Pilon Fracture

Nick Savva
8th December 2008
Etienne Destot  1911

First description

“Ankle Fractures that involve the weight bearing surface”

Coined term Pilon meaning pestle
Bonin 1950

“Roof of ankle disrupted”

Coined the term Plafond meaning decorated ceiling
Apley

Common sense

Twisting injuries cause common ankle fractures

Pilon fractures occur when a large force drives the talus upwards against the tibial plafond.
Incidence

Uncommon Injuries
Less than 1% of lower limb fractures
3-10% of tibial fractures
Low Energy Injuries

Rotational pattern Eg Skiing type injuries

Osteoporotic bone

Minimal comminution

Little soft tissue injury
High Energy Injuries

RTA

Fall from a height
High Energy Injuries

Severe soft tissue injury
Severe articular fracture
Metaphyseal comminution

“The distal tibial explosion fracture” Kellam and Waddel 1979

“Pilon fracture is a soft tissue injury with an associated fracture”
Initial Management

ATLS

Other injuries

10-20% have calc, knee, hip, spine, base of skull

20-30% if the pilon fracture is open
## Initial Management

<table>
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<tr>
<th>History</th>
<th>Mechanism of injury</th>
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<td>Comorbidities</td>
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<tr>
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<td>Smoking</td>
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<td>Examination</td>
<td>Open/Closed</td>
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<td></td>
<td>Soft tissue envelope</td>
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<tr>
<td></td>
<td>Deformity</td>
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<td></td>
<td>Neurovascular status</td>
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<td>Compartment syndrome</td>
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Initial Management

Photograph and cover wounds
Antibiotics and tetanus
Analgesia
Correct gross deformities
Immobilise and elevate

Radiographs
| AP / Lateral / Mortice |
| Other side? |

CT
| Imperitive preoperatively. Influences management in 60% (Tournetta 1996) |
Classification

“Pilon fracture is a soft tissue injury with an associated fracture”

<table>
<thead>
<tr>
<th>Soft tissue injury</th>
<th>Closed injury</th>
<th>Tscherne</th>
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<td>Open Injury</td>
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<td>Gustillo and Anderson</td>
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<tr>
<th>Fracture</th>
<th>X Ray based</th>
<th>Rüedi and Allgower</th>
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<td>CT Based</td>
<td>AO</td>
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<td>Tornetta</td>
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<td>Topliss</td>
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Tscherne Classification of Closed Fracture Soft Tissue Injury

Type 0  Minimal Soft Tissue Damage
Indirect injury with simple fracture pattern
Eg Torsional pilon fracture in a skier

Type 1  Superficial abrasion or contusion from fracture within
Moderate fracture configuration
Eg Fracture dislocation of ankle with abrasion over medial malleolus

Type 2  Deep contaminated abrasion associated with skin/muscle contusion
Impending compartment syndrome
Severe fracture configuration
Eg high energy pilon fracture

Type 3  Extensive skin contusion or crush. With subcutaneous avulsion.
Muscle damage severe
Compartment syndrome
Vascular injury
Comminuted fracture configuration
Beware Hemorrhagic Blisters
Gustillo and Anderson Classification of Open Fractures

Type I
- Laceration < 1 cm
- Clean Inside out?
- Minimal muscle contusion
- Simple fracture patterns

Type II
- Laceration > 1 cm
- Extensive soft tissue damage with flaps and deep avulsion.
- Minimal to moderate crush
- Minimal comminution

Type III
- Extensive soft tissue damage: skin, muscle and neurovascular structures
- High velocity injuries
- Crushing injuries

