Pilon Fractures

Philip Wolinsky

University of California at Davis Medical Center

Background

Distal tibia fracture with intra-articular extension

1-10% of LE fx's

20-25% are open

1/3 of patients have associated injuries

Spectrum of injuries:

1) Low energy rotational fx's

   Ankle type fractures/ Skiing, simple falls

2) High energy fx's:

   Axial compression, shear

   MVA, fall from a height

Treatment challenges:

Bony injury & Chondral injury & Soft tissue injury

Soft Tissue Envelop: Thin, Injured @ time of fracture, poorly tolerates an acute second surgical insult

Treatment Principles

Respect the soft tissue

Initial external fixation for length

Delay definitive rx: ORIF (typical), Limited ORIF/ external fixation (rarely)

Treatment Goals:

- Anatomic joint reduction (if possible)
- Restoration of mechanical axis
- Early ankle joint ROM
- Avoid soft tissue complications

Outcomes:

- Dependent on initial injury
- Probably dependent on articular reduction
- All have radiological evidence of DJD
- X-ray and clinical outcome do not correlate
- Soft tissue complication guarantees a bad result

To Optimize Outcomes:

- Reduce the joint surface
- Not at the expense of the soft tissue
- An anatomic reduction MAY give you a good result
- BUT, a bad soft tissue complication = a poor clinical result

Initial Assessment:

Soft Tissue Injury:

What is the Soft Tissue Injury?

Assess NV Status

Determine ACS Risk

Consider Timing of Intervention

Define the Injury- Fracture Pattern

Closed Reduction & Splint:

Improve Vascular Flow

Realign the Limb

Take Pressure off Soft Tissue

Initial Treatment: Reduction with or without External Fixation

Reduction with EF

Goals:

Stabilize the Soft Tissue Envelope

Regain/maintain gross length and alignment

Realign the Talus

Classify/Treat Fibula Fracture:

Fibula may be attached to the ATFL and PTFL fragments when present

Advantages to fixing or not fixing the fibula first, or at all

If you get it right the AL and/or PL tibial fragments will be in the right place

IF the fibula is comminuted and you fix it short or rotated you may not be able to fix the tibia correctly

If you are transferring the patient likely better if you just span it and don't fix the fibula

Define Articular Injury after Distraction:

Understand the Articular Fracture Pattern

Plain films in the ex fix (traction views)

CT scans are key:

Where is the: Articular injury/ Articular impaction/ Comminution/ The fracture lines to operate through

3 Columns: medial, lateral, posterior

Articular Fragments- there are consistent fragments

Topliss: Anatomy of Pilon Fractures

Analyzed 126 consecutive pilon fractures/ Found consistent patterns of fractures based on plain films and CT scans

6 Fragments: 1) Anterior, 2) posterior, 3) Medial, 4) Antero-lateral, 5) Postero-lateral, 6) Die Punch

Central die punch fragments are: Purely articular, Impacted, No soft tissue attachments, Will never reduce with ligamentotaxis alone

Anterior fragment: Bulk of the anterior tibial articular surface

Posterior fragment: Most of the posterior articular surface

Medial fragment: Attachment of the medial malleolus, Variable amount of articular surface

Antero-lateral: AITFL insertion

Postero-lateral: PITFL insertion

Fractures fall into coronal and sagittal patterns

Two Different Injury Patterns

Sagittal Family:

Younger patients, High energy injuries, Varus deformities

Simple sagittal split: Medial and lateral fragments

Inverted V: Additional anterolateral fragment

T type: A fracture line splits the lateral fragment coronally

Progression from a SS to a T was associated with increased comminution

Sagittal Family:

- Need some type of anterior approach
- Depending on where the anterior exit line is

Coronal Family:

Older patients, Lower energy injuries, Valgus deformity

Coronal split type:

- One fracture line along the inter malleolar axis
- Bisects the medial malleolus

Anterior split: Fracture line passes anterior to the medial malleolus

Posterior split: Fracture line passes posterior to the medial malleolus

"V" coronal fracture: Two coronal fracture lines/ Separates the medial malleolus as a triangular fragment/ The fracture lines diverge at the lateral edge of the plafond

"Y" coronal fracture: Two coronal fracture lines/ Separates the medial malleolus as a triangular fragment/ The fracture lines diverge centrally

