Tibial Plateau Fractures

Pattern Recognition and Other Tips

Jarrod Dumpe, MD
Atrium Health Navicent
May 22nd, 2021

Acknowledgement: AO Archive

Disclosures and Acknowledgments

- Financial Disclosures:
  - None
- Committee Appointments:
  - OTA Classification and Outcomes Committee
  - OTA Opioid Task Force
- Acknowledgements:
  - AO Archives
  - Dr. Madhav Karunaker

Spectrum of Injury

70y/o s/p 2ft fall off step ladder

45 y/o s/p Motor Vehicle Crash

35 y/o s/p Motorcycle Crash

Objectives

- Mechanism of Injury
- Examination of the Patient
- Understand Associated Injuries
- Describe Characteristic Fracture Patterns
- Develop a Treatment Plan
- Complications

Mechanism of Injury

- Bimodal distribution:
  - Young adults in high-energy mechanisms
    - Falls from height
    - MVC
    - MCC
  - Elderly adults in low-energy falls

- Axial loading +/- valgus or varus load

- 6-degrees of motion of the knee creates the multitude of fracture variants

Patient Evaluation

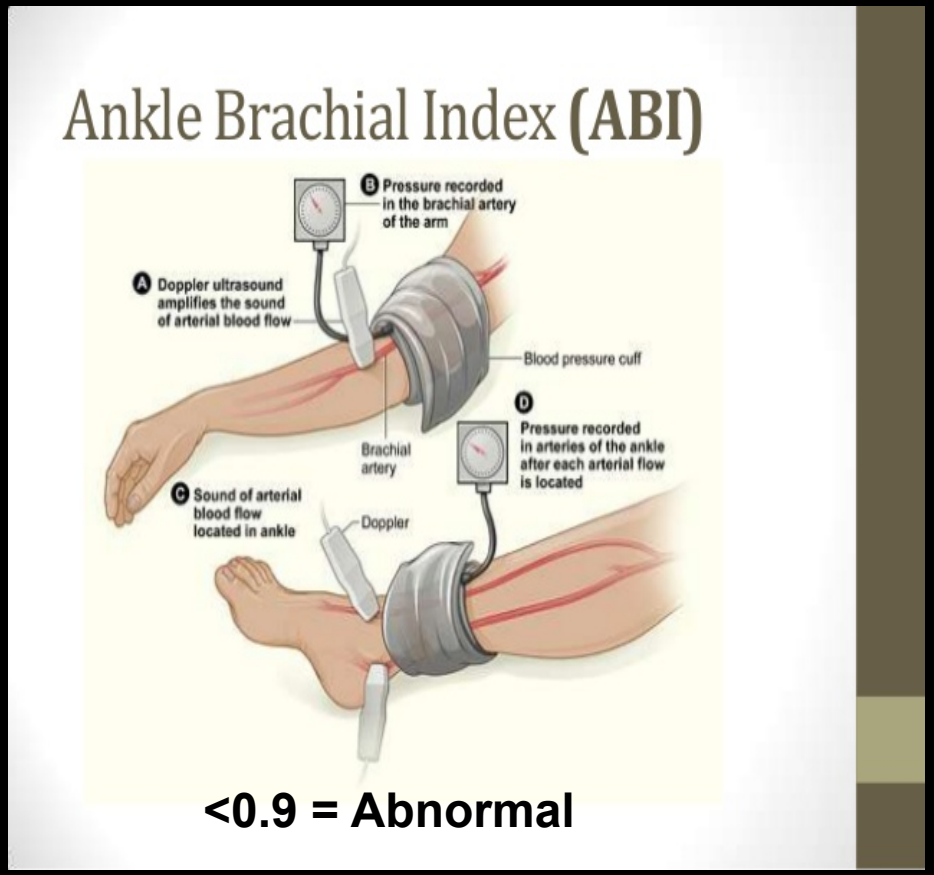
- Thorough History:
  - Mechanism
    - Will give you insights into possible other injuries
  - Age and bone quality
  - Smoking Hx
  - Diabetes
  - Vascular/Heart issues
  - Profession/Hobbies

Patient Evaluation

- Physical Exam:
  - Nerve exam
    - Check peroneal nerve function closely, especially in a varus injury
  - Vascular Exam
    - Thorough assessment to include ABIs if concerned
  - Skin/Muscle Exam
    - Look closely for open wounds/degloving injuries
    - Assess for Compartment Syndrome
  - Ligamentous Exam
    - May require Lidocaine injection. May need to be deferred until fracture stabilized

Associated Injuries

- Arterial Injury:
  - 3% risk in tibial plateau fxs
  - Can occur with any fracture but heightened concern with medial plateau fractures
  - Almost never present as hemorrhage but as intimal tears with thrombosis
  - ABIs should be done if at all concerned



- CTA if ABIs abnormal or indeterminate

Associated Injuries

- Compartment Syndrome:
  - 5 Ps (Pain out of Proportion, Pallor, Pulselessness, Parasthesias, Paralysis)
  - Documented risk about 2%
  - More common with Schatzker IV and VI, but can occur in any pattern
  - Surgical Emergency
  - Plan fasciotomy incisions with definitive fixation in mind.

Park S, Ahn J, Gee AO, et al: Compartment syndrome in tibial fractures. *J Orthop Trauma* 23(7):514–518, 2009.

