Tibial Plateau Fracture

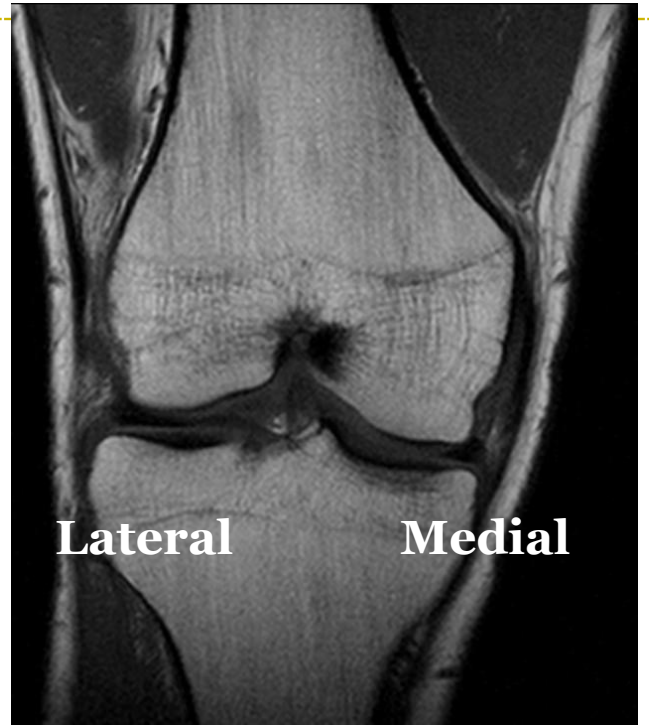
Dr Houssemeddine Kouki

Epidemiology

- Incidence
  - 1-2% of all fractures
  - 10.3 per 100,000 people annually
- Demographics
  - mean age 52
  - bimodal distribution
  - males in 40s (high-energy trauma)
  - females in 70s (low energy falls)
- Location
  - lateral plateau 70-80%
  - bicondylar 10-30%
  - medial plateau 10-20%

Anatomy

- lateral tibial plateau
  - convex in shape
  - proximal to the medial plateau
  - less dense bone
- medial tibial plateau
  - concave in shape
  - distal to the lateral tibial plateau
- Biomechanics
  - medial tibial condyle bears 60% of load through knee
  - lateral tibial condyle bears 40% of load through knee

