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## Disclaimer

- Some illustrations are from the internet and intended for educational purpose only

## Scope

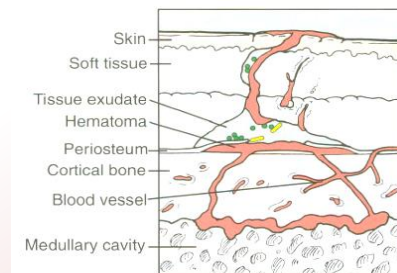
### Open fracture

- Definition
- Classification
- Management



## Open Fracture: Definition

- Condition when fracture site or fracture hematoma is connected to external environment through skin breakage
  - Formerly “compound fracture”
    - No longer use
  - Contamination of fracture site/hematoma
    - Risk of infection



## Open Fracture Classification [Anderson & Gustilo]

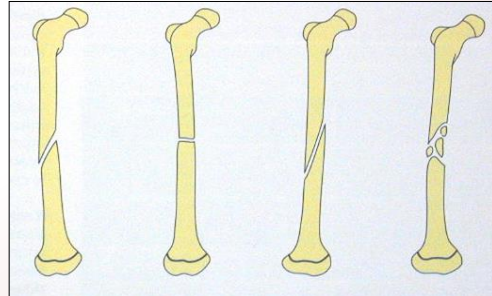
|         | Soft-tissue   | Bone  |
|---------|---|---|
| Grade 1 | Clean laceration $\leq 1$ cm  | Simple fracture                                       |
| Grade 2 | Laceration $< 1$ cm long<br>No extensive soft-tissue damage,<br>skin flaps, or avulsions.       | Simple or mildly comminuted fracture                  |
| Grade 3 | Laceration wound any size<br>Extensive soft tissue damage<br>(muscle, vessel, nerve, skin loss) | Segmental fracture or severely<br>comminuted fracture |

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| Grade 3A | + Maintain adequate soft-tissue<br>coverage of bone   |   |
| Grade 3B | + Periosteal stripping & bony<br>exposure<br>Usually severely contaminated                      |   |
| Grade 3C | + Arterial injury that requires repair<br>regardless of wound size                              |   |

## Fracture Configuration

- Simple fracture
  - One fracture line
    - Transverse
    - Oblique
    - Spiral
- Comminuted fracture
  - More than 2 bone fragments



## Open Fracture Grade 1



## Open Fracture Grade 2



## Open Fracture Grade 3A



## Open Fracture Grade 3B



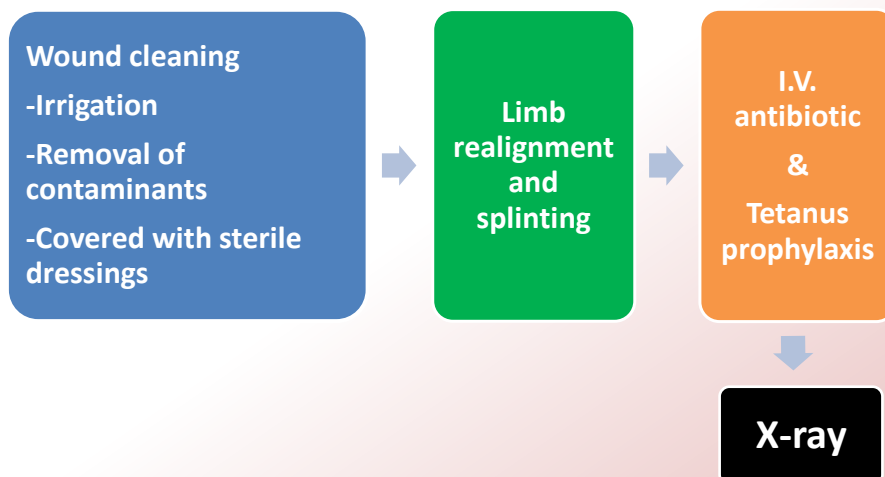
## Open Fracture Grade 3C



## Principle of Open Fracture Treatment

1. Aggressive wound debridement
  - Removed devitalized and/or contaminated tissue
2. Early antibiotic administration
3. Definitive fracture stabilization
  - Internal or external fixation
4. Delayed wound closure

## E.R Management



## Infection in Open Fracture

- Common organisms
  - *S. aureus*
  - *S. epidermidis*
- Antibiotic administration can reduce infection rate in open fracture by 59%
  - Use as therapeutic not prophylaxis treatment



## Antibiotic for Open fracture

| Type    | Antibiotic             |
|---------|------------------------|
| Grade 1 | Cefazolin              |
| Grade 2 | Cefazolin              |
| Grade 3 | Cefazolin + Gentamycin |