Associated Injuries

- Skeletal Injuries:
  - Fibular head Fx: discussed in ligament section
  - Tibial Tubercle Fx:
    - Seen more commonly in Schatzker V and VI injuries
    - Extensor mechanism disrupted
    - Poor outcome if missed
    - Not captured by medial or lateral plates
  - Intercondylar Eminence Fx:
    - Have cruciate ligaments attached to them
    - Repair usually creates ligamentously stable knee

Associated Injuries

- Soft Tissue Injuries:
  - Meniscal Injuries
    - Seen in 50-90% of fractures
    - Peripheral detachments are the most common
    - The more displaced the fracture is, the more likely there is a tear (80% w displacement >5mm)

Gardner MJ, Yacoubian S, Geller D, et al: The incidence of soft tissue injury in operative tibial plateau fractures: a magnetic resonance imaging analysis of 103 patients. *J Orthop Trauma* 19(2):79–84, 2005

In 103pts, Stannard et al. found that 71% tore at least one major ligament and 53% tore multiple ligaments

Stannard JP, Lopez R, Volgas D: Soft tissue injury of the knee after tibial plateau fractures. *J Knee Surg* 23(4): 187–192, 2010. LOE II

Associated Injuries

- Cruciate Ligament Injuries
  - ACL injuries seen in 40-60% of fractures
  - PCL injuries seen in 20-40% of fractures
  - Most injuries are avulsion injuries

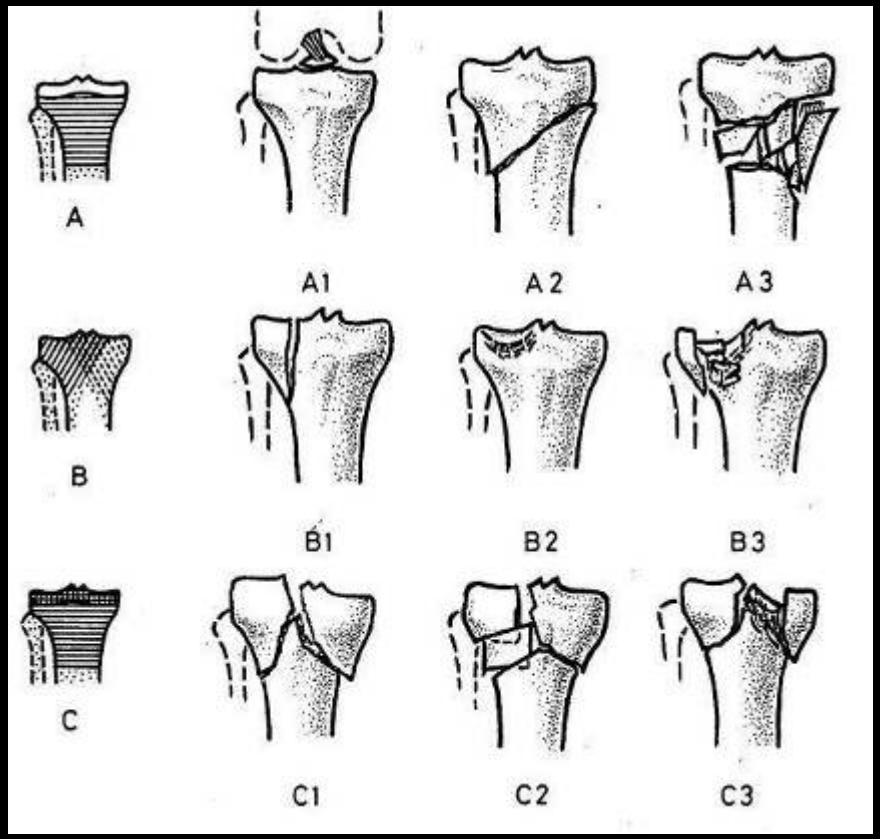
- Collateral Ligament/PLC Injuries
  - Wide variation in reported incidence
  - May be an indication to fix fibular head fractures
  - Repair at time of surgery if present

Associated Injuries

- Peroneal Nerve Injury
  - 3% documented risk with plateau fractures
  - Typically a stretch injury
  - Rarely recover completely
  - Not recommended to routinely explore acutely
  - Important to document preoperatively
    - Counseling the patient about recovery
    - Medico-legal reasons

AO Classification

- 4 = Tibia
- 1 = Proximal
- A = Extraarticular
- B = Partial articular
- C = Complete articular



