

Management of open fractures

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AOT Advanced Principles Course

Goals

- Prevent infection
- Fracture stabilization and union
- Soft tissue coverage

Three interdependent goals!

”Soft tissue injury with a broken bone”

- Four components:
 - Fracture
 - Soft tissue damage
 - Neurovasculare compromise
 - Contamination

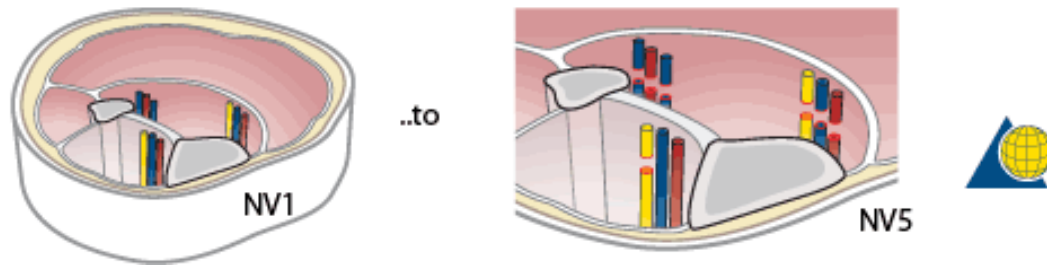
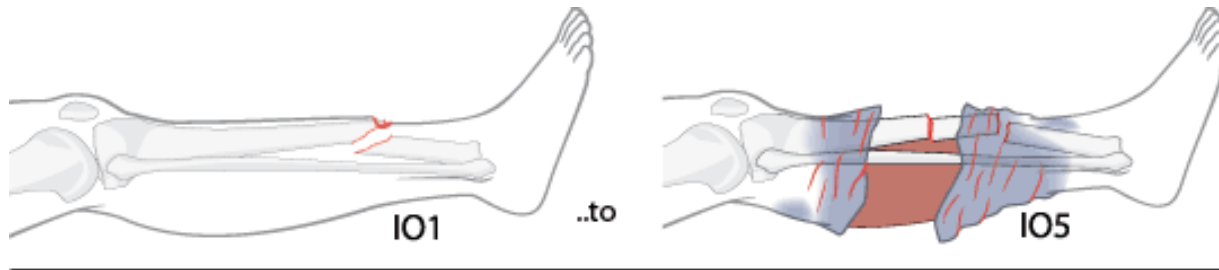
Classification

- Gustillo and Anderson
- AO (adapted from Tscherne)

Gustillo and Anderson

Type	Wound	Contamination	Soft-tissue damage	Bone injury
1	1 cm -	Clean	Minimal	Simple, minimal comminution
2	1 cm +	Moderate	Moderate, some muscle	Moderate comminution
3A.	10 cm +	High	Severe with crushing	Soft-tissue cover possible
3B.	10 cm +	High	Severe loss of cover	Requires reconstructive surgery
3C.	10 cm +	High	Vascular injury requires repair	Requires reconstructive surgery

AO classification



- Grading of skin (I), muscles and tendons (MT) and neurovascular (NV), each of which are divided into five degrees of severity

The “big 5” in open fracture care

- Treat as an emergency
- Debridement and redebridement
- Stabilize fracture and soft tissue
- Soft tissue care and early closure
- Antibiotics

The “big 5”

- **Treat as an emergency**
- Debridement and redebridement
- Stabilize fracture and soft tissue
- Early closure
- Antibiotics

Treat as an emergency

- General:
 - ATLS 1° survey
 - ATLS 2° survey
 - Tetanus
 - Antibiotics

Treat as an emergency

- Local
 - Do not expose unnecessarily (3–4x increase in infection rate)
 - Superficial foreign body can be removed
 - Saline dressing, alignment, and splinting
- Distal
 - Neurovascular status

The “big 5”

- Treat as an emergency
- **Debridement and re-debridement**
- Stabilize fracture and soft tissue
- Early closure
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Debridement

- Clinical assessment of tissue necrosis
- Highly subjective
- Two discreet phases:
 - Wound irrigation
 - Removal of all necrotic or devitalized tissue including bone

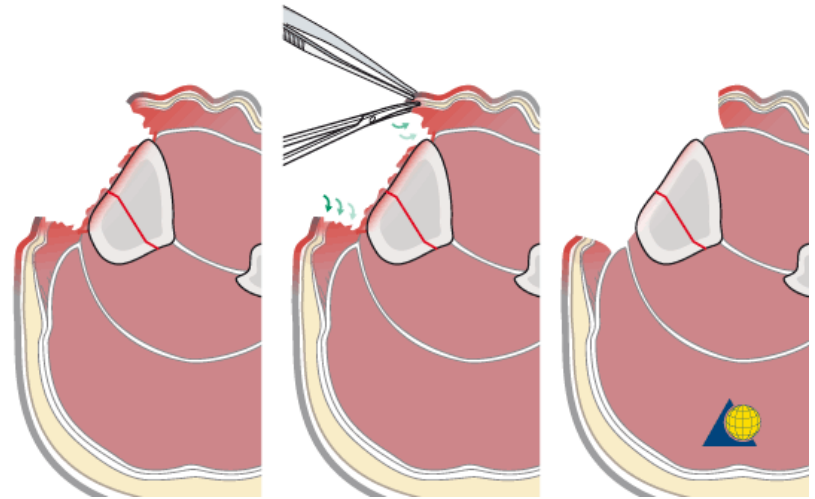
Irrigation

- Several liters of fluid
- Warm sterile saline
- Beware pressure systems
- Remove all foreign material
- “The solution to pollution is dilution”



