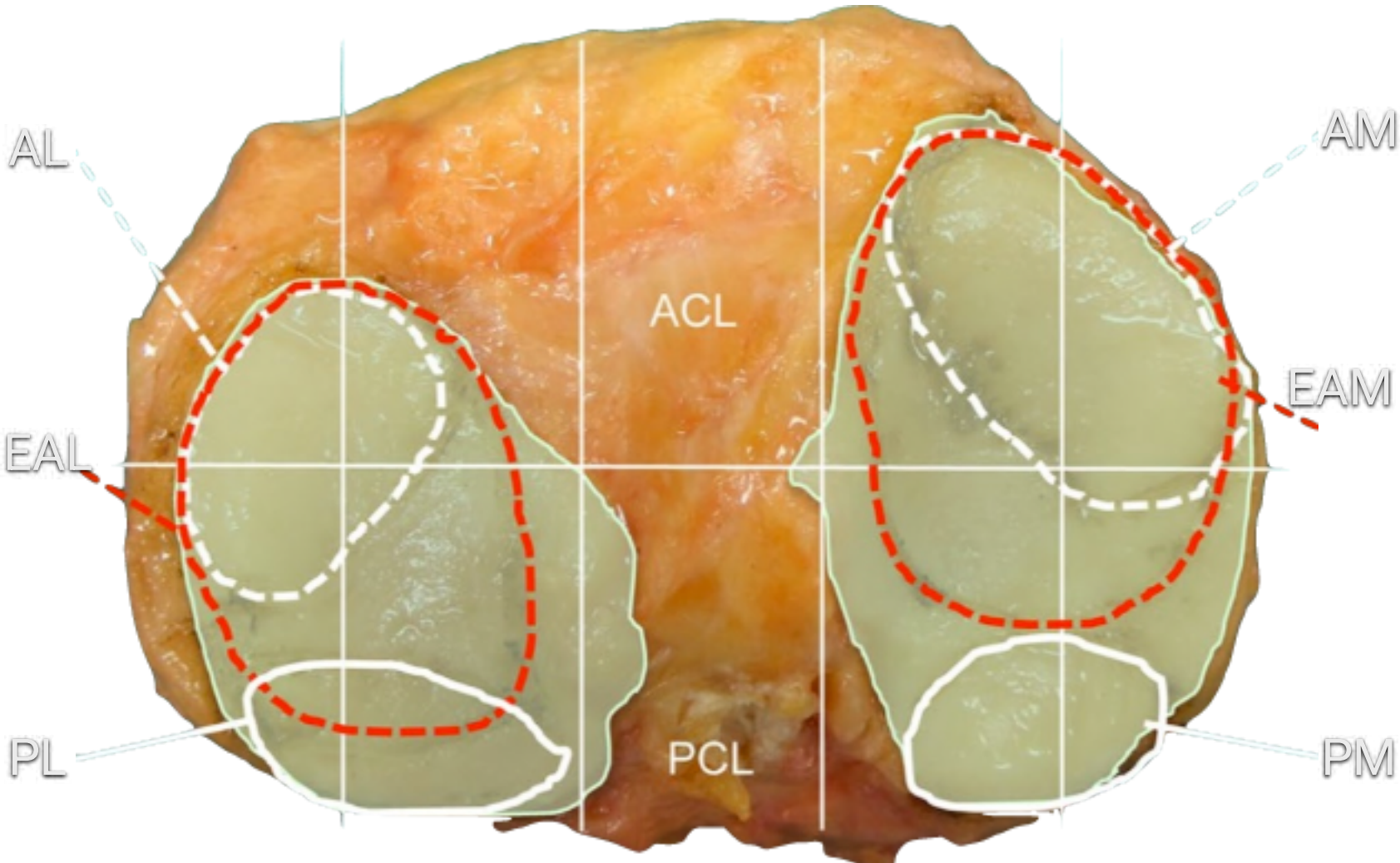
- Biomechanics of fixation
- Touch of depressed articular fragment
- Soft-tissue tolerance


How can the articular surface of the tibial plateau be best exposed? A comparison of specific surgical approaches

Matthias Krause[1,2] · Sebastian Krüger[3] · Gunnar Müller[3] · Klaus Püschel[4] · Karl-Heinz Frosch[1]

“The most important risk factor for malreduction in complex tibial plateau fractures is an impaired visualization of the articular surface”

Arch Orthop Trauma Surg 2019


AL
AM
ACL
EAM
EAL
PL
PCL
PM

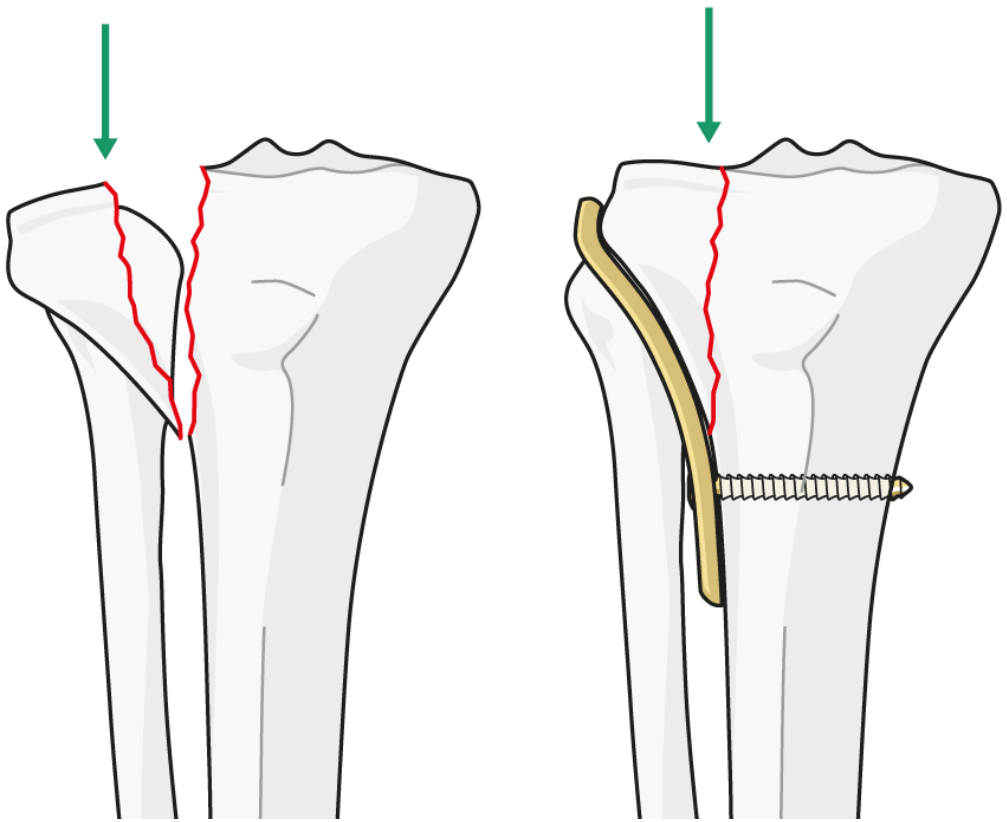
Reduction

- Joint
  - Direct
  - Anatomical
  - Compression

- Metaphysis / Diaphysis
  - Indirect / direct
  - Functional
  - Buttress / Bridge