Most common system to use for research

“Column/Fragment” Concept

Maybe the best for surgical planning

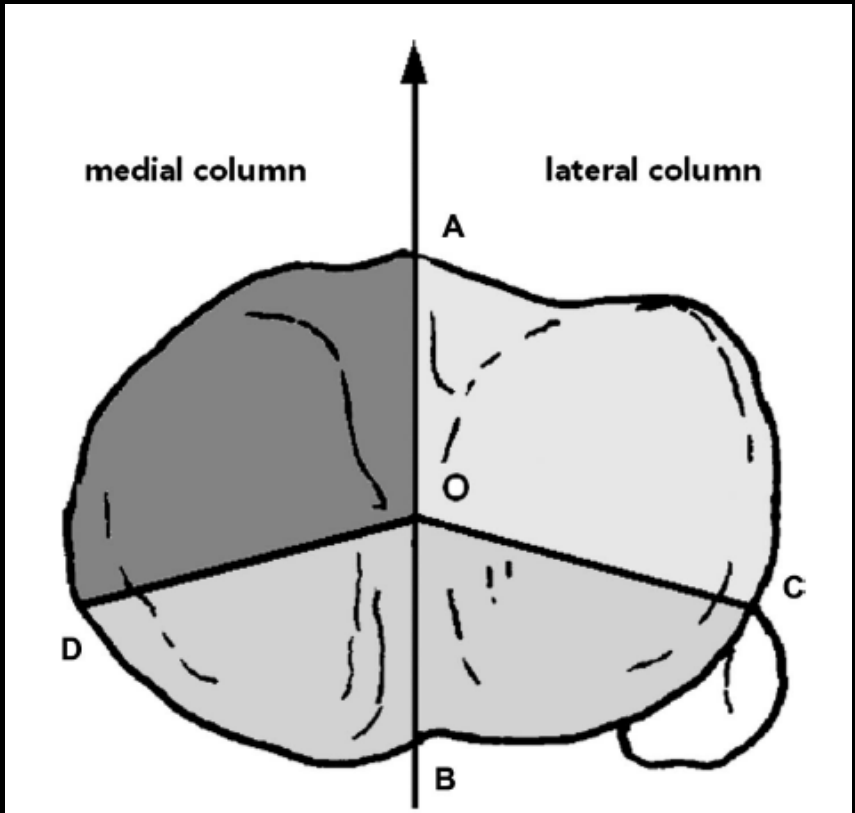
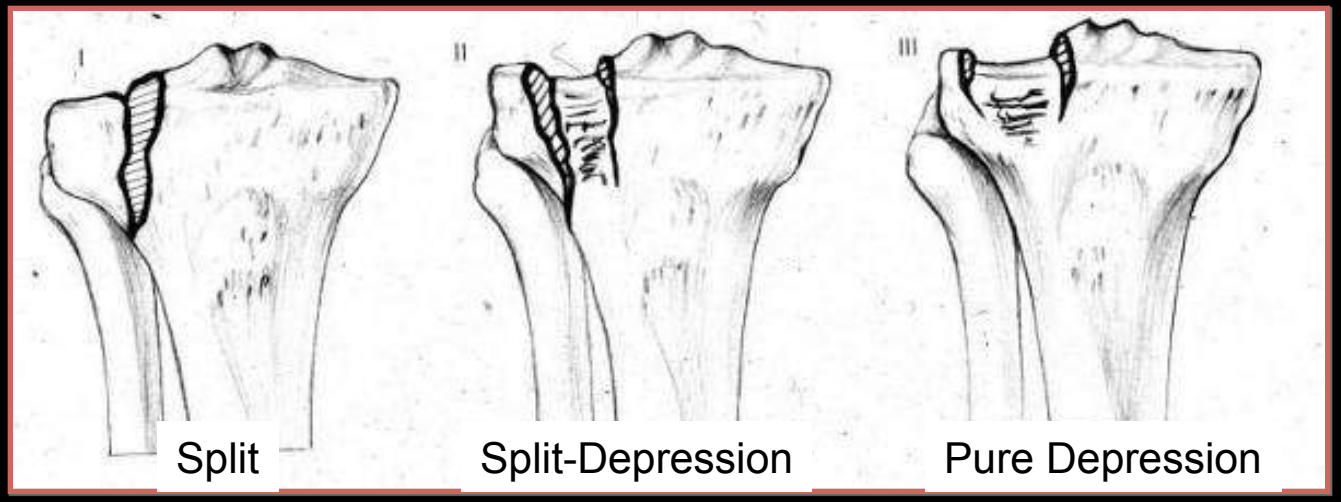


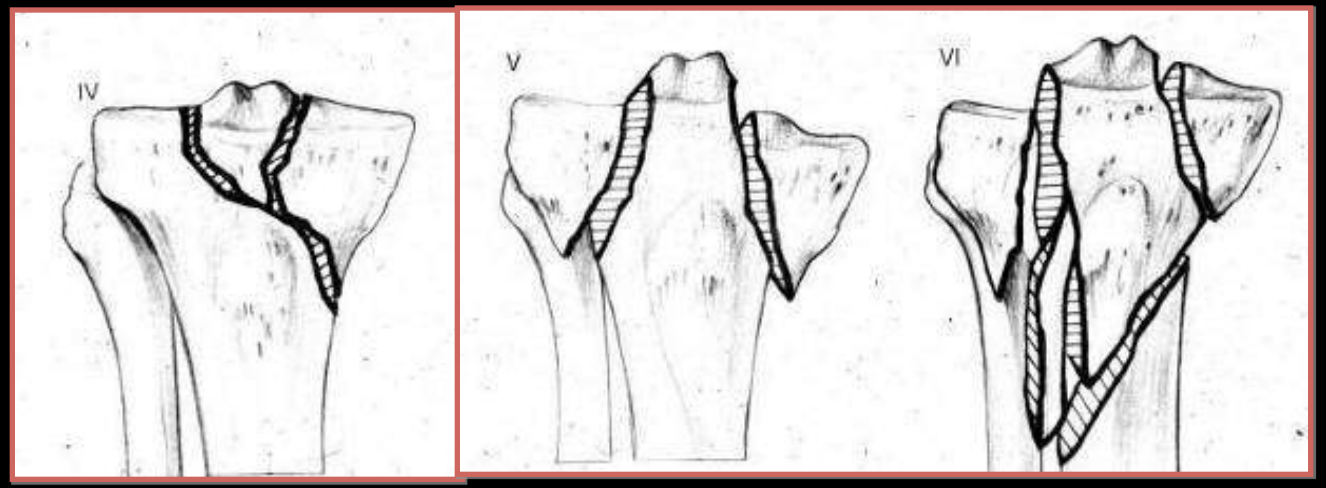
FIGURE 1. Three-column classification.