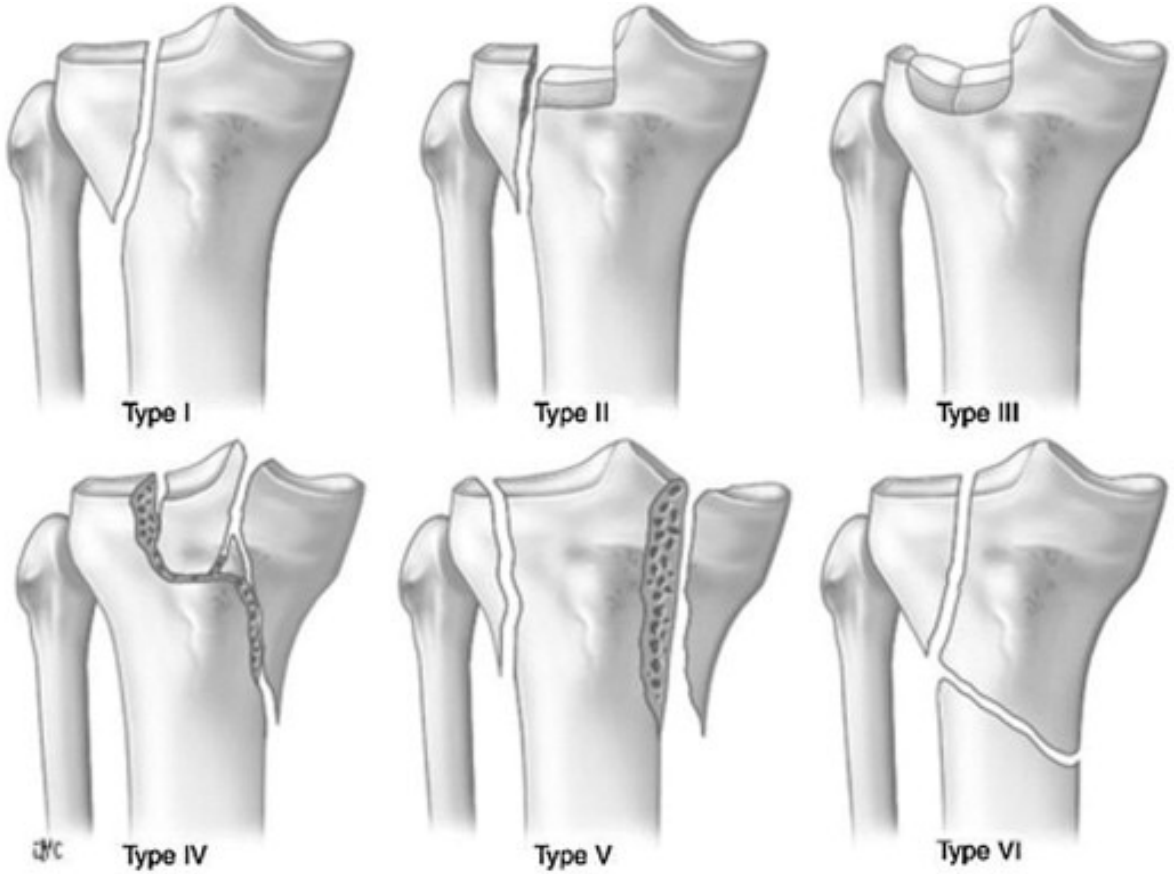


Mechanisms

- valgus load
  - lateral plateau
- varus load
  - medial plateau
- axial load
  - bicondylar
- combination
  - fracture dislocation
  - high energy
  - usually medial-sided plateau fractures
  - frequently associated with soft tissue injuries
- low energy
  - usually lateral plateau fractures