Debridement

- Sequential
 - Skin
 - Fat and fascia
 - Muscle
 - Bone



Debridement

- No delay!
- Timelines are controversial
- Pitfalls:
 - Insufficient exposure
 - Too cautious
 - Poor planning

Fractures with open joint injuries

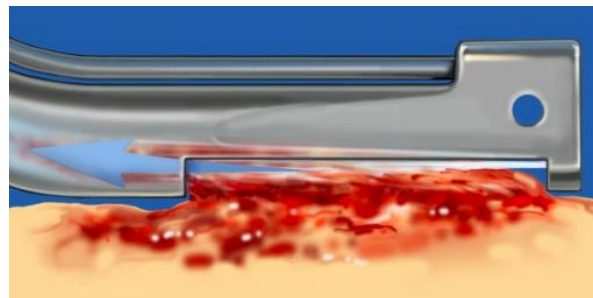
- Devitalized tissue must be removed
- Joint surfaces should not be allowed to become dry
- If possible, the open joint should be closed primarily
- If not possible, the joint must be kept clean and moist (moisture-retaining dressing) → early definitive closure

Re-debridement

- May be difficult to determine the viability of marginal tissue in the first stage
- → 48 h later planned re-debridement and secondary wound closure
- Conduct further tissue excision

Advances

- Antibiotic beeds or Genta fleece
- **Vacuum dressings (NPWT)**
- New dressings (silver)
- Hydro-scalpel



Negative pressure wound therapy (NPWT)

- Therapy not dressing
- Manages exudate
- Prevents colonization
- Promotes granulation
- Lower infection rate



- Liu et al. NPWT versus conventional wound dressing in the treatment of open fractures: A systematic review and meta-analysis. 2018 Int J Surg

The “big 5”

- Treat as an emergency
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- **Stabilize fracture and soft tissue**
- Early closure
- Antibiotics

Stabilize soft tissue and fracture

- External fixation:
 - Plan pins
 - Consider temporary versus definitive
- Internal fixation:
 - Depending on grade, contamination, fracture type and delay
- Bone defect → Masqualet technique

The “big 5”

- Treat as an emergency
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- **Early closure**
- Antibiotics

Closure (controversial)

- Primary closure → Grade I clean wounds and articular
- Delayed primary closure → Grade I, II and IIIA
- SSG or local/free flap → Grade III B & C
- Close co-operation with plastic surgeons

Delayed wound coverage

- > 5 days, independent risk factor for wound infection in open grade III tibia fractures.
 - Lack et al. 2015
- > 72 h, increases infection risk in grade III open tibia fractures
 - Mathews et al. 2015, Chua et al. 2014

The “big 5”

- Treat as an emergency
- Debridement and redebridement
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- Early closure
- **Antibiotics**

Antibiotics

- Prophylactic antibiotic therapy proven

Gosselin et al. Antibiotics for preventing infection in open limb fractures. Cochrane Database Syst Rev 2004

Lack et al. Type III open tibia fractures: Immediate antibiotics prophylaxis minimizes infection. J Orthop Trauma 2015;29:1-6.

- Start as soon as possible. > 66 min delay increases infection rate. Lack et al. 2015.

Antibiotics

- How? Intravenous (plus local?)
- Which? Protect against *Staphylococci aureus*
- Proportional to severity of injury!
- How long? 24–48 hours (until skin cover?)

Antibiotics

- How? Intravenous (plus local?)
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Antibiotics

- Second generation cephalosporin 1,5 g/8hours
- For more severe open fractures → gram negative coverage:
 - Piperacillin/ Tazobactam
 - or Ciprofloxacin + cephalosporin
 - or Aminoglycoside (according to weight, renal function)

Antibiotics

- How? Intravenous (plus local?)
- Which? Protect against Staphylococci aureus
- Proportional to severity of injury!
- How long? 24–48 hours (until skin cover?)

Duration of Administration of Antibiotic Agents for Open Fractures: Meta-Analysis of the Existing Evidence

Juergen Messner,¹ Costas Papakostidis,² Peter V. Giannoudis,¹ and Nikolaos K. Kanakaris¹

Prolongation of antibiotic treatment > 72 h did not seem to offer any protective effective against septic complications of open fracture.

Even shorter treatment 24-48h were also equivalent to prolonged regimens > 72 h

Take-home messages

- Operating room fast
- Adequate debridement
- Appropriate antibiotics and dressing (NPWT)
- Stabilize fracture and soft tissues
- Delayed closure within 72 hours