Luo et al. JOT 2010

Schatzker Classification



Split | Split-Depression | Pure Depression



Medial Split | Bicondylar | Metadiaphyseal dissociation

Best system to use to discuss with other Ortho-pedists

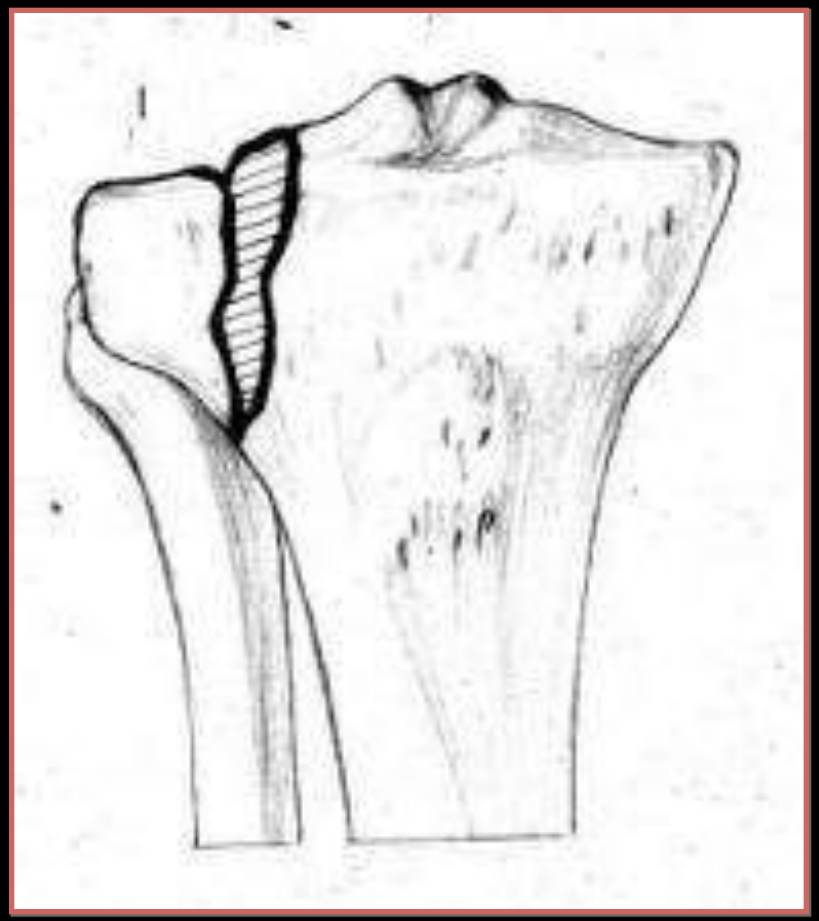
Wide Variation Fx Patterns

Schatzker VI

Schatzker VI

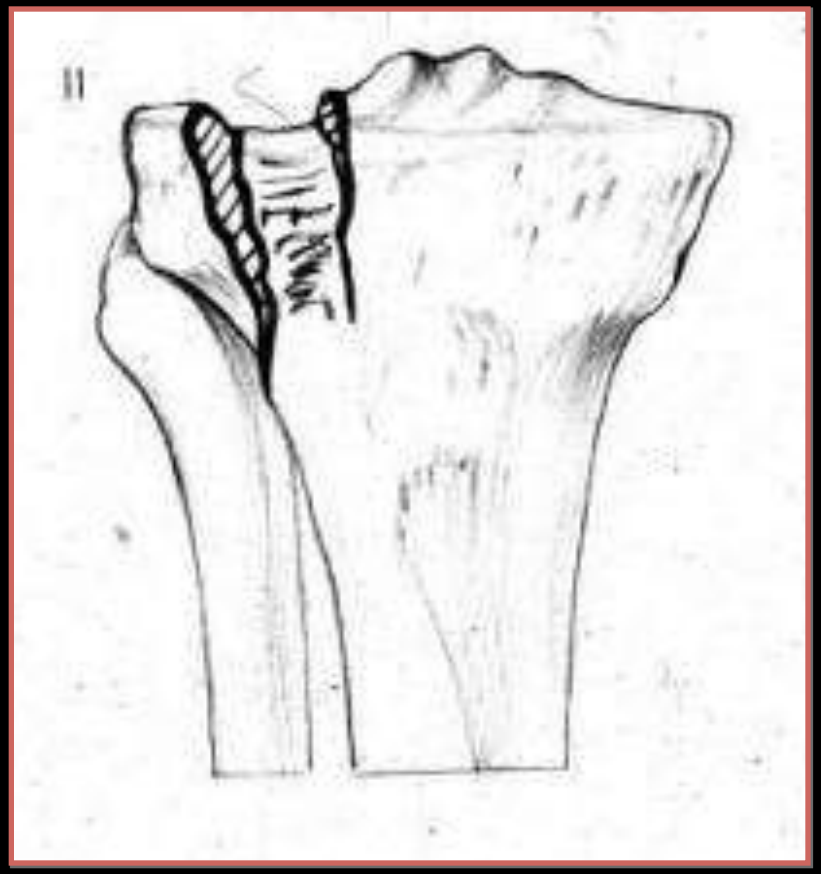
Schatzker VI

Schatzker I – Sagittal Split



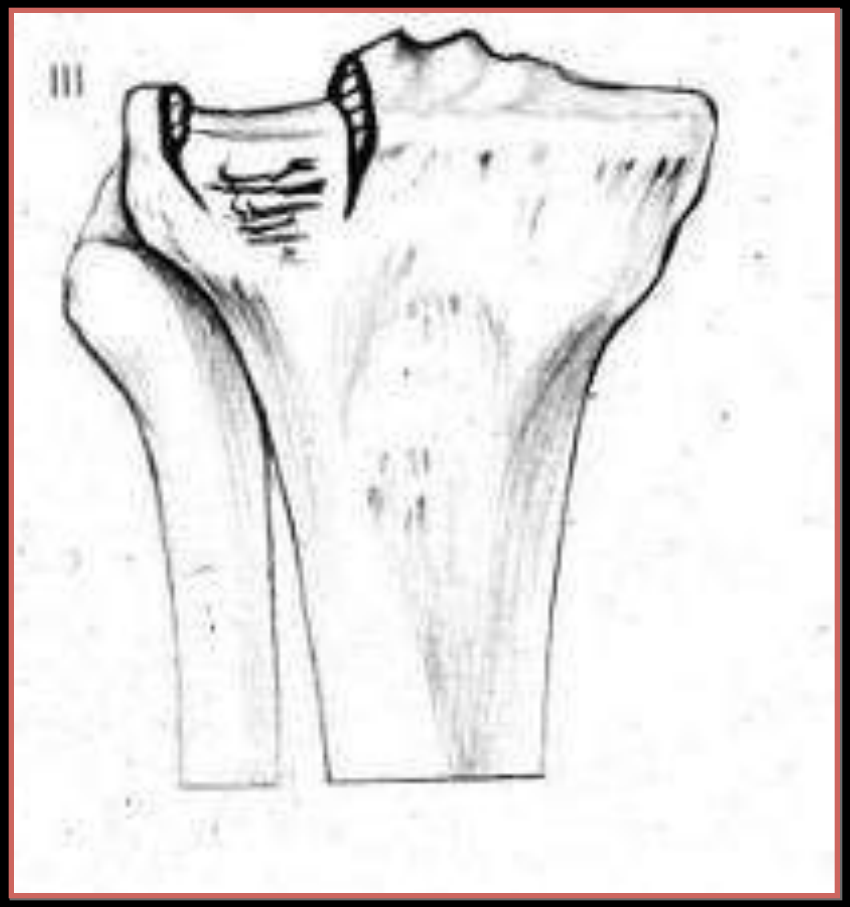
- Most common in young patients
- Typically in the sagittal plane
- Treat with buttressing