As the injury energy increases the posterior split evolves into a "V" pattern

As the injury energy increases the anterior split evolves into a "Y" pattern

Amount of Joint Impaction/ Comminution Varies

Asses the Metaphysis/ Diaphyseal Extension and Fracture Pattern

Define Metaphyseal Fracture Pattern

Designing the Fixation Constructs:

Define Mechanics of Instability

Column Specific Fixation

Plate Location Options:

- Antero-lateral plate: Good fixation of AL and PL fragments with 3 screws, Only 1 screw in medial fragment
- Medial plate: 4 screws in medial fragment, One in AL, 2 in PL

Design A Logical Mechanical Construct:

- Apex Medial= Lateral Support
- Apex Anterior/ Posterior Articular Fragment(s)= Posterior Support
- Anterior Talar Translation/ Defect: Anterior Support

Surgical Approaches

Multiple Approaches to get at the columns

AL: Bohler Approach

- Superficial peroneal nerve
- AL Approach Deep: Tendons Retracted Medially
- AL: Plate Position
- Joint Distraction: Distract for better joint visualization

Direct Anterior Approach

Multiple possible intervals:

- EHL/TA (vessels proximal to the ankle joint)
- EHL/EDL (vessels distal to the ankle joint)
- EDL/ peroneus tertias

Good access to AM and AL parts of the joint

Antero-Medial Approach:

- Good medial and anterior exposure/ access
- Tough to get to/fix the AL Chaput fragment

Minimally Invasive Medial Approach:

- Useful for tunneling a medial column plate with minimal dissection

Extensile Approach:

- Can see the entire front of the tibia

PL Approach:

- Useful for fixing the fibula and a posterior tibia articular fragment
- May be helpful to have something to build back to in the front- sometimes the only piece that has a "read"
- Often stage the anterior approach
- Make sure you get it right
- Do not let the screws cross to the front

Small flexible plates

Postero-Medial Approach:

Cannot fix PM fragments using a PL approach

Use Everything to Create a Preoperative Plan:

Position, Sets, Approach, Fragments, Reduction Strategy

Incision Number and Spacing

How many incisions are too many?

Do they really have to be spaced 7 cm apart?

What happens if they are not?

Incision Spacing

Only 17% of the skin bridges in 46 fractures were > 7 cm

Mean bridge was 5.9 cm

9% soft tissue complication rate

32 fractures: 2 approaches

14 fractures: 3 approaches

Angiosomes:

Explains why incisions can be placed within 7 cm of each other

An anatomical tissue block that is supplied by a “source vessel” that spans from the bone to the skin

The source vessels have branches that supply the deep tissues and the overlying skin

The branches start deep, then go through the deep fascia to supply the skin

That’s why SQ dissection is so bad

3 Angiosomes in the Distal Tibia:

- Anterior tibial
- Posterior tibial
- Peroneal

The wounds that had the most trouble were AL/PL combinations

- Had the smallest skin bridges
- The AL incision is on the most lateral aspect of the AT angiosome
- The PL incision is in the center of the peroneal angiosome
- They minimized anterior dissection over the fibula to try to prevent damage to the source vessels suppluing the overlying skin

Ideally incisions should be on the edges of angisomes esp you need to undermine the skin

Not always possible for pilons where access to the fracture(s) determine the optimal incision location

Multiple longitudinal incisions parallel to the angiosome source vessels may cause the least compromise of the blood supply to the superficial tissues

<u>Preventing Soft Tissue Complications:</u>

- Plan incisions
- Don't raise skin flaps
- Don't cross angisomes
- Staged approaches
- Control: smoking, HbA1c, nutritional status

Technical Tips:

Simplifying the Fracture Pattern from a C to a B acutely

Distractor/ External Fixator:

- Very helpful to obtain articular visualization
- Understand the effect of the position of the distal pin
  - A posterior pin|: causes a dorsiflexion moment/ Can make if difficult to see anteriorly and centrally
  - An anterior pin: Can cause a plantar flexion moment/ Excellent joint visualization/ May cause a more proximal sagittal plane deformity
  - Central pin:
    - Place parallel to the joint/ Otherwise can cause a coronal plane deformity

Small Plates/ Ex fix:

- Get and temporarily hold the reduction
- Decrease the number of fragments

Definitive External Fixation Options:

Definitive frame types:

- Circular frames (Ilizarov type):
  - Thin wires and ½ pins
- Combination (hybrid frames)

Doesn't mean just pull on it- Reduce the articular surface!