Principle for plate fixation

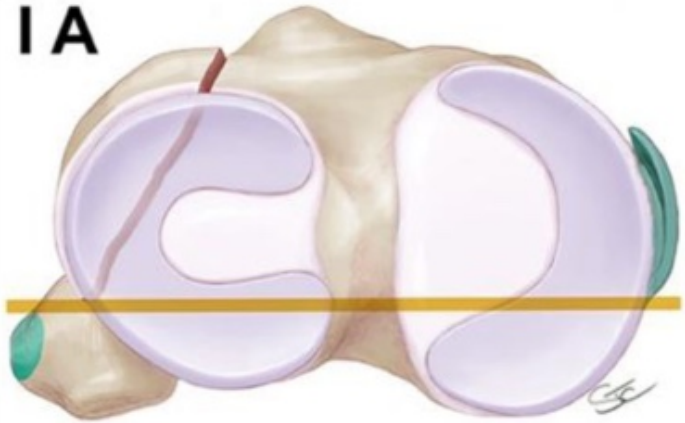
- Buttress fixation is preferred for column fractures
- Main buttress plate is chosen according to the **injury mechanism**
- Bridging is used for comminuted metaphyseal fractures



Type I - Split Wedge

Schatzker - 1974

I A

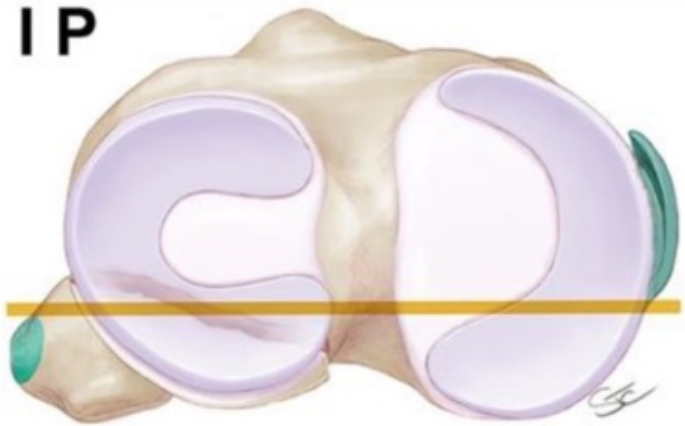


Area of the instability:
Anterolateral

Approach: Anterolateral

Possible techniques:
. Lag screws
. Buttress plate

I P



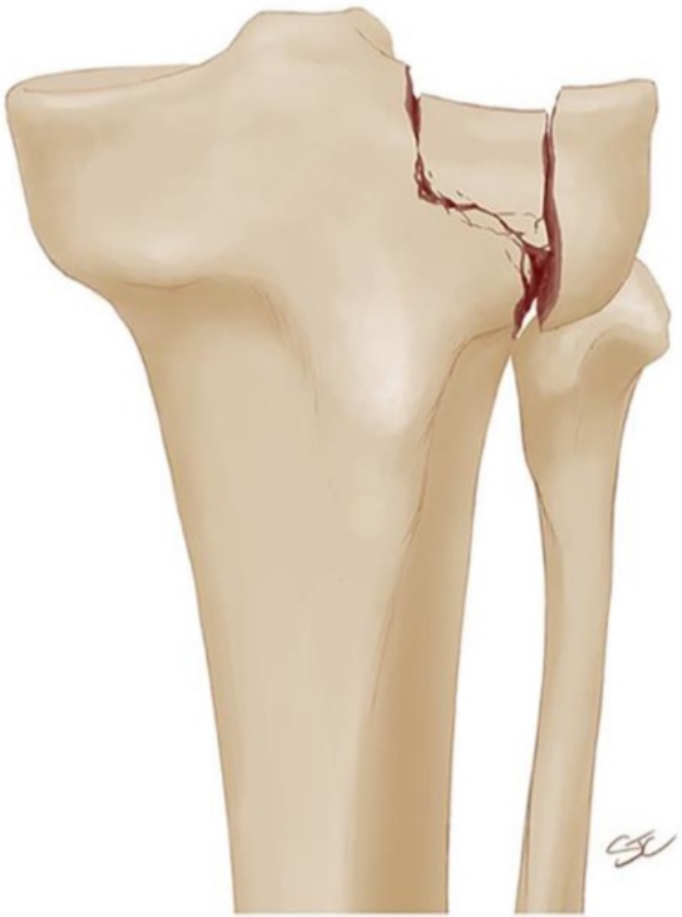
Area of the instability:
Posterolateral

Approach: Posterolateral

Possible techniques:
. Lag screws
. Buttress plate

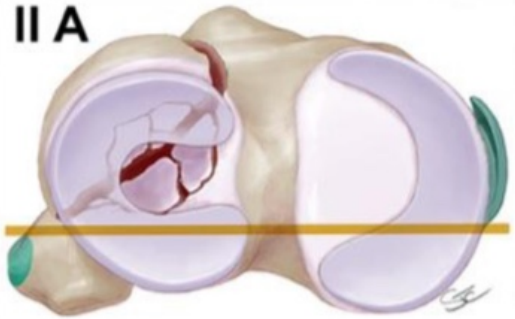
Kfuri & Schatzker - 2018

Type II - Split Wedge Depression



Schatzker - 1974

II A

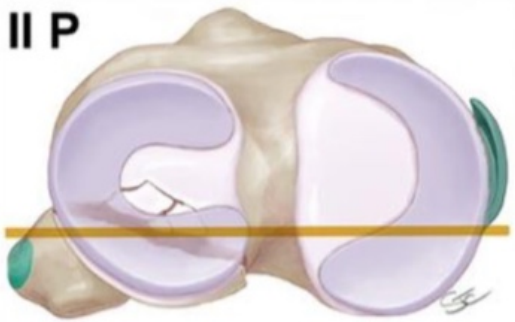


Area of the instability:
Anterolateral

Approach: Anterolateral

Technique: Buttress plate

II P

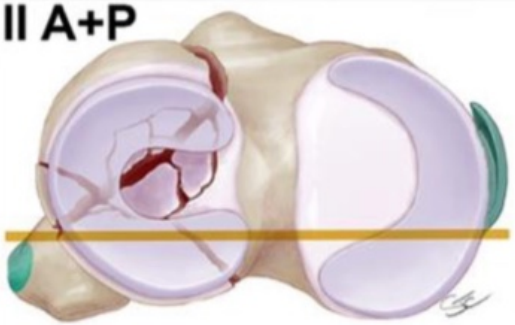