Classification

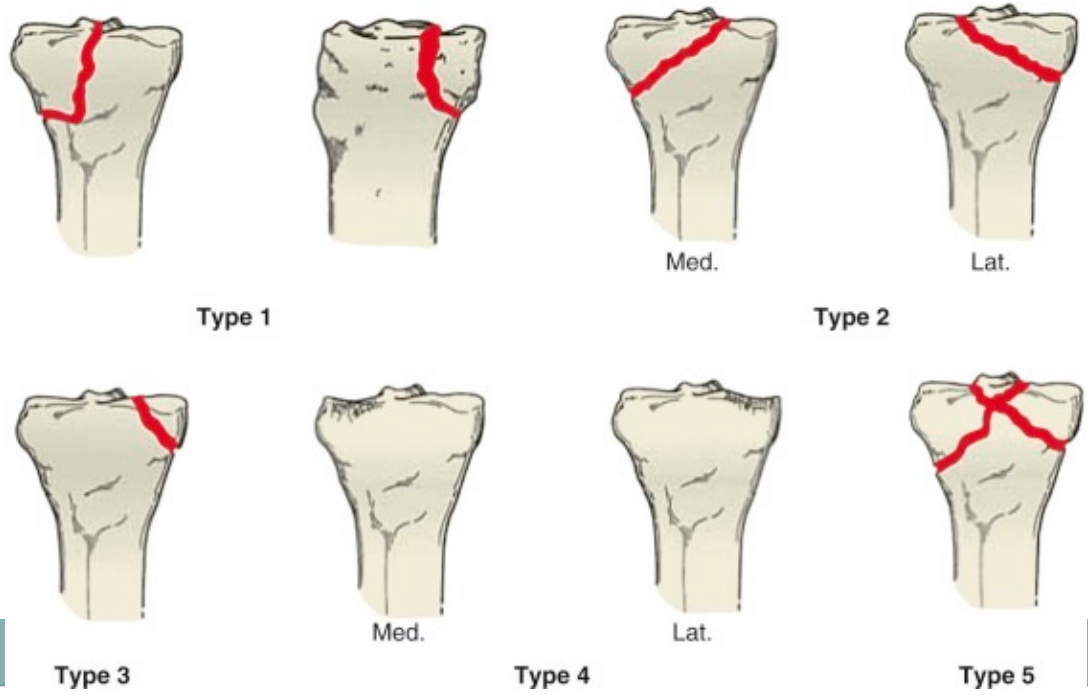
- Schatzker classification



Classification

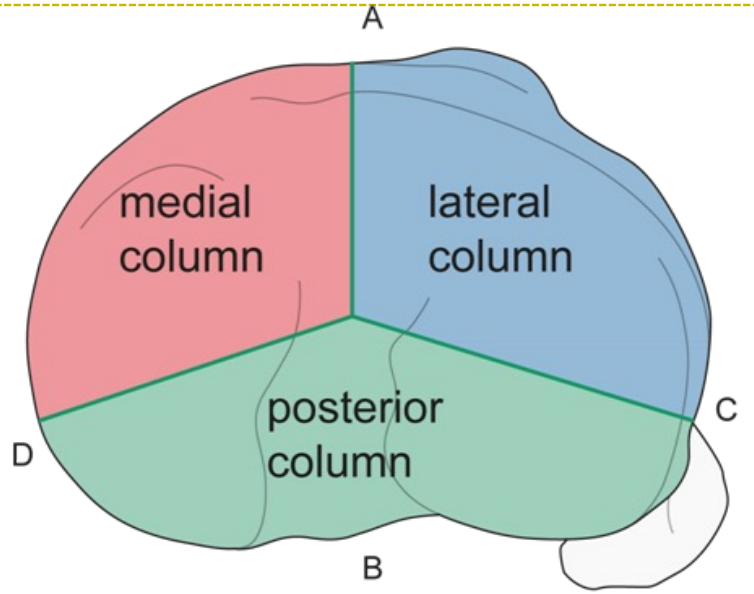
Hohl and Moore Classification

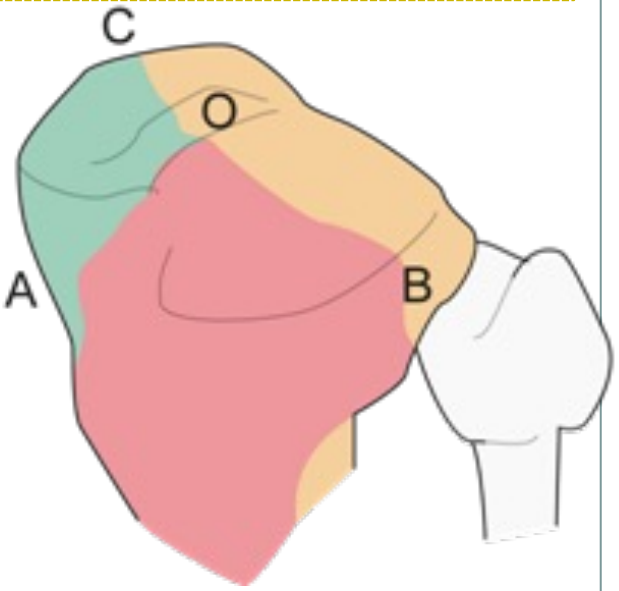
- Useful for true fracture-dislocations
- fracture patterns that do not fit into the Schatzker classification (10% of all tibial plateau fractures)
- fractures associated with knee instability



Classification

- 3-column concept
- utility :
  - includes posterior plateau fractures that are not considered in Schatzker classification
  - helps determine fixation strategy





Associated injuries

- meniscal tears
  - lateral meniscal tear
  - more common than medial
  - associated with Schatzker II fracture pattern
  - associated with >10mm articular depression
  - associated with >6mm condylar widening
- medial meniscal tear
  - most commonly associated with Schatzker IV fractures
- ACL injuries
  - more common in type IV and VI fractures (25%)

Associated injuries

- compartment syndrome
  - associated soft tissue injuries have little bearing on final outcomes
- neurovascular injury
  - commonly associated with Schatzker IV fracture-dislocations
  - common peroneal nerve is most common nerve injury

Physical exam

- Anamnèse
  - mechanism of injury : high-energy vs low-energy
  - unable to bear weight after injury
  - baseline functional status
  - comorbidities

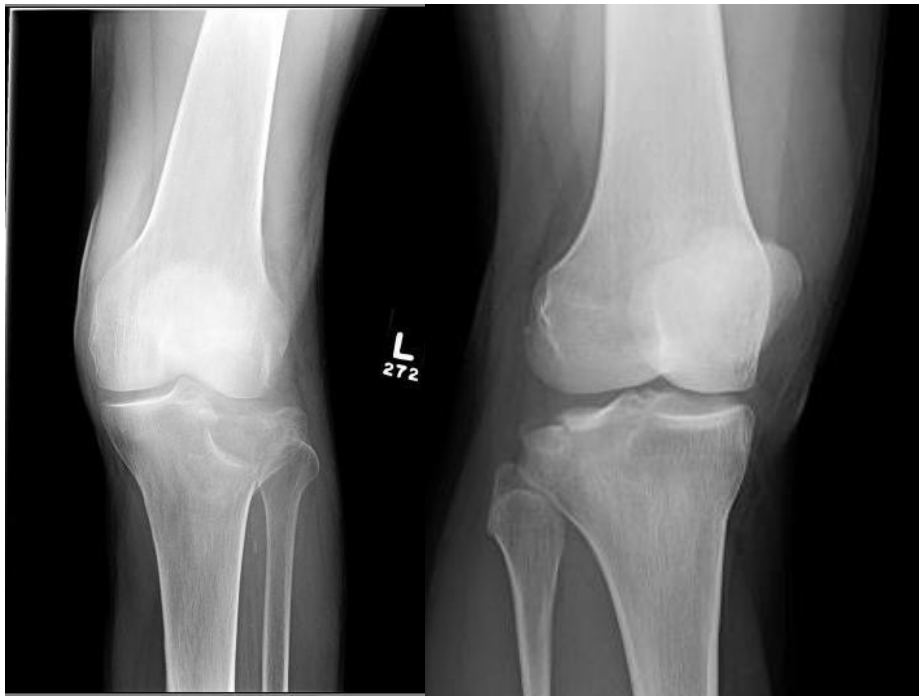
- Physical exam
  - inspection
    - look circumferentially to rule-out an open injury
    - assess soft-tissues for timing of operative intervention
  - palpation
    - evaluate for compartment syndrome