Schatzker II – Split Depression



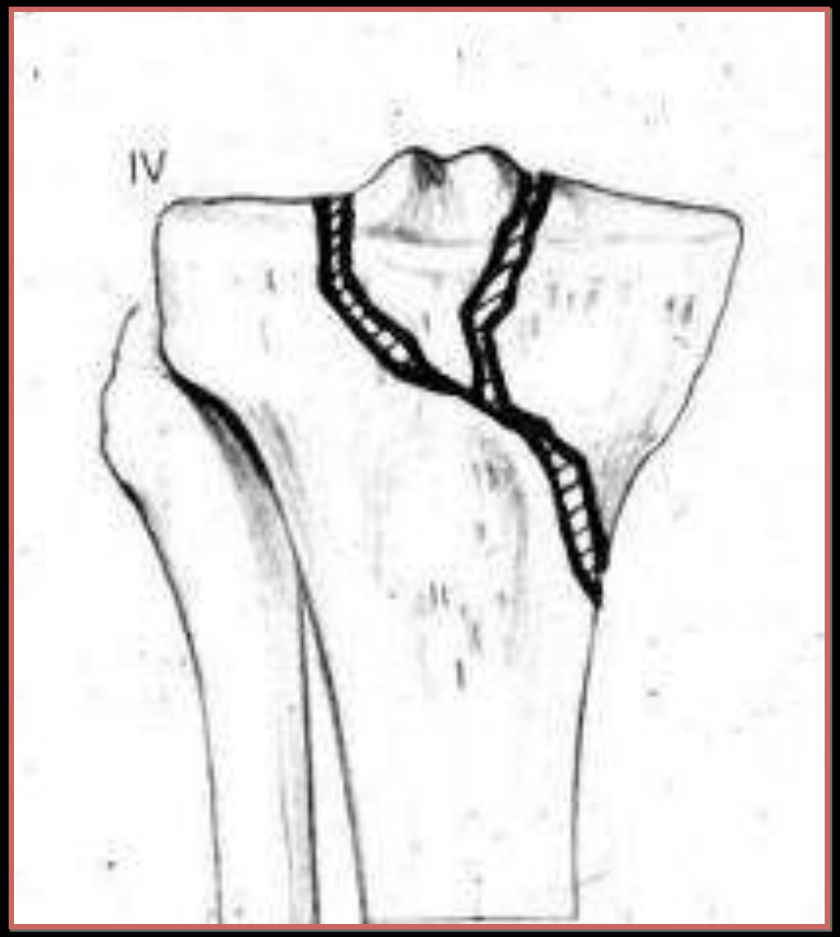
- Seen most in the 4th decade of life
- Cancellous bone is softer than in younger patient so both splits and depresses
- Must address depression at surgery and fill void after elevating

Schatzker III – Pure Depression



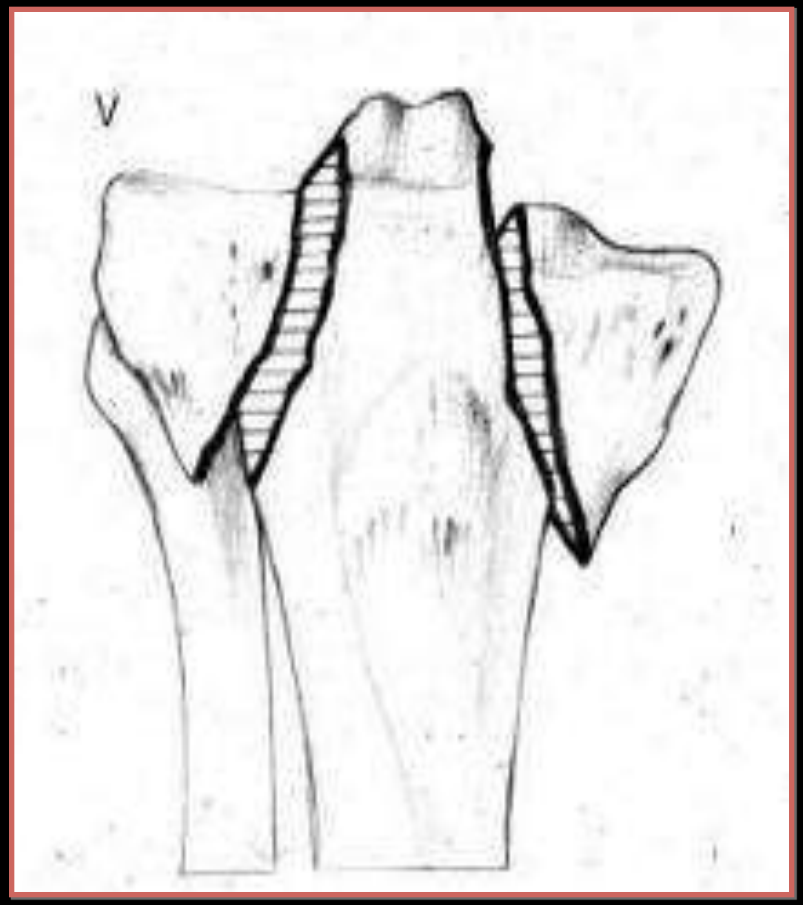
- Low-energy mechanism in the elderly with poor bone quality
- Some say do not really exist
- Can be considered a fragility fracture