Type III a
- Adequate bone coverage

Type III b
- Periostial stripping and bone exposure

Type III c
- Vascular injury requiring repair

12% 56%
Rüedi and Allgower

Non displaced

Large articular fragments

Highly comminuted
Topliss Classification

126 fractures

Metaphyseal/Diaphyseal dissociation
    Simple/Comminuted
    Level noted

Fibula fracture
    Danis Weber

Disruption of syndesmosis noted

CT used to define constant fragments and patterns
6 Main Fragments

Fig. 5a
CT scans of articular fragments showing a) anterior (A), posterior (P), and medial (M) and b) anterolateral (AL) and posterolateral (PL) fragments.
Sagittal Group

Higher energy fractures
Higher metaphyseal diaphyseal dissociation
Varus alignment
Coronal Group

- Lower energy fractures
- Lower metaphyseal fracture
- Valgus alignment

CT scans of coronal family fractures showing:
- a) the coronal split (CS)
- b) the anterior split (AS)
- c) the posterior split (PS)
- d) the V and e) the Y types of fracture.
Fracture Patterns

Fig. 1a
Radiographs showing pilon fractures in a) valgus and b) varus with the incidence in our series.
Diastasis

Fig. 2a

Fig. 2b

Radiographs showing a) ligamentous and b) functional diastases in pilon fractures.
Lateral Disruption Fractures

Fig. 3a
Radiographs showing lateral-disruption-type fractures with disruption of the normal talofibular relationship (circled). Figure 3a – Intact lateral column.

Fig. 3b
Figure 3b – Disrupted lateral column.
Useful?

- Plate design
- Most prox # 16cm
- Observer error
- Ex Fix placement
- Plate placement
Treatment Options

Non Operative
- Plaster
- Os calcis pin traction
- Os calcis pin in plaster

Operative
- ORIF
- Spanning Ex Fix
- Spanning Ex Fix with reconstruction of the joint surface
- Non Spanning
  - Mono Axial
  - Ring
  - Ilizaroff
  - Hybrid

No Nails!
Results of Non Operative Treatment

Jergeson 1957  Surgical reconstruction impossible

Ayeni 1988
Non-surgical management. Cast NWB 10 weeks. WB 2 weeks
Displaced or comminuted fractures did poorly in casts.
Ruedi and Allgower

Fractures of the lower end of the tibia into the ankle joint. Injury 1:92,1969
Fractures of the lower end of the tibia into the ankle joint. Results 9 years after ORIF.
Injury 5:130,1973

Consecutive series of 84 patients

4 Principles

- Plate fibula
- Reconstruct articular surface
- Bone graft to metaphysis
- Medial Plate
Technique
Results

Fantastic

Good or excellent in 74% at 4 years
At 9 years they had mostly improved!
Good surgery good results
Poor surgery poor results

Wound problems in 12%
Arthrodesis 5%

No classification of fracture type
Retrospectively ?33% type 3

Average age 37
Skiing injuries 90%

Recommended early surgery
Are results of Swiss study group in Davos reproducible in Basel?

<table>
<thead>
<tr>
<th>Patients</th>
<th>75 patients</th>
<th>Age</th>
<th>Ave age 48 years</th>
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<tbody>
<tr>
<td>Mechanism of Injury</td>
<td>47% - skiing/sport</td>
<td>34% RTA</td>
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<table>
<thead>
<tr>
<th>Type</th>
<th>Percentage</th>
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<tr>
<td>Type 1/2</td>
<td>53%</td>
</tr>
<tr>
<td>Type 3</td>
<td>47%</td>
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<table>
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<tr>
<th>Healing Problems</th>
<th>8% temporary healing problems</th>
<th>0% osteomyelitis</th>
</tr>
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<tbody>
<tr>
<td>Arthrodesis</td>
<td>5% arthrodesis</td>
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</table>

80% had good results subjectively from patients  
70% good results from surgeon pain, ROM

Concluded that inferior results due to age of patients, mechanism of injury and quality of surgeons!