### Dosage

•Cefazolin            2g q 8hr

•Gentamicin        3-5 mg/kg/day

•Clindamycin is recommended if allergic to beta-lactamase

•Fluoroquinone is recommended if allergic to aminoglycoside



## O.R. Management

- When?
  - As soon as possible (emergency)
- How?
  - Debridement
    - All devitalized or contaminates skin, muscle, etc
  - Irrigation
    - NSS ± antiseptic or antibiotic
      - 3-9 liters depending on severity
  - Fracture stabilization
    - Internal or external fixation
  - Wound closure
    - May not be possible initially

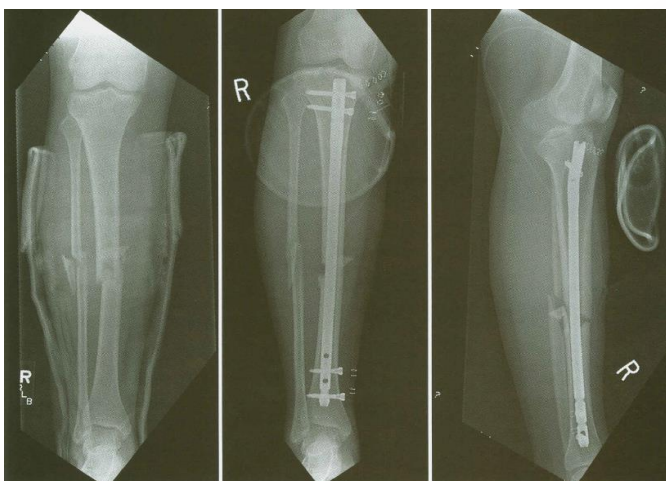
## Fracture Stabilization

| Type     | Recommended fixation                 |
|----------|--------------------------------------|
| Grade 1  | Any device suitable for the fracture |
| Grade 2  | Intramedullary nail                  |
| Grade 3A | Intramedullary nail                  |
| Grade 3B | External fixator                     |
| Grade 3C | External fixator                     |

## Internal Fixation: Plate-Screws



## Internal Fixation: Intramedullary Nail



## External Fixation



### **MANGLED EXTREMITY SEVERITY SCORE (MESS)**

#### **Determine Amputation VS Limb Salvage**

##### **•Parameters**

- Shock
- Skeletal/Soft-Tissue
- Ischemia
- Age

##### **•Interpretation**

- Scores of 3-6: Viable
- Scores of 7-12: Ultimately required amputation

| Type               | Characteristics           | Injuries  | Points |
|--------------------|---------------------------|---|--------|
| <b>Shock Group</b> |                           |   |        |
| 1                  | Normotensive hemodynamics | Blood pressure stable in field and in operating room  | 0      |
| 2                  | Transiently hypotensive   | Blood pressure unstable in field but responsive to intravenous fluids                                 | 1      |
| 3                  | Prolonged hypotensive     | Systolic blood pressure <90 mm Hg in field and responsive to intravenous fluid only in operating room | 2      |

| Type                              | Characteristics | Injuries  | Points |
|-----------------------------------|-----------------|---|--------|
| <b>Skeletal/Soft-Tissue Group</b> |                 |   |        |
| 1                                 | Low energy      | Stab wounds, simple closed fractures, small-caliber gunshot wounds      | 1      |
| 2                                 | Medium energy   | Open or multiple-level fractures, dislocations, moderate crush injuries | 2      |
| 3                                 | High energy     | Shotgun blast (close range), high-velocity gunshot wounds               | 3      |
| 4                                 | Massive crush   | Logging, railroad, oil rig accidents                                    | 4      |

| Type   | Characteristics | Injuries   | Points |
|--|-----------------|--|--------|
| <b>Ischemia Group</b> (*If ischemia time >6 hours, add 2 points) |                 |  |        |
| 1  | None            | Pulsatile limb without signs of ischemia   | 0*     |
| 2  | Mild            | Diminished pulses without signs of ischemia  | 1*     |
| 3  | Moderate        | No pulse by Doppler, sluggish capillary refill, paresthesia, diminished motor activity | 2*     |
| 4  | Advanced        | Pulseless, cool, paralyzed and numb without capillary refill                           | 3*     |
| <b>Age Group</b>   |                 |  |        |
| 1  | <30 Y           |  | 1      |
| 2  | 30-50 Y         |  | 2      |
| 3  | >50 Y           |  | 3      |

## Conclusion

- **Open fracture**
  - Definition
    - Fracture site/hematoma connected to wound
  - Classification [Anderson & Gustilo]
    - Degrees of soft-tissue injury (skin & vascular)
  - Treatments
    - Surgical emergency to reduce infection
    - Debridement & stabilization
    - Antibiotic administration is mandatory
    - Tetanus prophylaxis
    - MESS help determining if limb salvation is possible



**END**