Schatzker IV – Medial Plateau



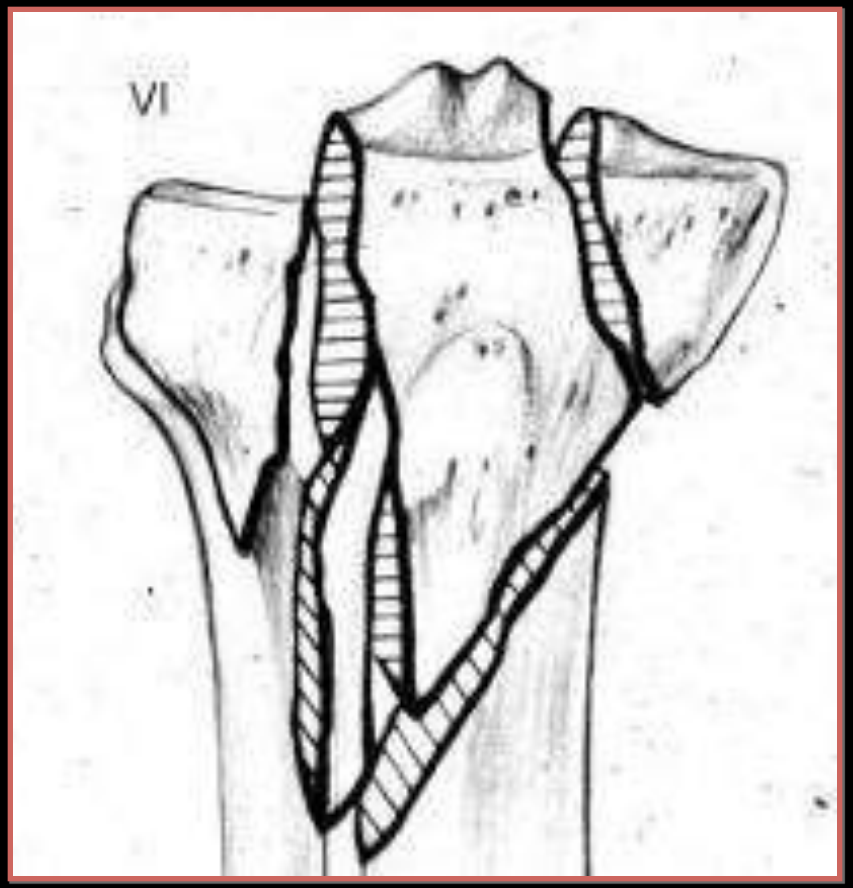
- Think knee dislocation and arterial, nerve, ACL/PCL injuries, compartment syndrome
- Unstable
- Remember that an XR is a single shot in time.
- Repeat exams throughout the day and night needed
- Treat with medial plate

Schatzker V – Bicondylar



- Medial and lateral plateau fracture lines
- High energy
- Usually significant soft tissue injury
- Typically needs medial and lateral plates
  - Rare cases can be treated with one plate

Schatzker VI – Diaphyseal Seperation



- Complete articular disruption from the diaphysis
- High Energy
- Higher rate of compartment syndrome
- Usually with bad soft tissue injury that may delay surgery for weeks

High Energy Plateau Fractures

Treatment Goals

- Good evaluation of the patient
  - History
  - Physical Exam
  - Good XRs and CT with reformats +/- 3D
  - Is the fracture surgical?
  - Do they need admitted or can they be sent home and brought back to clinic

- Is the fracture length stable
- Is this high energy

They need an Ex Fix?

Non-Operative Indications

- Stable knee joint in full extension
- Less than 5mm articular incongruence
- Normal mechanical axis
- Low demand pt

Good - Excellent results

- Lansinger - 90%
- Duwelius - 89%
- DeCoster - 61%

Operative Goals

- Obtain congruous knee joint
  - Plateaus at correct heights
  - No significant widening
- Obtain functionally stable knee
- Balanced load transmission across knee
- Restore axial alignment

Articular Incongruence

- How much is too much?
  - Literature confusing
  - > 5 mm too much
  - Any incongruence in presence of instability

Brown et al, JOT, 1988

Blokker et al, CORR, 1984

Honoken et al, JOT, 1995

Barei et al, JBJS, 2006

Angular Alignment

Arthrosis:

