Distal Tibial Fractures

Dr. R. Lachowski and Dr. J. Kwee

Grand Rounds, McMaster Orthopaedics, March 21, 2007
Definitions

- **Plafond** - pluh-fon; Fr. pla-fawn - a ceiling, whether flat or arched
  
  Random House Unabridged Dictionary 2006

- Tibial Plafond - Refers to the dome of the articular surface of the distal tibia
**Definitions**

- **Plafond Fracture** – Synonymous with a Pilon Fracture
  - Usually Axial Loading, High Energy
  - Can be rotational with *lower* energy
  - Articular Surface Involvement
  - Can have severe comminution
  - Severe soft tissue injury
Aside

- Correct: Pilon – *pee-lohn* - French term for pestle, or tool for pounding or crushing.
  - Coined by Destot 1911

- Incorrect: Pylon - *pahy-lon* - Traffic Marker. Egyptian stone doorway or entrance
  - Maleoli as an entrance?
  - Likely poor pronunciation
    - Michelson, 2004
Contrast this to the ‘Typical’ ankle fracture:

- Low energy
- Usually Rotational
- Minimal Comminution
- Can still involve the articular surface but not a Plafond Fracture
  - Posterior maleolar fracture
- Relatively little soft tissue injury
Plafond Fractures

G. C 17/07/02

K.C. 4/12/06

Not a Plafond
Epidemiology

- Relatively Rare
  - 1% of All lower extremity fractures
  - 10% of Tibial Fractures
- Bilateral 0-8%
- Open Plafond Fractures 10-50%
- Compartment Syndrome 0-5%
- Other Fractures 27-50%

Marin 2006, Rockwood and Green 2006
Outcomes

- Devastating injury
- Multiple re-operation
  - Wound complications, infection
  - Free flaps
- Amputation or arthrodesis common
- Functionally - Williams in 2004
  - 59 patients followed for mean 48 months
  - Only 17 (28%) were working
  - Scored significantly lower on SF-36 than age matched controls
Classification

- Rüedi and Allgöwer - 1979

Type I – Fracture involving minimal displacement
Type II – Significant displacement of the joint surface
Type III – Impaction and comminution of the articular surface
Classiﬁcation

- AO/OTA ’43’
- Plafonds are type C
  - 1 - Articular simple, Metaphyseal simple
  - 2 - Articular Simple, Metaphyseal complex
  - 3 - Articular and Metaphyseal complex
Work-up

- **Hx:** Often fall from height, motor vehicle collisions
- **Ph:** Pain, Swelling, Blisters, Compartment Pressures
- **Associated Injury** – Head, Spine, Abdomen
- **Associated Fractures** - Calcaneus, lumbar spine, pelvic vertical shear
- **Imaging**
  - X-rays
  - CT Scan – Needed for pre-operative planning
Soft Tissues

- Management is a priority
- High energy injury – Soft tissues often severely injured or open
- Tscherne Classification
  - Grade 0 – No appreciable soft tissue injury
  - Grade 1 – Significant abrasion or contusion to skin or subcutaneous tissue
  - Grade 2 – Deep abrasion or contusion to the muscle
  - Grade 3 – Severe crush or contusion with subcutaneous avulsion and severe muscle damage
Soft Tissues
Soft Tissues

- **Tips**
  - Delay definitive management
  - Until swelling improves
  - Staged procedure
  - Leave the fibular wound open
  - Muscle flaps
Principles

Injury Severity
+
Soft Tissue Complications
+
Bony Reduction
=
Functional Outcome
Techniques

- Closed Reduction + Cast
- ORIF
- Ex-Fix
  - Conventional, Articulated
  - Fine wire (Ilizarov)
  - Hybrid (Ilizarov distally, conventional fixator proximally)
  - Ex-Fix + ORIF minimally invasive articular reconstruction
- Staged
- Combined
The Balance