Area of the instability:
Posterolateral

Approach: Posterolateral

Technique: Buttress plate

II A+P



Areas of instability:
Anterolateral and Posterolateral

Approach: Extended anterolateral

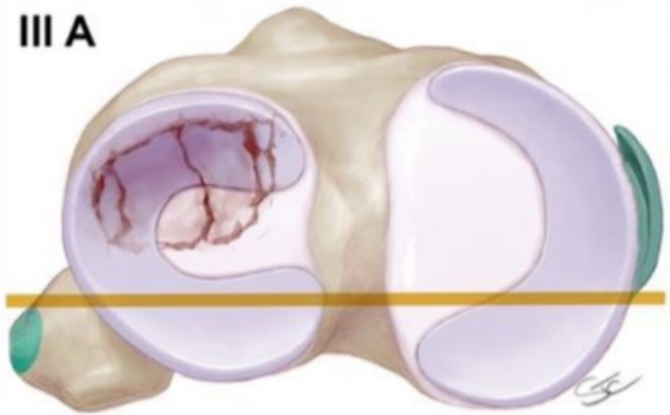
Technique: Anterolateral and
Posterolateral buttress plates

Kfuri & Schatzker - 2018

Type III - Pure Depression

Schatzker - 1974

III A



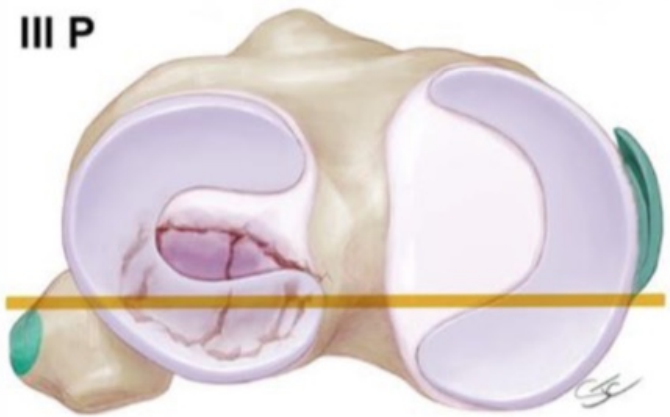
Low energy, reduced bone density

Mechanism: Valgus and Hyperextension

Technique: Articular surface reduced from underneath (bone tamping); Metaphyseal window is required; Bone grafting and raft screws

Control: Fluoroscopy and/or Arthroscopy

III P



Low energy, reduced bone density

Mechanism: Valgus and Flexion

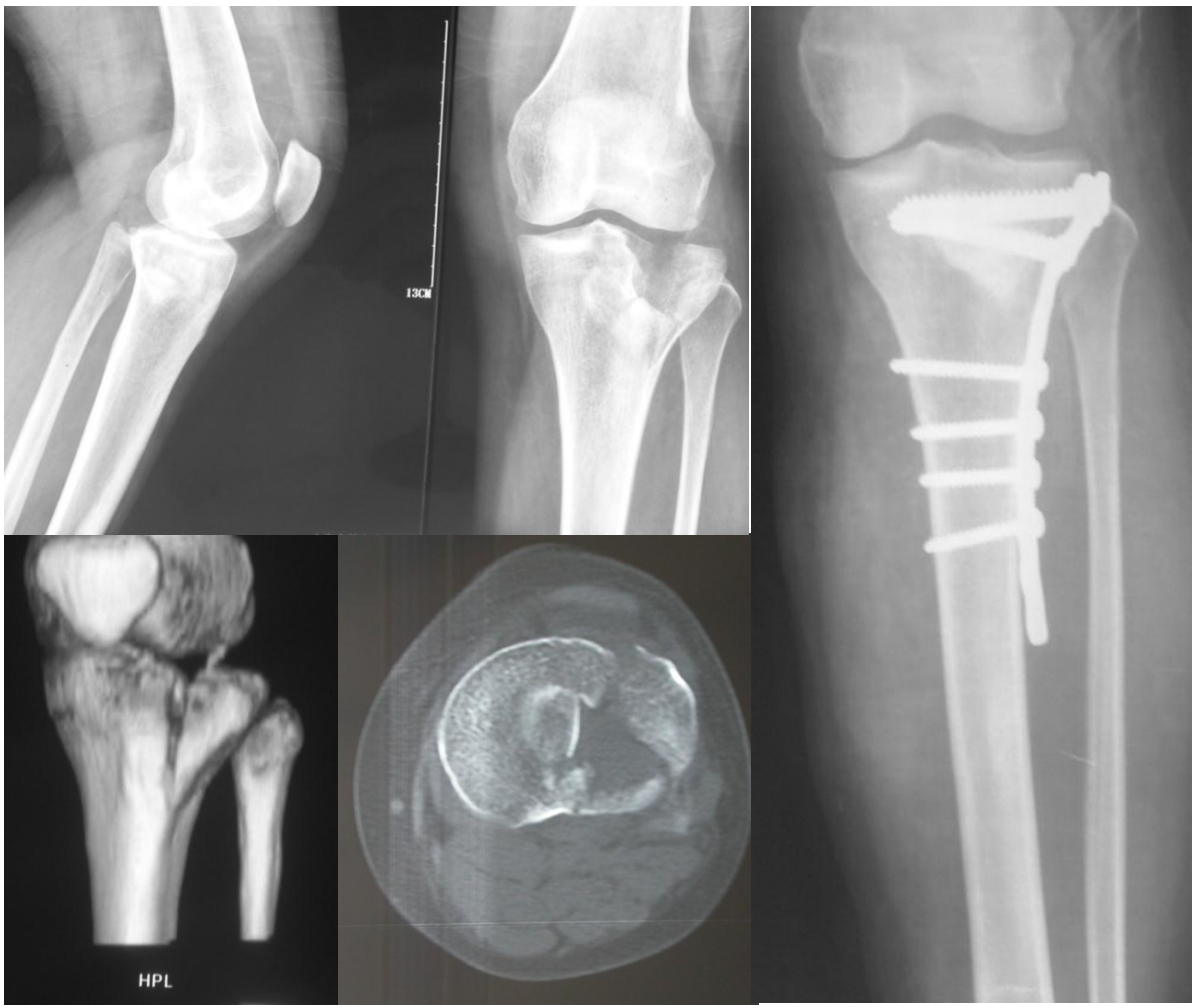
Technique: Articular surface reduced from underneath (bone tamping); Metaphyseal window is required; Bone grafting and raft screws