- Valgus < 10°: 14%
- Valgus > 10°: 79%
- Varus >5°: Poorly tolerated

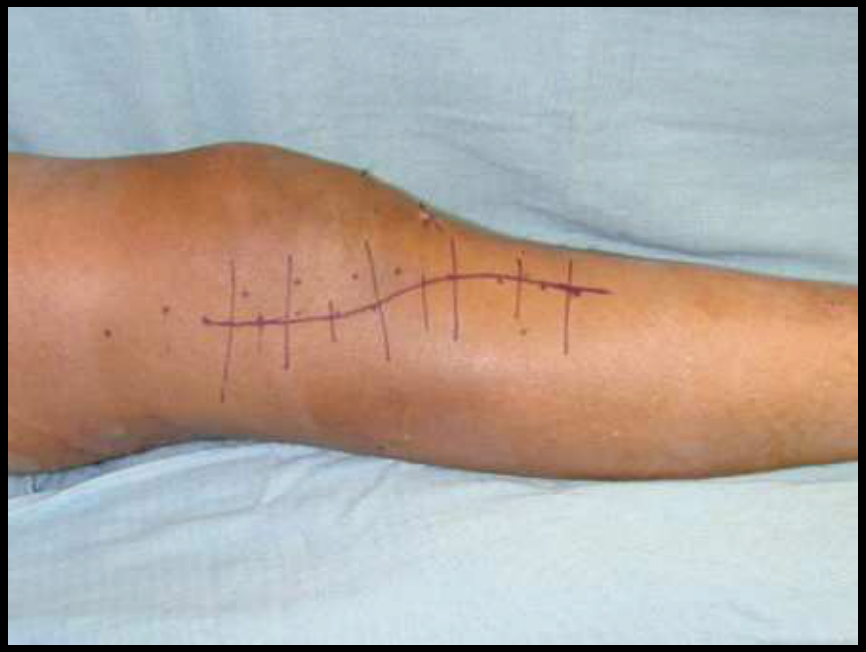
Independent of articular congruity

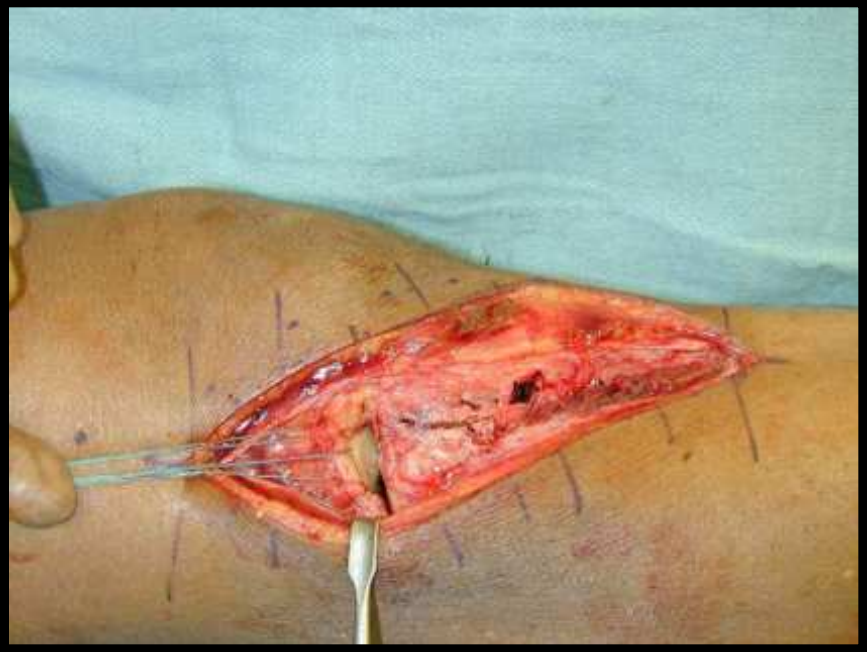
•Rasmussen, Acta Orthop Scand,1972

Surgical Planning

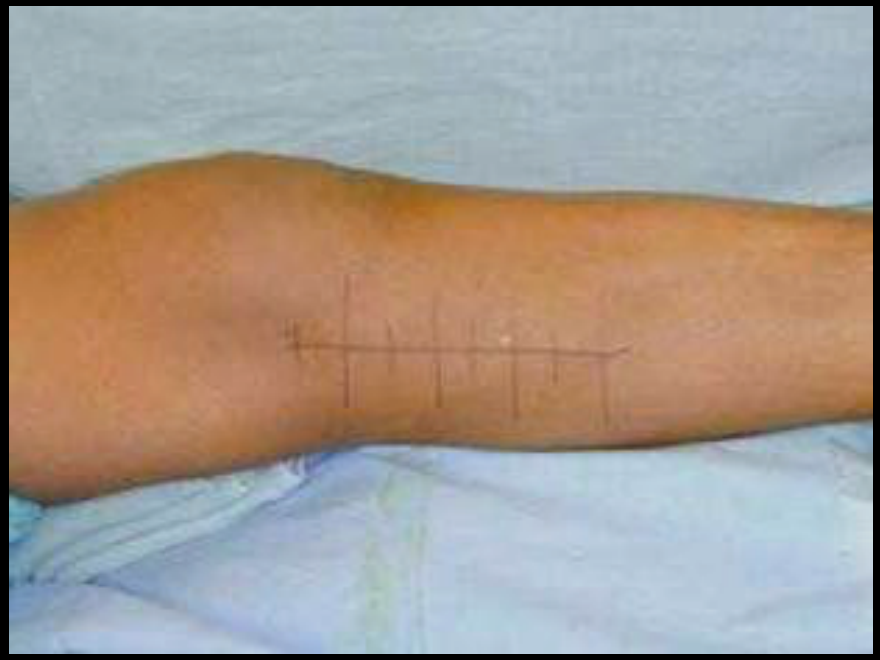
Incision Possibilities

Anterolateral

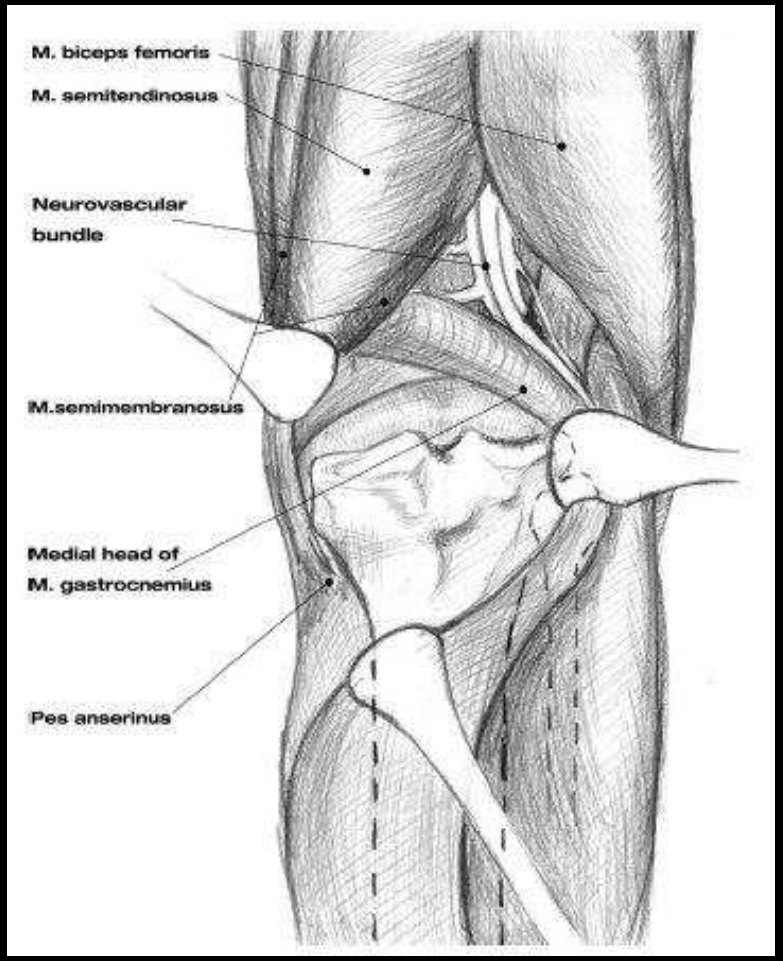




Medial



Prone Approach
(medial and/or lateral)