- **ORIF** – using AO Techniques
- Rüedi and Allgöwer Laid out Principles
  - Restore Length
  - Articular Reconstruction
  - Bone Grafting
  - Stable Medial Fixation
- **Pros** – Good reduction and rigid fixation
  - Accuracy of reduction related to quality of results
- **Cons** – Injury to already compromised soft tissues
  - Wound sloughing, infection
  - Non-Union due to devascularization
  - Some studies reported complication rates of 40%
External Fixation
- Spanning the joint
  +/- articulating fixator
- Fine wire fixators allow joint reconstruction without spanning joint
  +/- Articular reconstruction

Pro - attempt to minimize soft tissue damage

Con - May compromise articular reconstruction
  - Malunion
  - Pin Tract Infections
Combination modalities well documented

- Staged procedures
  - Ex-Fix +/- plating of fibula
  - Delayed (days-weeks) reconstruction of articular surface
- Ex-Fix + articular reconstruction
Evidence

- Maximize Long Term Function
- Minimize Complications – Wound breakdown, infection etc

- Cochrane: 0 Meta-analysis
- Medline: Many papers, many techniques, few good comparisons

- Retrospective Review 79 Fractures
- AO/OTA 43 B and C only
- 63 Treated with ORIF (Most Staged)
- 16 Ex-Fix and Limited ORIF (Some Staged)
- More C3 fractures in Ex-Fix Group

**Results:**
- Equal Skin Slough, Infection, Malunion, Non-union
- Age, and C3 Fracture Type were associated with more complications
- Post-Traumatic Arthritis 11 of 16 in Ex-Fix, 12 of 29 in ORIF
- Foot Function Index worse in patients with Ex-Fix and those with C3 fractures

**Bottom Line** – Can’t Comment on Fixation, but worse injury is correlated with worse outcome

Retrospective Review

32 Fractures, all treated with Ex-fix and MIS articular reconstruction followed minimum 24 months (mean 48 months)

Used Rank Order by independent observers
- Severity of bony injury
- Articular Reduction
- Post-operative Arthritis
- SF-36, subjective ankle score, ability to return to work

Results
- Severity and Reduction correlated with Post-Op Arthritis
- Reduction or Arthritis had no correlation with functional scores
- Severity correlated with functional scores
- Patient education, Female sex, and WSIB status correlated with functional scores

Bottom Line: Small study, suggesting severity of injury better predictor of functional outcomes at 2 years.
A Selection of Literature


- Retrospective Study
- 51 Patients, 92% AO/OTA Type C #, mean fu 68m
  - 15 Patients **Primary ORIF** if closed
  - 28 Patients **Ex-Fix and MIS ORIF**
  - 8 Patients **MIS ORIF followed by short term Ex-Fix followed by staged Medial ORIF**

- Results:
  - Biased because only closed fractures only in 1° ORIF
  - Trend toward better ROM, less pain, and fewer limitations in staged group

- Bottom Line: Small numbers - suggest no association between surgical technique and post-op arthritis or infection
Wyrsch *et al.* Operative Treatment of Fractures of the Tibial Plafond. A Randomized, Prospective Study *JBJS* 1996:78A(11)p1646

- PRCT – Surgeons picked a ‘preferred’ technique
  - Patients randomized to a technique
  - 18 Patients **ORIF** +/- Delay
  - 20 Patients **Ex-Fix** +/- **MIS ORIF** +/- Delay
  - 21% Type I, 36% Type II and 44% Type III R&A

Results:
- 15 Complications in ORIF group (dehissance or infection)
- 4 Complications in the Ex-Fix group
- Correlation of injury severity (Type II and III) with arthritis at minimum of 24 months follow-up
  - No difference with different fixation type (Only 24 months)

Bottom Line: Injury correlated with arthritis more than fixation. Fewer complications in Ex-Fix group.
Take Home

- No clear direction in treatment from literature
  - Broad spectrum of injuries
- Principles
  - Best reduction possible while minimizing soft tissue injury
- Use techniques properly
  - Use flaps if necessary
  - Know each techniques’ limitations
Thank you!