Control: Fluoroscopy and/or Arthroscopy

Kfuri & Schatzker - 2018

Lateral column fracture

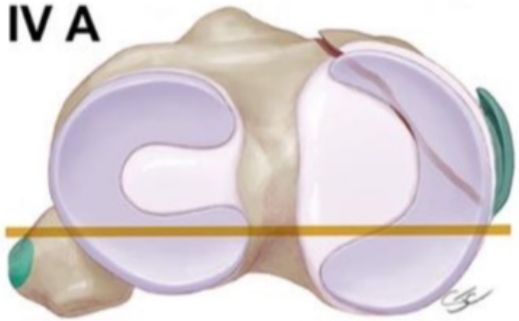
Valgus extension mechanism



Type IV - Medial Condyle

Schatzker - 1974

IV A

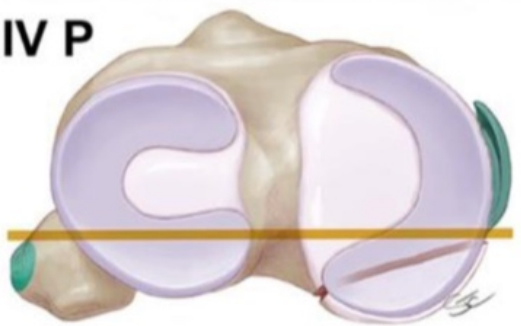


Area of instability: Anteromedial

Approach: Anteromedial

Technique: Anteromedial buttress

IV P

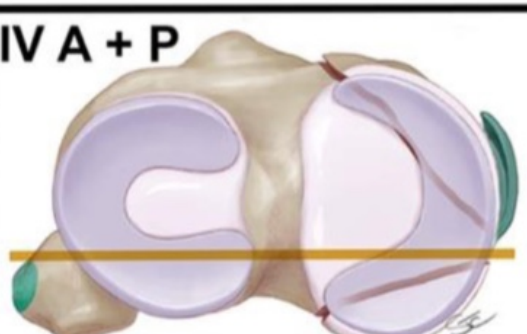


Area of instability: Posteromedial

Approach: Posteromedial

Technique: Posteromedial buttress

IV A + P



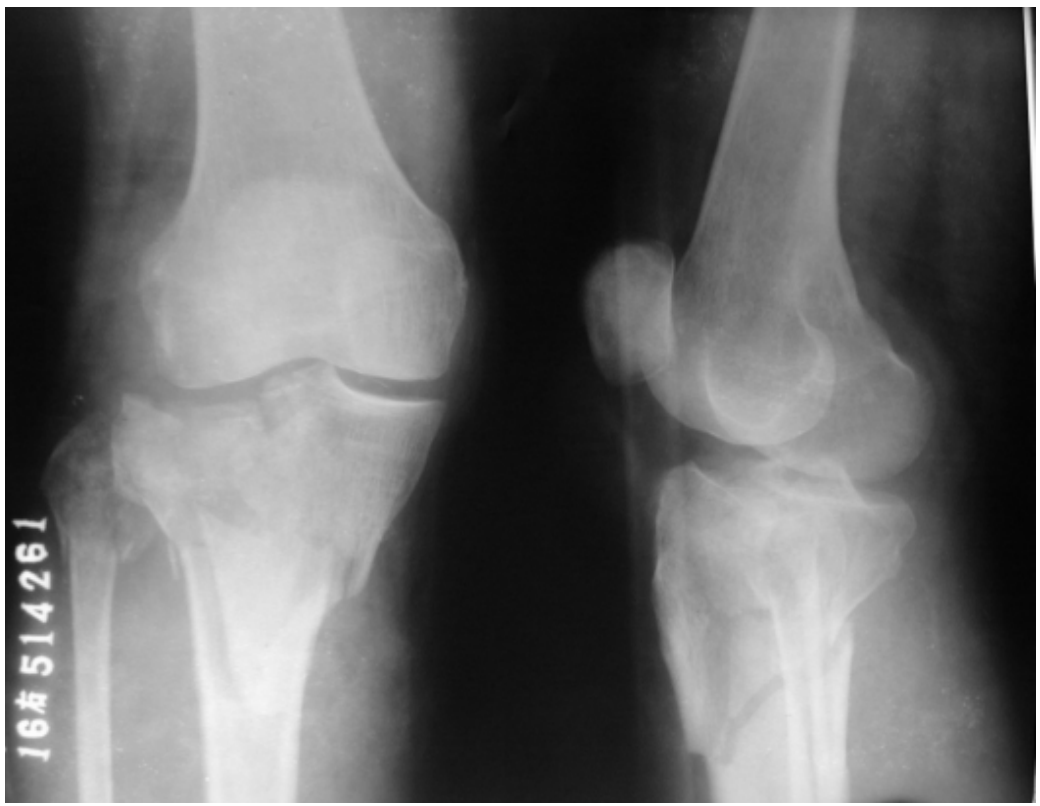
Areas of instability:
Anteromedial and Posteromedial