Physical exam

- varus/valgus stress testing
  - any laxity >10 degrees indicates instability
  - often difficult to perform or deferred in acute setting given pain
  - stability assessed in full extension
- neurovascular exam
  - perform ankle-brachial index if any asymmetry in pulses
  - ABI <0.9 proceed with arteriogram
  - assess tibial and common peroneal nerve function

Radiography

- recommended views
  - AP
  - lateral
  - oblique helpful to determine amount of depression
- optional views
  - plateau view
  - 10 degree caudal tilt to match posterior tibial slope

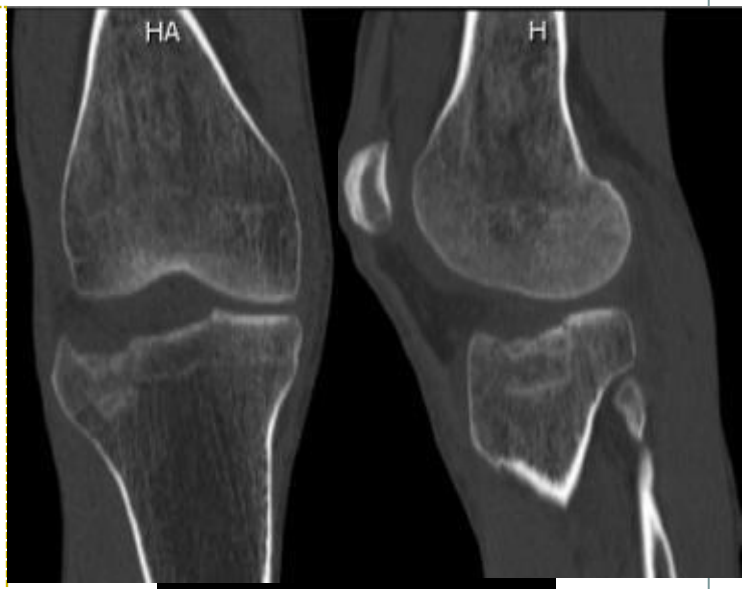


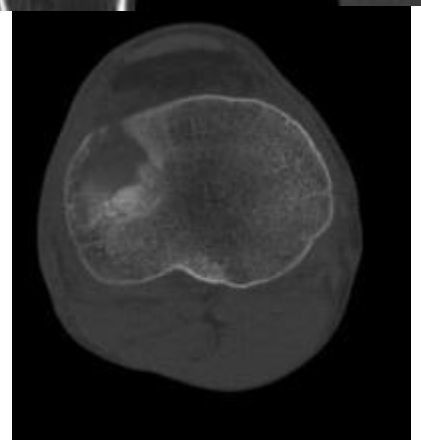
Radiography

- findings
  - on AP
    - depressed articular surface
    - sclerotic band of bone indicating depression
    - abnormal joint alignment
    - fracture plane involving medial/lateral plateau
  - on lateral
    - posteromedial fracture lines must be recognized
    - abnormal tibial slope

CT Scan

- indication
  - negative radiographs with high index of suspicion for tibial plateau fracture
  - preoperative planning
  - obtain after ex-fix if definitive fixation delayed if soft-tissues are not amenable for surgery
- findings
  - articular depression
  - degree of comminution
  - fracture plane and location
  - posterior coronal split fracture best appreciated on axial and sagittal views