Continued to recommend early ORIF
Band Wagon

Kellam and Wadell: 1979 J. Trauma19: 593-601

26 fractures

Type 1/2 84% Good results
Type 3 50%

Crucial factors
Length of immobilisation
Quality of reduction

Prolonged immobilisation resulted in poor outcome
Reiterated the point made by Danis and Weber wrt ankle #

“There is not point in fixing a periarticular fracture if the fixation is not good enough to allow early joint movement”

42 patients

71% high energy injuries

22% open injuries

Non union rate 25%

Infection 13%

Arthrodesis for type III 32%

Good results

Type 1/2  80%

Type 3  32%
142 fractures treated over 19 year period by multiple surgeons
Variety of open and closed methods of treatment
60% high energy
Type 1/2 70% good or excellent results

Type 3 half treat by ORIF and half by other means
47% good or excellent results if treated by ORIF
17% good or excellent if treated by other means

Good reduction associated with a good outcome
Poor reduction associated with poor outcome

12% ankle arthrodesis
Wound complications doubled for type 3s  37% sepsis in type 3s!

Small group treated with limited incision plate placement fared much worse
60% high energy injuries
3 Type 1, 27 Type 2 and 30 Type 3
Open # to theatre within 3 days
Closed # to theatre at mean of 5 days

<table>
<thead>
<tr>
<th></th>
<th>Type 1 and Type 2 (%)</th>
<th>Type 3 (%)</th>
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<tbody>
<tr>
<td>Deep Infection</td>
<td>0</td>
<td>37</td>
</tr>
<tr>
<td>Skin slough</td>
<td>17</td>
<td>37</td>
</tr>
<tr>
<td>Malunion</td>
<td>3</td>
<td>23</td>
</tr>
<tr>
<td>Non-union</td>
<td>7</td>
<td>27</td>
</tr>
<tr>
<td>Arthrodesis</td>
<td>10</td>
<td>26</td>
</tr>
<tr>
<td>Re-operation</td>
<td>30</td>
<td>60</td>
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</tbody>
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One of the above major complications in 50% (Type 1/2 30%, type 3 70%)
Poor results in 50%
Complications

Teeny and Wiss (1993) CORR 292, 108-117

Los Angeles

Conclusion

A suggestion that in large urban centres mechanism of injury was different.

Risks too high in type 2 and 3 fractures
Unacceptably high levels of complications

Alternative methods of treatment should be considered
Revisit surgery for secondary deformity and degeneration!

They really did give up!
Spanning Ex Fix with Limited ORIF

Bone et al CORR 1993;292:101-7

Delta Frame

Surgery delayed by 5 days

18 Type III of which 10 open fractures
No wound problems or deep infection
3 need secondary bone grafts to achieve union

75% good or excellent results

However limited movement results in poor cartilage nutrition and healing
Articulated Spanning Ex Fix

Bonar and Marsh JBJS 1995;77:1498-1509

Similar results

Difficult to get axis of movement at the ankle only!
Non Spanning Ex Fix

Anglen J Orthop Trauma 1999;13:92-97

29 Grade III Pilon fractures
8 Open fractures

6 non unions (21%)
3 wound complications
1 deep infection
7 pin site infections

Ligamentataxis doesn’t always work!

50% unacceptable outcome
Non Spanning Ex Fix Limited ORIF

Tournetta J Orthop Trauma 1993;7:489-96

Skeletal traction for 5-10 days prior to
Hybrid external fixator and minimal internal fixation

Series of 26 pilon fractures.
69% Type III
Time to healing 4.2 months
4 Deep infections (15%)
11 required bone grafting later

81% good or excellent
Comparison of Ex Fix Systems

Papadokostakis JBJS 2008 90B;1:1-6

Metatanalysis

Infection  No significant difference
Non union  No significant difference
Time to union  No significant difference

Greater incidence of malunion with spanning external fixator

Generally poor use of outcome measures
Comparison of Ex Fix and Plates

Wyrsch et al JBJS 78A;1646-1657: 1996

RCT Not really randomised

Group 1 Internal fixation
- Surgery 3-5 days
- 28% Infection
- 33% Wound dehiscence
- 16% Amputation