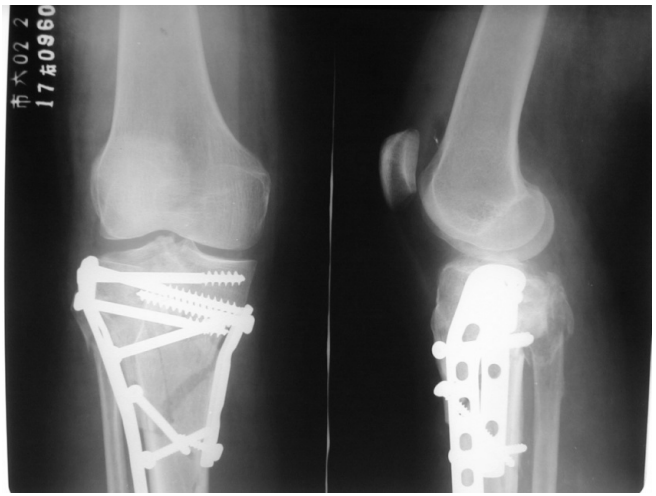
Approach: Extended direct medial

Technique:
Anteromedial and posteromedial buttress

Kfuri & Schatzker - 2018

Schatzker type V, VI—2 or 3-column fracture



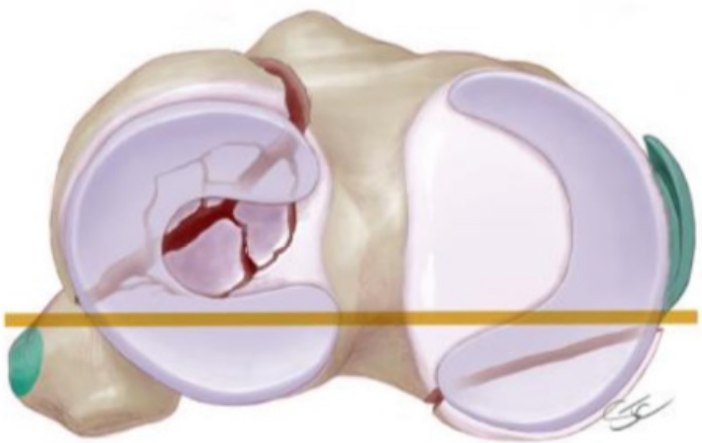


Dual plating

Type V: Bicondylar

Schatzker - 1974

V AL + PM



Kfuri and Schatzker - 2018

This is the most typical type V variation

Areas of instability:
Anterolateral and Posteromedial

Surgical approaches:
Anterolateral and Posteromedial

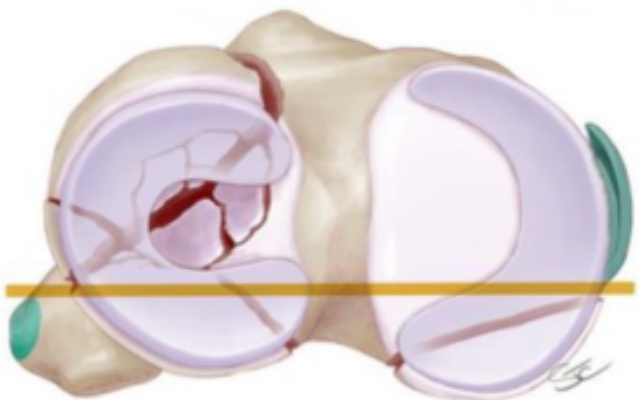
Technique:
Anterolateral and posteromedial buttress

***In bycondilar fractures one should check each one of the quadrants, as multiple combinations may occur**

Type VI - Bycondilar and Shaft Dissociation

Schatzker - 1974

Type VI AL + PL + PM



Kfuri & Schatzker - 2018

How does the Type VI differ from Type V?

Type VI has two main areas of instability:

Epiphyseal/Articular: lack of continuity of the tibial rim

Meta-Diaphyseal: length and rotation

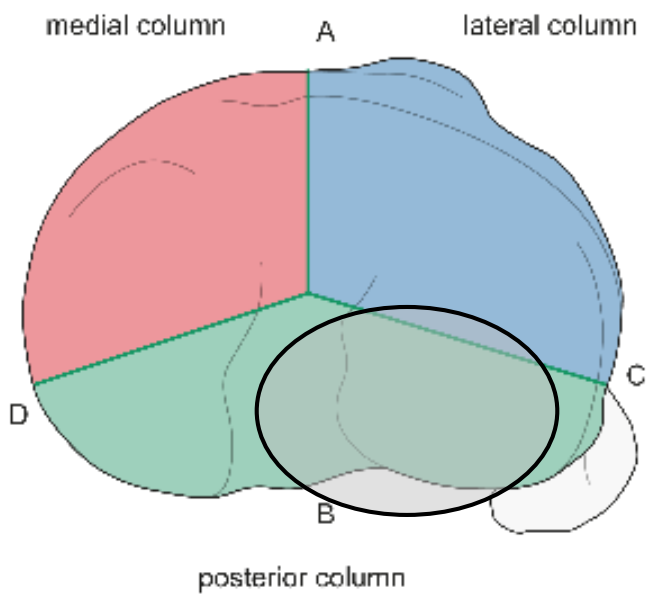
Approaches in this case: Posteromedial and extended anterolateral

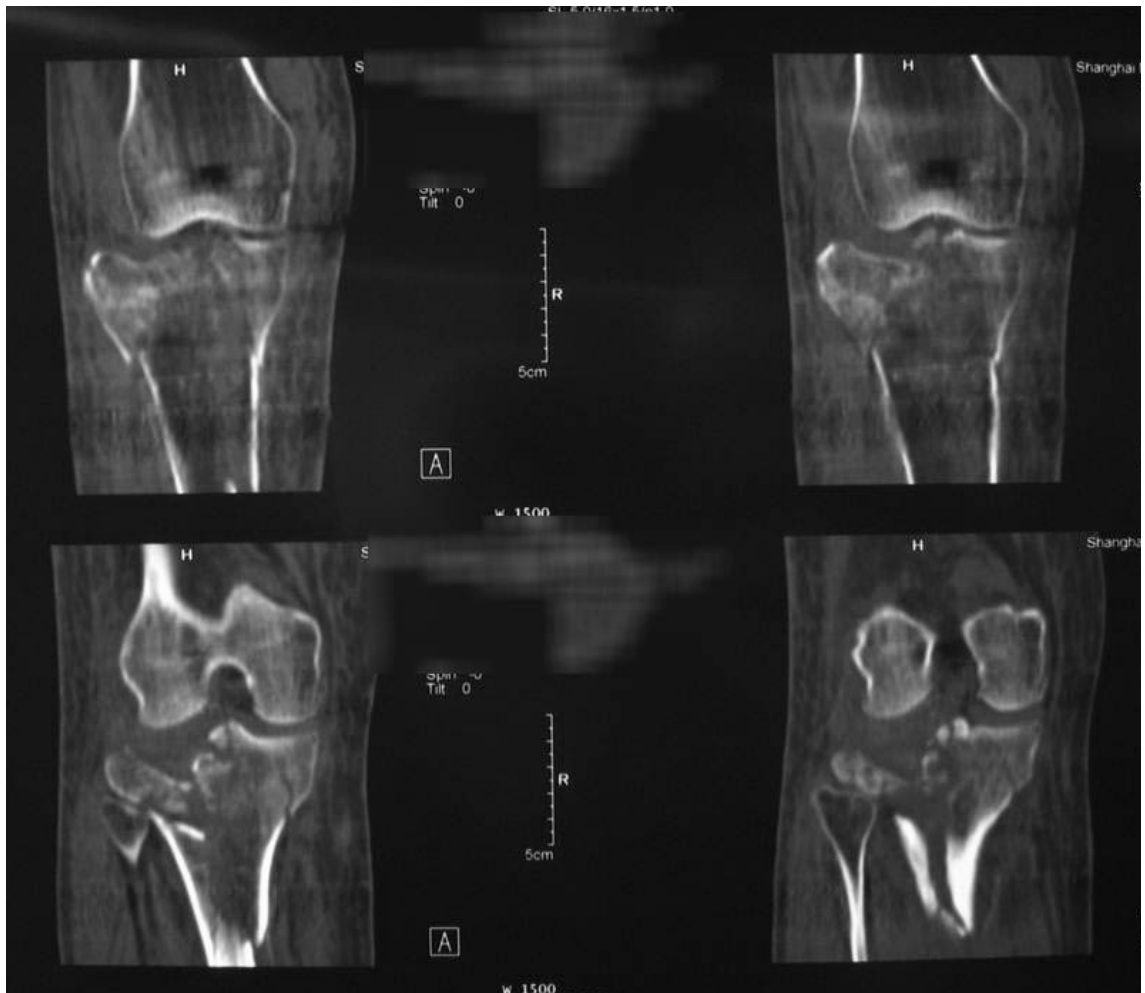
Articular instability: Restore the continuity of the rim and buttress AL, PL, and PM