MRI

- Identify meniscal and ligamentous pathology
- occult fractures

Treatment

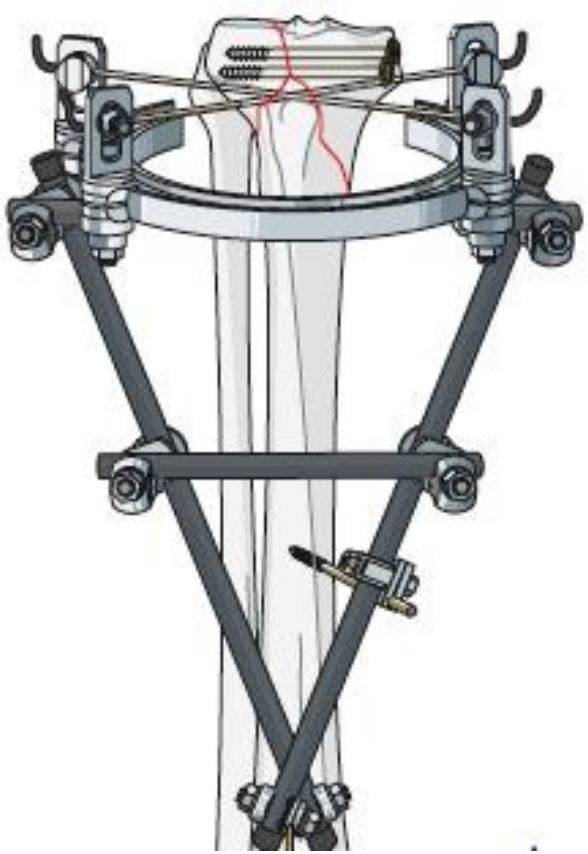
- Nonoperative:
  - minimally displaced split or depressed fractures: articular depression < 5-10 mm
  - low energy fracture stable to varus/valgus alignment varus/valgus instability <10 deg
  - significant comorbidites that preclude surgical intervention
  - condylar widening < 5mm
- Chirurgical:
  - Bridging external fixation with delayed ORIF
  - External fixation with limited open/percutaneous fixation of the articular segment
  - ORIF
  - Arthroscopically assisted reduction and internal fixation
  - Arthroplasty

Bridging external fixation with delayed ORIF

- indications
  - severe open fracture with marked contamination
  - highly comminuted fractures where internal fixation not possible
  - Fracture / Dislocation
- advantages
  - allows soft tissue swelling to decrease before definitive fixation
  - decreases rate of infection and wound healing complications
  - restores length and alignment which helps to better characterize fracture on preop CT

External fixation with limited open/percutaneous fixation

- technique
  - reduce articular surface either percutaneously or through small incisions
  - stabilize reduction with percutaneous lag screws or wires
- pros
  - minimizes soft tissue insult
- cons
  - pin site complications
  - arthrofibrosis
    - incidence as high as 15% after temporizing external fixator
  - high malunion rates



ORIF

- indications
  - articular depression > 5-10 mm
  - condylar widening > 5mm
  - varus/valgus instability >10 deg
  - medial plateau fractures
  - bicondylar fractures
- timing
  - acute ORIF
    - Lower-energy fractures with mild swelling
  - temporizing knee-spanning external fixation w/ delayed ORIF
    - significant soft tissue injury/swelling
    - polytrauma

ORIF

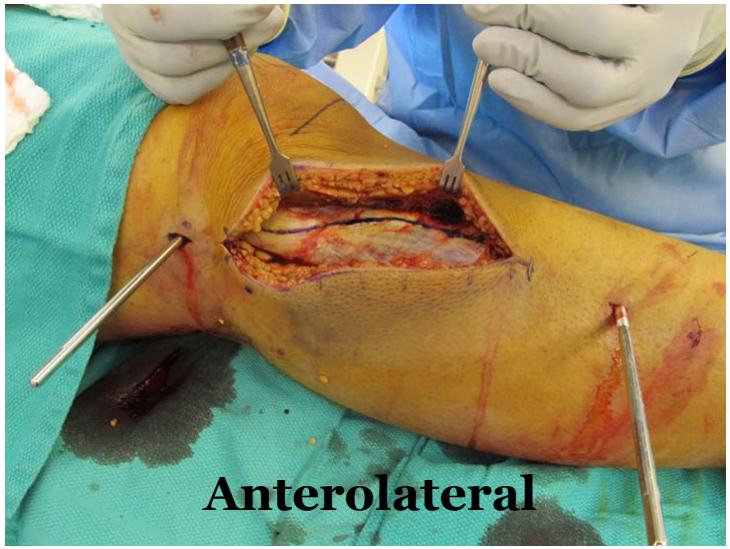
Objectifs

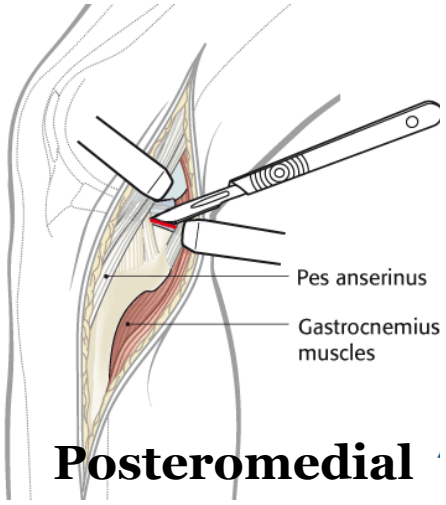
- restore alignment
  - coronal
  - sagittal
  - tibial slope
- normal condylar width
- congruent articular surface
- stable knee
- minimize additional soft tissue trauma