Luo et al. JOT 2010

Midline Incision

Complications

Infection

<u>Progressive Improvement</u>

Less use of anterior midline
Increased use of 2-incisions

70% down to 10-20%

Complications

Stiffness

5°-110°

Stable fixation, pain control, aggressive PT, emphasize extension

Complications

Compartment Syndrome

10-15%

High index of suspicion

Vigilance

Complete compartment releases

Plan your incisions

Complications

- Surgical Complications:
  - Two Most Common:
    - Operating through poor soft tissues; aka operating too early
    - Poor understanding of the fracture pattern

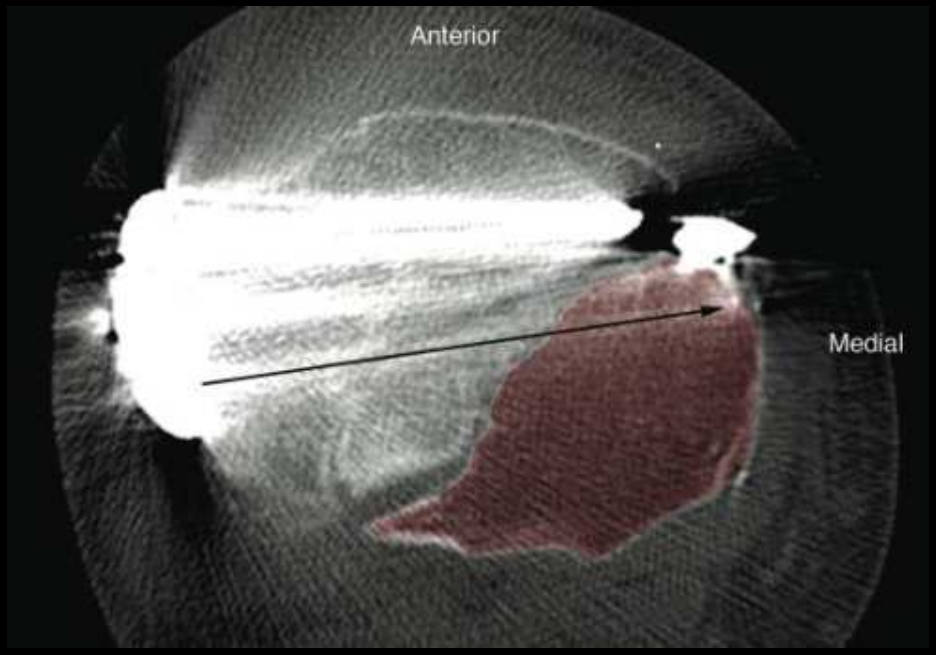
Poor Preoperative plan

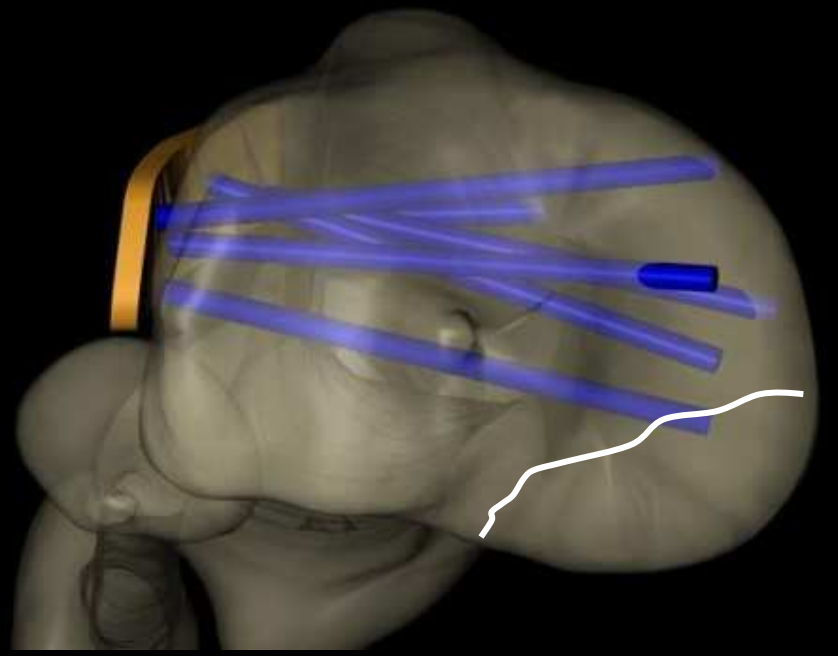
Locking screws DO NOT save the day!

No medial buttress, only lateral locking plate

Lateral locking only?

- Medial side critical for stability
- Anterolateral locking plates miss





Barei et al, JOT 2008

Summary

- Thoroughly evaluate the patient
  - Frequently associated with other pathology
- Be able to communicate clearly the injuries and fracture pattern using common classification systems when talking with other Orthopedic professionals
- Be able to formalize an initial treatment plan
  - Knee immobilizer and home with appropriate clinic follow up
  - Admit for frequent repeat examinations for possible arterial injury or compartment syndrome
  - Take to OR for Ex Fix and/or compartment syndrome
  - Not something we deal with. As long as patient stable and there are no pending disasters, prepare patient for transfer to higher level of care.
- If taking to OR
  - Respect soft tissues and use staged fixation when appropriate
  - Understand the fracture pattern and appropriate fixation strategies
- Complicated injuries with increased complication rates even in experienced hands

Thank you

Questions?