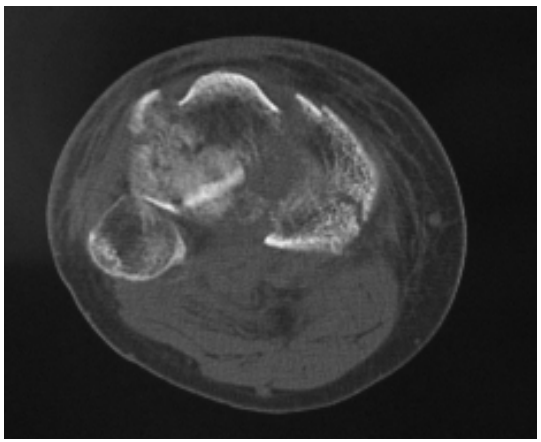
Shaft instability: Restore length, rotation, and alignment. Technique: Bridging plate

3-column fracture

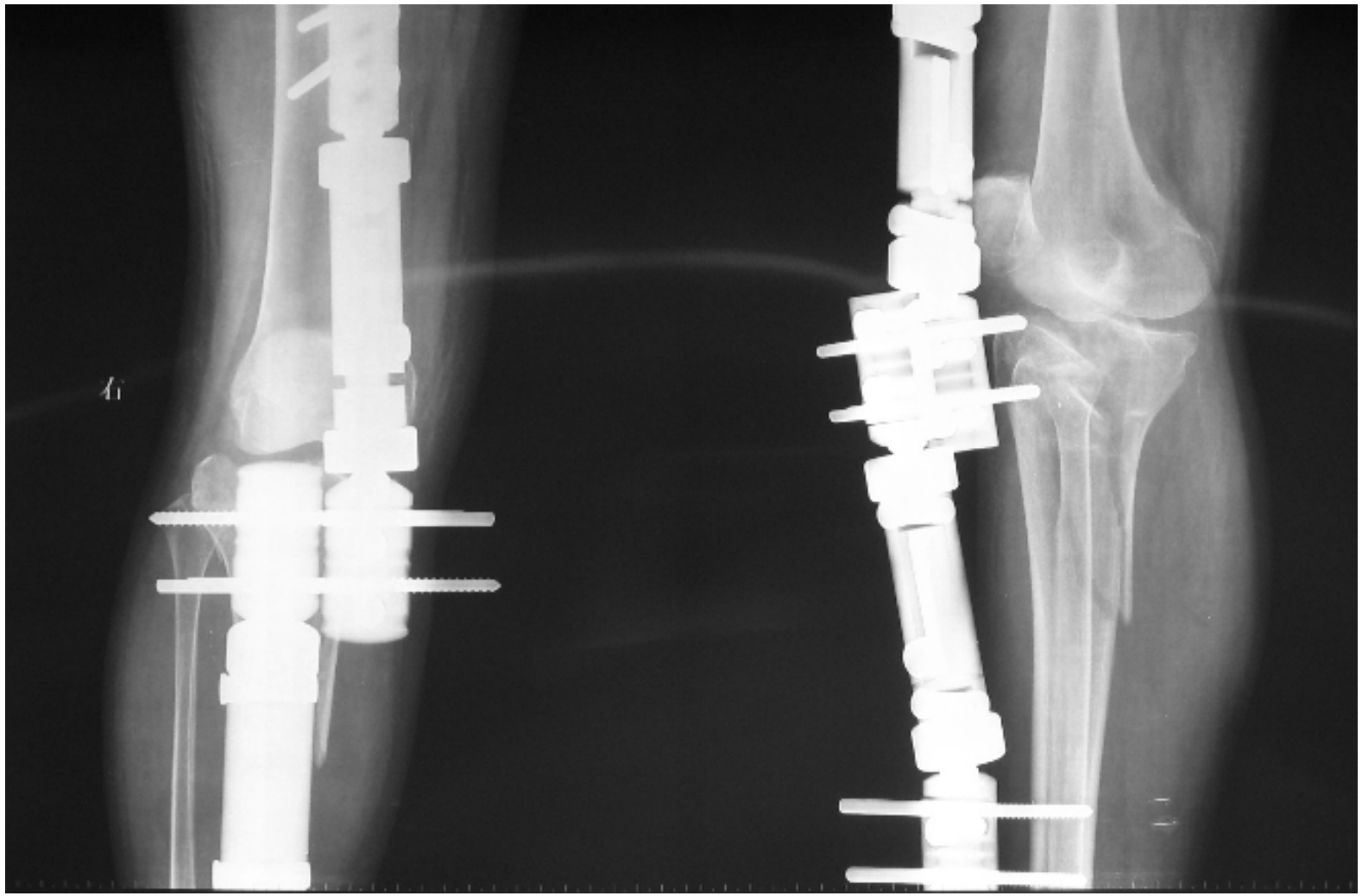
Flexion varus mechanism



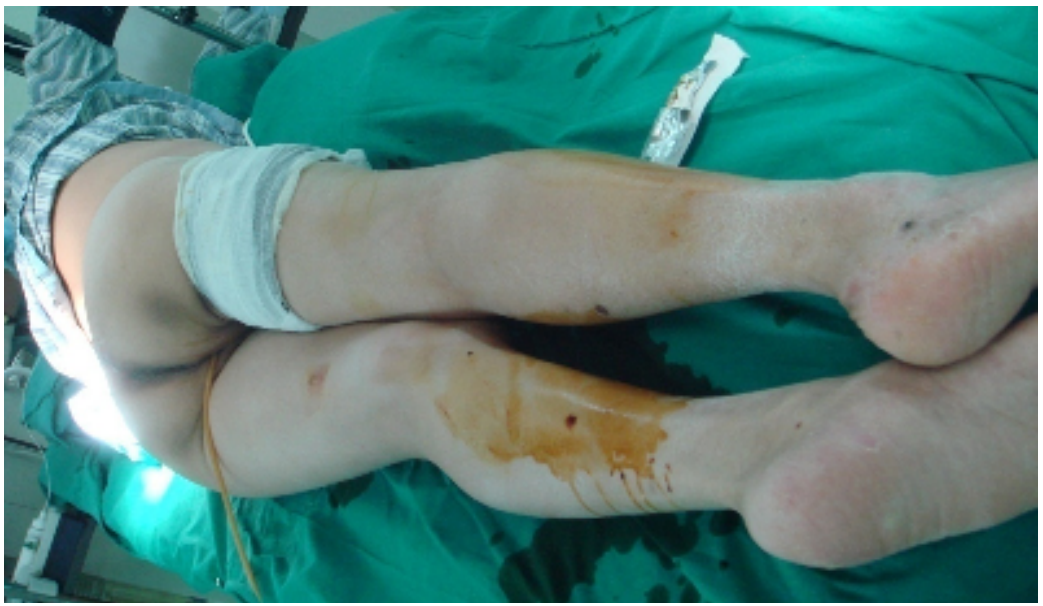

H
S
H
Tilt 0
R
5cm
A
H
H
Tilt 0
R
5cm
A
W 1500
C 450 SL 2.0

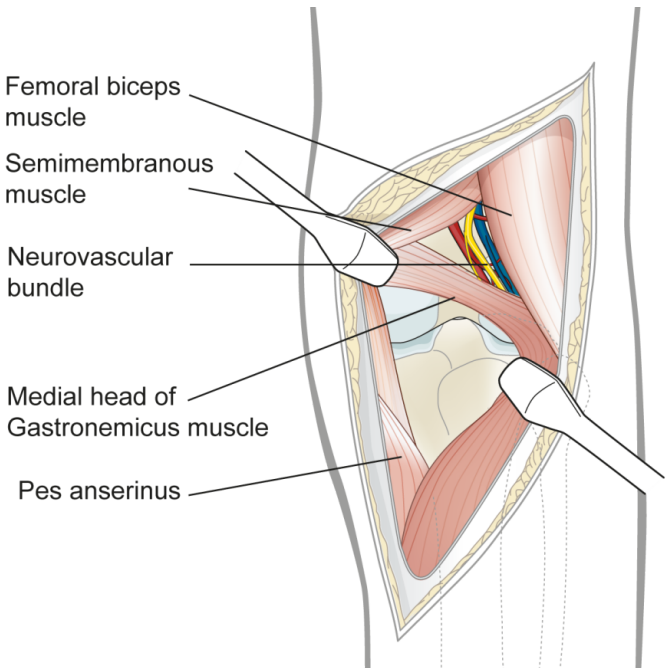