Group 2 External fixation+/- limited ORIF
- Immediate surgery or delay of 10 days or more
- 10% complications (minor infection)

At 2 years no clinical difference between groups

Concluded that ex fix is as effective as ORIF but carries less risk of wound complications
Staged Protocols

Concept of temporary ex fix introduced

Helfet 1994
Immediate plating of fibula with spanning ex fix

Allows control of soft tissues prior to formal ORIF

Sirkin and Saunders 1999

56 AO type 43C fractures
Reconstruction delayed by an average of 13 days
29 closed fractures  1 deep infection
17 open fractures   2 deep infections
Staged Protocols

Patterson and Cole 1999

22 AO type C fractures

Fibula nail and ex fix

Formal ORIF delayed by average of 24 days

No wound complications or deep infections

Major soft tissue complications avoided!
Managing the Soft Tissue Injury

Soft tissue management critical

“Span and Scan”

Staged protocol 10-28 days

Span the fracture with a delta Ex Fix

Fix fibula? Controversial

Ice
Elevation
Foot pumps

CT scan
Plan surgery
Patience
Get to know your patient
Managing the Soft Tissue Injury

Widely spaced incisions (7-10cm)
Mini incisions
Minimal incisions/dissection
Atraumatic technique
Allgower Donati suture technique
Femoral distractor
### Special Techniques

<table>
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<th>Open fractures</th>
<th>Meticulous debridement</th>
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<tr>
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<td>Bead pouch</td>
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<td></td>
<td>Vacuum dressing</td>
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<td>Early plastics involvement</td>
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Negative Pressure Wound Therapy


RCT Pressure Dressing or Vac Dressing

NPWT drained for 1.5 days cf 4 days
Infection rate half

Suggest NPWT for

Open fractures
Non closable wounds
At risk closures
Summary

Span and scan
Wait
Wait longer
Reconstruct the joint surface
Reattach joint to diaphysis

Discussion Points
Fix the fibula?
How long?
One big incision?
Several small?
Ex fix
Traditional double plating
Locking plates?
## Exceptions

<table>
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<th>Low energy injuries</th>
<th>Immediate surgery?</th>
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<tr>
<td>Undisplaced fractures</td>
<td>Non Op treatment</td>
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Exceptions

Disasters

Ankle Fusion for the Definitive Treatment of Non Reconstructable Pilon Fracture
Bozic, Thordarsen, Hertz FAI 29;9:914-918

Los Angeles
1 Pilon per week
All operated upon by Thordarsen
Posterolateral cannulated blade plate
14 patients
All united at mean of 15 weeks

Don’t try this at home
Complications After Treatment of Tibial Pilon Fractures
Thordarson Journal American Academy Orthop Surg Vol 8,No 4, July/August 2000

**Avoidance strategies**

**Intraoperative**
- Joint penetration
  - Meticulous planning
- Malreduction
- Inadequate fixation
- Implants

**Perioperative**
- Wound dehiscence
- Patience!
- Superficial infection
- Deep infection
- Span and scan
- Vacuum dressings?

**Late**
- Stiffness
- Mal-union
- Non-union
- Osteoarthritis
- Rehabilitation
Outcomes

Tibial Plafond Fractures. How do these ankle function over time?

Pollak 2003, Williams 2004

Overall clinical outcomes of pilon fractures    SF-36 and ankle scores

• 2-5 years significantly poorer general health scores cf normal

• Do much worse than tibial plateau fractures

• 15-30% were disabled and 40% had changed jobs as a result of the fracture.
Outcomes

OA is present in >50% patients

Clinical outcome not associated with OA score

The overall rate of fusion 10%.

Improvement up to 5 years

The main predictors of final outcome were the severity of the original injury (in all series) and the quality of the initial reduction.