ORIF

Voies d'abords

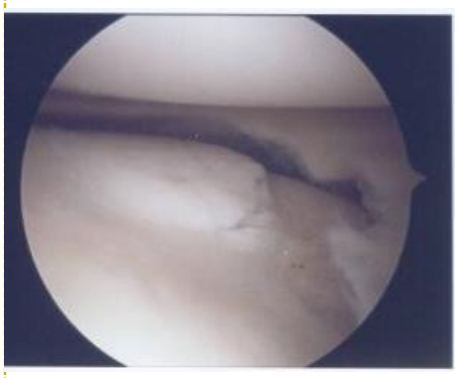
- Anterolateral
  - Lateral plateau involvement
  - Combination with medial for complex plateau
- Posteromedial
  - Medial plateau
  - Coronal split
- Posterolateral
- Posterior
- Dual approaches
- Anterolateral
- Posteromedial

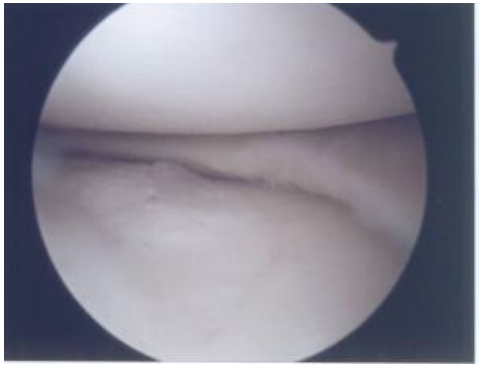




ORIF

- Reduction (direct or indirect)
  - open fracture split and elevate ("open the book")
  - create cortical window and elevated with bone tamps
- Assess reduction
  - submeniscal arthrotomy, fluoroscopically , arthroscopically
- Fill metaphyseal void:
  - autograft
  - allograft (cancellous chips)
  - bone graft substitutes
    - calcium phosphate cement :
      - high compressive strength for filling metaphyseal void, less subsidence than ICBG, osteoconductive , biodegradable , highly porous



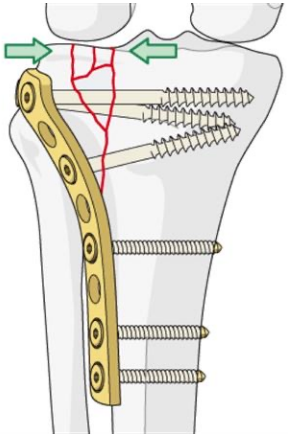


ORIF

- absolute stability constructs should be used to maintain the joint reduction
- screws
  - can be used in isolation: isolated depression or simple split fracture
  - often used in conjunction with plate fixation
- options
  - raft screws
    - placed in subchondral bone parallel to joint surface to support elevated articular fragments
  - lag screws
    - placed perpendicular to plane of split fractures

ORIF

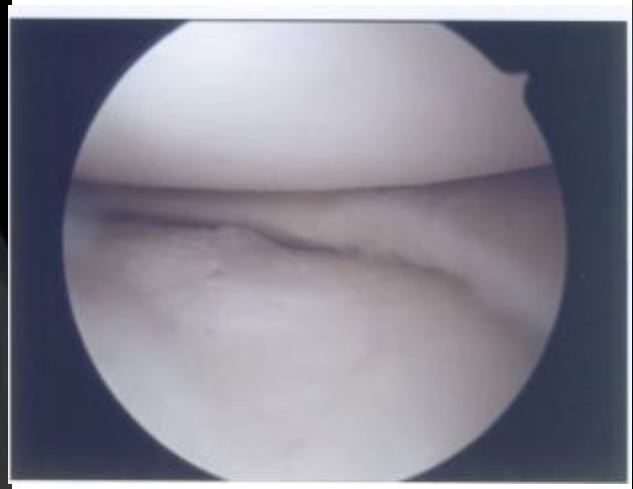
- conventional non-locking plates
  - buttress plates best indicated for partial articular fractures
    - posteromedial fractures
    - simple split
- peri-articular locking plates
  - fixed angle mitigates risk of varus collapse
    - comminuted fractures
    - osteoporotic bone