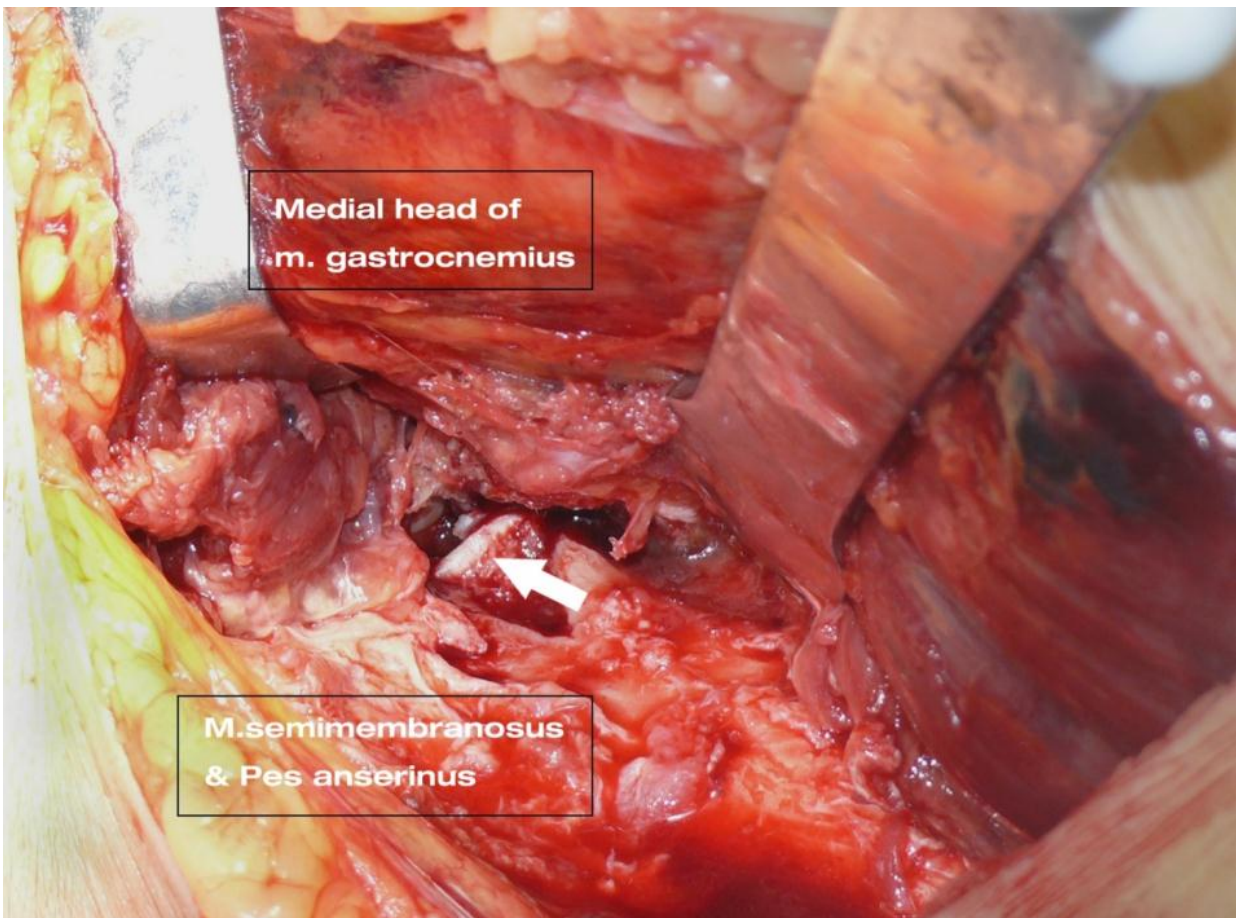

F

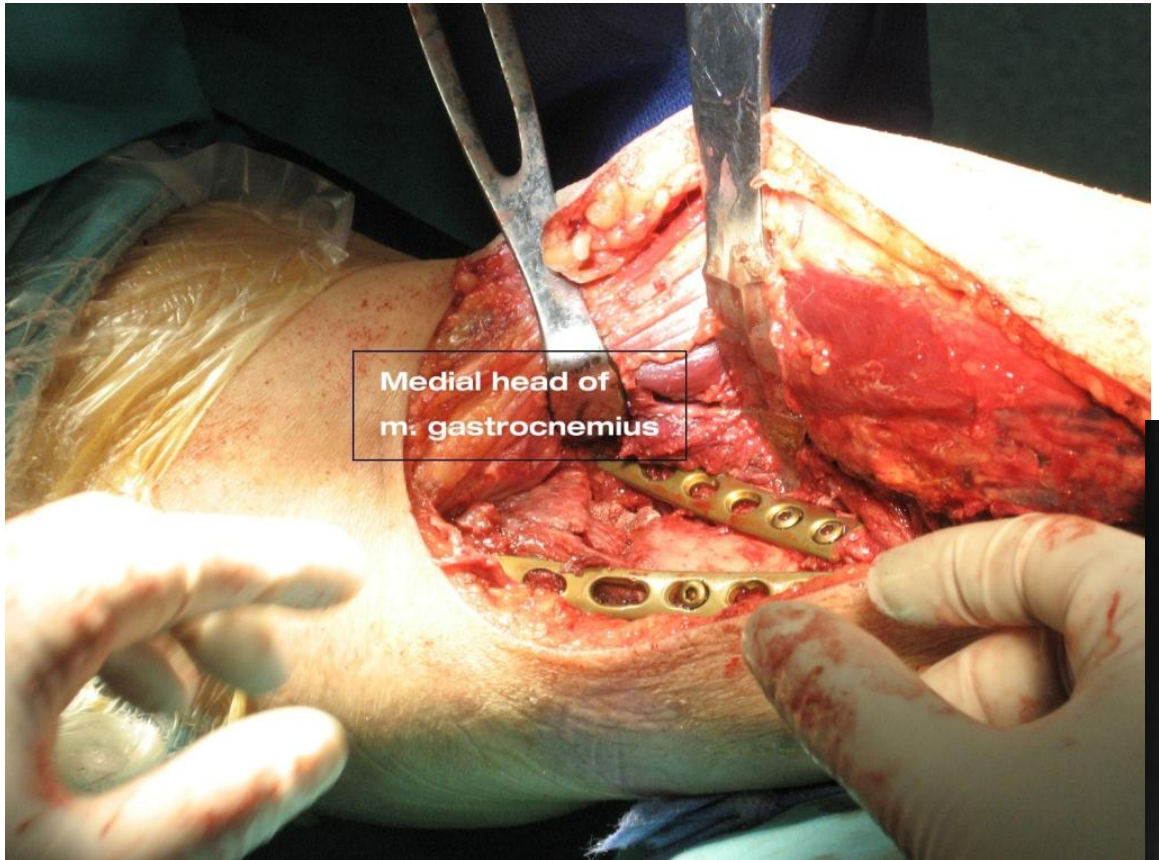


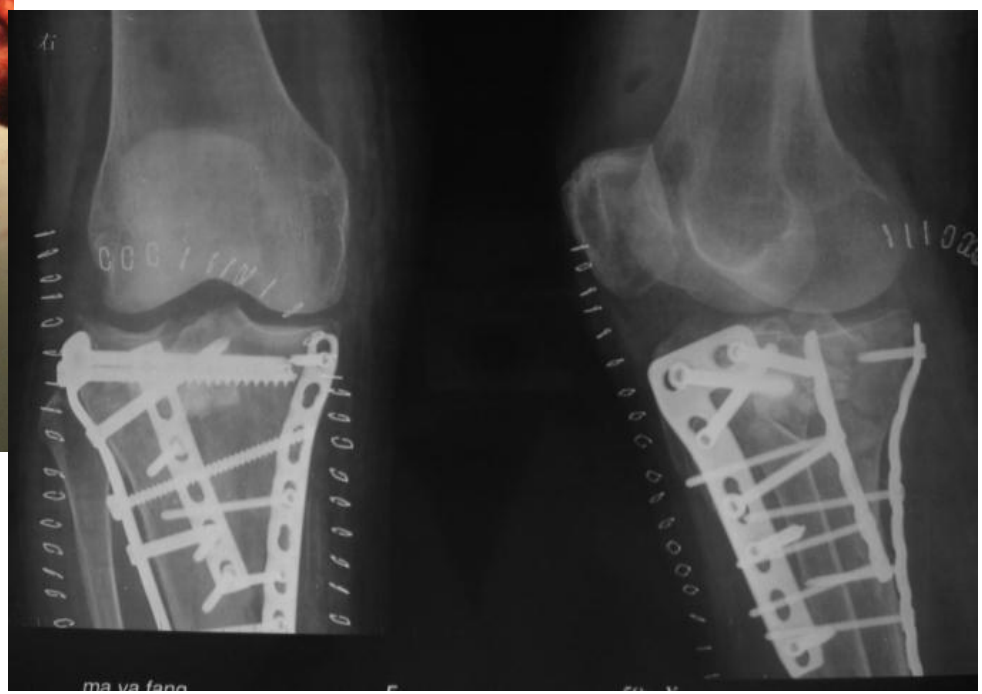
Floating position




Femoral biceps muscle
Semimembranous muscle
Neurovascular bundle
Medial head of Gastronemicus muscle
Pes anserinus


Medial head of
m. gastrocnemius
M.semimembranosus
& Pes anserinus


Medial head of
m. gastrocnemius




R
lat

Take-home messages

- Fully understanding the fracture is essential for decision making and definitive fixation
- Approach selection and fixation should consider the soft tissue, mechanism of injury, and 3D morphology
- 3D classification and injury mechanism provides a new way of thinking for the treatment of tibial plateau fractures