Update on Acute Management of Open Tibia Fractures

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Incidence

- More common than in any other long bone
- About 25% of all tibial shaft fractures are open
## Classification

Table 2: Gustilo Classification of Open Fractures\(^6\)

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Clean wound &lt;1 cm in length</td>
</tr>
<tr>
<td>II</td>
<td>Clean wound &gt;1 cm in length without extensive soft-tissue damage, flaps, or avulsions</td>
</tr>
<tr>
<td>IIIA</td>
<td>Adequate soft-tissue coverage despite extensive soft-tissue damage, flaps, or high-energy trauma irrespective of the wound size</td>
</tr>
<tr>
<td>IIIB</td>
<td>Inadequate soft-tissue coverage with periosteal stripping, often associated with massive contamination</td>
</tr>
<tr>
<td>IIIC</td>
<td>Arterial injury requiring repair</td>
</tr>
</tbody>
</table>
Associated Injuries

- 30% of patients have multiple injuries
- Proximal or distal tib-fib joints may be disrupted
- Ligamentous knee injury and/or ipsilateral femur
- Neurovascular structures
- Foot fractures
- Compartment syndrome
Antibiotics


- First Generation Cephalosporin
- +/- Aminoglycoside
- +/- Pen G or Clindamycin if Pen allergic
- 24-72hr course depending on severity of injury
What antibiotics to use?

J Acute Trauma Care Surgery Sept 2014

- New protocol stratifying open fractures
- Grade I-II – cefazolin
- Grade III – Ceftriaxone for 48 hrs
- Aminoglycosides, Vancomycin and PCN removed from protocol
- 174 open lower extremity long bone fractures

• Soft tissue infection was 21% pre and 25% post, not significant.

• Rates of drug resistant organism were not significantly different

• Use of aminoglycoside and Vancomycin was significantly reduced without significantly increasing infection rates
Open fracture and Antibiotics

JOT June 2015

- Observational study
- 137 patients

- > 5 days to wound coverage was significant
- >66 minutes to getting IV antibiotics was significant
- Immediate antibiotics and coverage in less than 5 days limited infection rate to 2.8%,
  - Delay in one factor – 10.2%
  - Delay in both factors – 40.5%
Treatment of Soft Tissues

- Thorough debridement and irrigation (in that order)
- All foreign material, necrotic muscle, unattached bone fragments, exposed fat and fascia are debrided
- Fasciotomies performed if indicated even in open fractures
Time to operative debridement

JOT Nov 2014

- Canadian Study
- 2001-2009
- 737 fractures
- 413 tibia fractures
- 285 upper extremity fractures
- 93 femur fractures

- Overall 6% infection rate
- Median time to surgery was 9 hours for those without infection and 7 hours for those with infection (p=0.04)
- Grade III fractures were 37% of all infections (P < 0.001)
- Infection correlated to Gustilo grade
- No correlation with time to surgery or antibiotics
Bone Defects

- PMMA – aminoglycoside +/- vancomycin
- Bead pouch
- Solid spacer
BMP

- BMP-2 (Infuse) FDA approval in subset of open tibia fractures BESTT study group JBJS 84, 2002
- Significant reduction in the incidence of secondary procedures
- Accelerated healing
- Lower infections
Soft Tissue Coverage

- Definitive coverage within 7-10 days if possible
- Most type 1 wounds will heal by secondary intent or can be closed primarily
- Delayed primary closure usually feasible for type 2 and type 3a fractures
NPWT: Fewer flaps? Fewer infections?

- NPWT had less infections than gauze dressings in 2/4 studies, no difference in 1 and higher in 1
- Beyond 72 hrs no diff in 8/10 studies, higher in 2/10
- Flap rates reduced 13-60% as compared to historical reports

CORR May 2015
- Systematic review
- 1 RCT, 12 retrospective studies
Soft Tissue Coverage

- Type 3b fractures require either local advancement or rotation flap, split-thickness skin graft, or free flap
- STSG suitable for coverage of large defects with underlying viable muscle
Time to flap coverage

- Logistic regression analysis
- No increased risk for days 1-7
- The odds of infection increased significantly for each day after 7 days.

JOT May 2014
- Shock Trauma study
- 69 patients
- 2004-2009
Delayed debridement and infection

JBJS Am
- Mar 2014
- 459 open fractures

- Mean time to OR for debridement was 11 hours
- 10% infection rate
- 0% in Grade I
- Grade II and III infection rates increased with increased delay to OR
  - Higher rates with tibia fractures
  - Higher rates with higher Gustilo grade
  - Higher rate with wound contamination
Cost of after hours surgical debridement

JOT Nov 2014

- Economic model
- Based on national samples for patients presenting between 6pm and 2 am and undergo operative debridement within 6 hours

- Total additional costs of between $2-4 million annually.
Bony Stabilization

- Multiple options depending on fracture pattern and soft tissue injury:
  - IM nail
  - External fixation
  - ORIF
IM Nail

- Excellent results for type I open fractures

- Type II and type IIIa fractures
  - average union of 24 and 27 weeks
  - deep infection rate 3.5\%*

- Complications increased with type IIIb fractures
  - average time to union was 50 week
  - infection rate 23\%*

*Court-Brown JBJS 1991
Reamed vs Unreamed for open tibia fractures

J Ortho Surg Research
Aug 2014

- China
- Metanalysis of Cochrane including Chinese sources
- 695 references were identified but only 4 matched study criteria

- No difference in healing rate, secondary surgery, implant failure rate, compartment syndrome and infection
Which treatment results in the fewest reoperations?

CORR July 2015

- Meta-analysis
- 1980-2013

- IM nails may be superior to other methods
- Unreamed nails may be superior to reamed nails.
- Conclusions based on trials with high risk of bias and poor precision.
External Fixation

- Compared to IM nails, increased rate of malunion and need for secondary procedures

- Most common complication with ex-fix is pin track infection

  (21% in one study)*

*Tornetta JBJS 1994
Risk factors for nonunion and infection after secondary nailing after external fixation

Orthopaedic Traumatology and Surgical Research Feb. 2015

- Retrospective study in France 1998-2012
- 55 patients
- 16 closed and 39 open fractures
- Mean time to 2nd procedure 9 +/- 10 weeks

- 4 infections
- Union rate 96%
- Infection risk correlated to Gustilo grade and time to surgery
ORIF

- Most common for open periarticular fractures
- 13% patients developed osteomyelitis after plating compared to 3% of patients after ex-fix*

*Bach and Handsen, Clin Orthop 1989
What is a critical size defect in the tibia?

- 30 patients had a “wait and see” strategy
- 14 (47%) never required a secondary procedure
- Less likely with a reamed nail
- Less likely in female patients
- All 37 patients had higher rate of reoperation and worse patient reported outcomes

JOT Nov 2014

- Cohort study
- 37 patients with defect > 1cm and
- > 50% cortical diameter
Mid term follow-up of BKA vs Limb Salvage

- Military personnel
- Combat trauma
- 2006-2010
- 49 patients with limb salvage compared to similar cohort of BKA patients
- Median f/u was 4 years

- No difference in SF-36 physical or emotional score for salvage vs BKA
- No difference in pain scores
Summary

- Give antibiotics early
- Get to OR urgently for Type III fractures
- IM Nail probably the best device for stabilization
- Convert ex fix to IM Nail early
- Get closure or flap coverage within 7 days
- Outcome most affected by severity of soft tissue injury, higher grade open fractures do worse