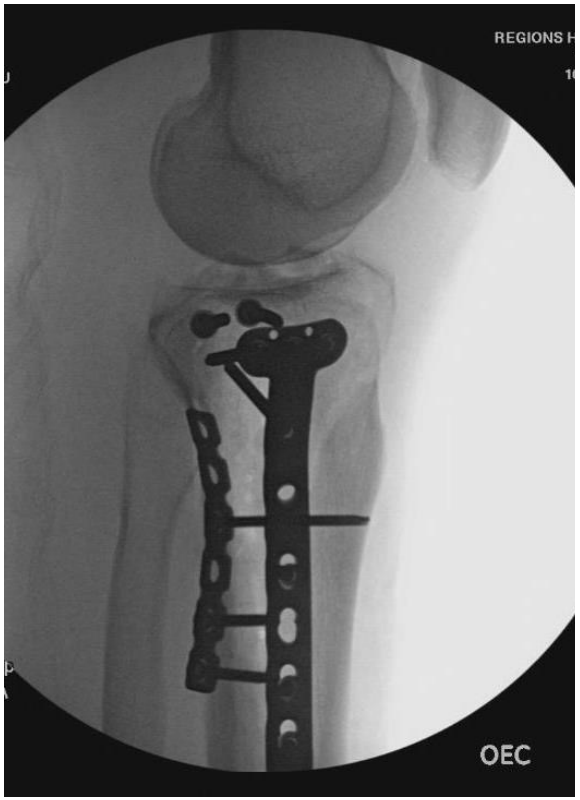
Schatzker I

Schatzker II

Schatzker III

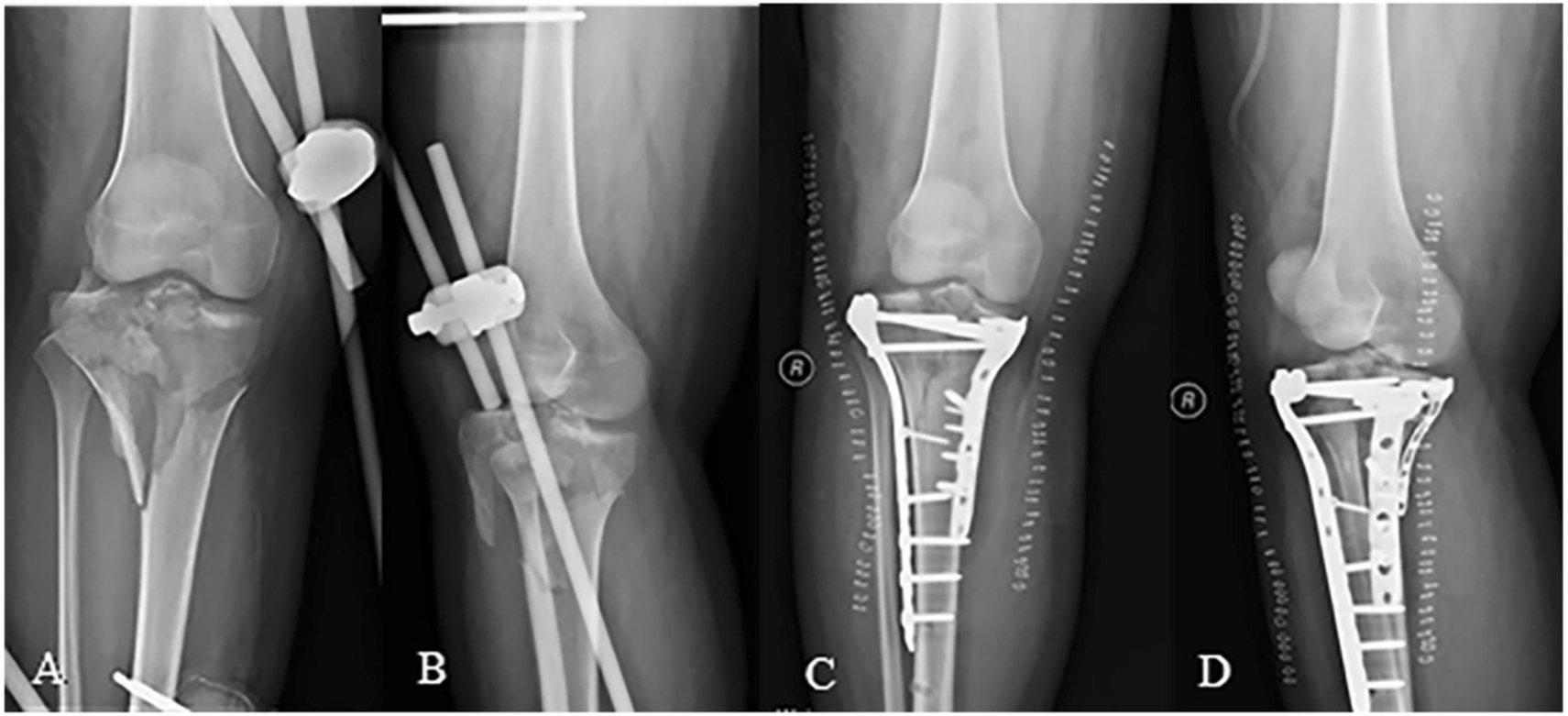


Schatzker IV



Schatzker V

Schatzker VI



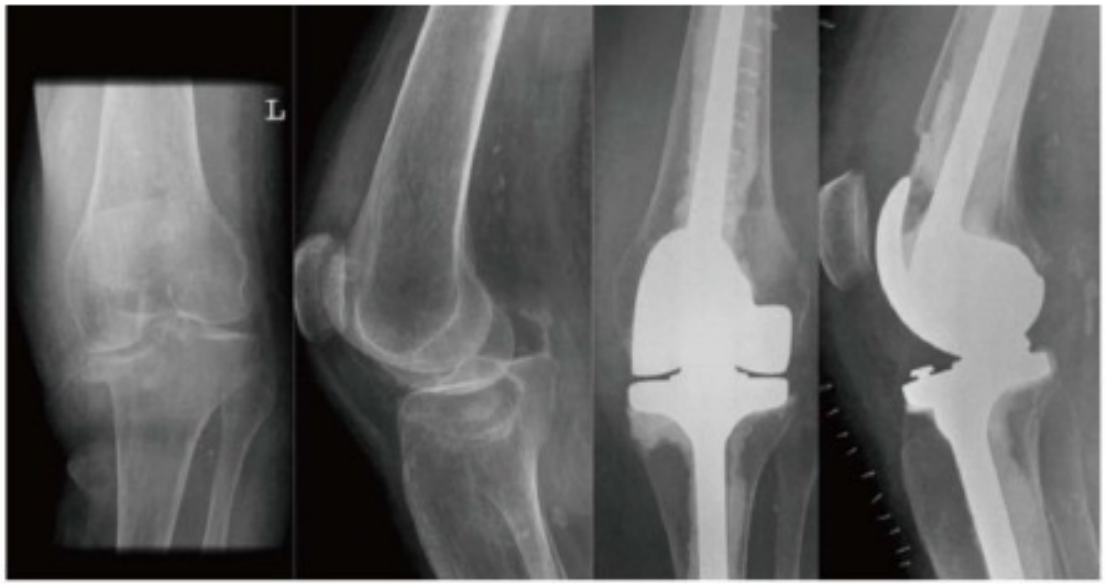
Schatzker VI

ORIF

- hinged knee brace with early passive ROM
- early passive range of motion
- non-weight bearing for 6 weeks followed by partial weight-bearing for further 6 weeks then weight-bearing as tolerated

Arthroplastie

- consider in patients >65-years-old with osteoporotic bone
- earlier time to weight bearing
- improved outcomes for primary TKA compared to TKA for failed ORIF



Complications

- Post-traumatic arthritis
  - Incidence: 25-35%
    - 3-7% undergo TKA at 10+ years
  - risk factors for arthritis
    - Meniscectomy, malalignment > 5 deg, instability, bicondylar fracture
- Compartment syndrome
  - Incidence: 7-20%
  - risk factors
    - Schatzker type IV, high-energy mechanism, associated fibula fracture, fracture length, associated plateau-shaft injury
- Loss of reduction
  - Incidence: 5-30%
  - risk factors
    - inadequate fixation, severity of fracture, osteoporosis

Complications

- Knee stiffness
  - Incidence :10-25%
  - risk factors
    - increasing age, higher BMI, severity of fracture, prolonged immobilization, involvement of tibial eminence, polytrauma
- Infection
  - incidence : 2-11%
  - risk factors
    - poor surgical timing based on swelling, open fractures, longer operative time
- Nonunion/malunion
  - incidence
    - 2-4%
    - uncommon due to rich blood supply of cancellous bone
  - risk factors
    - Schatzker type VI (metaphyseal-diaphyseal junction)
    - comminution
    - unstable fixation

Take home message

- Understand the fracture pattern
- Respect the soft tissues
- Partial articular (Schatzker 1-3)
  - Buttress plates and/or interfragmentary screws
- Beware of medial plateau (Schatzker 4)
- Complete articular (Schatzker 5,6)
  - External fixation
  - Preop plan
  - ORIF