Management of the Open Fractures

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Objectives:

- Discuss the evaluation of open fractures including physical exam and radiographic studies
- Define the use of antibiotics used with open fractures
- Discuss potential complications associated with open fractures
Assessing Injury

Dynamic / Integrated Process

Resuscitation

Emergency Intervention

Damage Control Orthopaedics

Surgical Intervention

Definitive Intervention
Primary Orthopaedic Survey

- Hemodynamic Instability
- Obvious Deformity Or Open Wounds
- Vascular Compromise To Limb
- Neurologic Deficit
Orthopaedic Management – Survey Of Injury

• Secondary Survey
  † Make A Limb Look Like A Limb
  † Re-assess Neurovascular Status
  † Provisionally Stabilize Long Bones & Pelvis

• Tertiary Survey
  † Re-evaluate All Tenderness, Crepitus, Ecchymosis
  † Radiograph Any Suspected Injury
    • 11-18% Fractures Missed On Initial Surveys
Orthopaedic Priorities

- Emergent Intervention
  - Provisional Pelvic Stability
  - Correct Ischemia
  - Reduction & Splinting

- Surgical Intervention
  - Pelvic Ex Fix
  - Wound Debridement
  - Provisional Stability

- Definitive Intervention
  - ORIF & IM Nails
  - Wound Coverage / Closure
What gets us out of bed?

Open Fractures
Pelvic Fractures
Compartment Syndrome
Open Fractures / Mangled Extremities
Open Fractures - History

High Mortality

High Amputation Incidence
## Open Fractures - Epidemiology

<table>
<thead>
<tr>
<th>Location</th>
<th>Total fractures</th>
<th>Open fractures</th>
<th>% open fractures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper limb</td>
<td>15,406</td>
<td>503</td>
<td>3.3</td>
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<tr>
<td>Lower limb</td>
<td>13,096</td>
<td>488</td>
<td>3.7</td>
</tr>
<tr>
<td>Shoulder girdle</td>
<td>1,448</td>
<td>3</td>
<td>0.2</td>
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<tr>
<td>Pelvis</td>
<td>942</td>
<td>6</td>
<td>0.6</td>
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<tr>
<td>Spine</td>
<td>683</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>31,575</strong></td>
<td><strong>1,000</strong></td>
<td><strong>3.17</strong></td>
</tr>
</tbody>
</table>

*Court-Brown CM, McQueen MM, Quaba AA (eds), Management of open fractures (1996)*

- Tibia - 21.6%
- Femur - 12.1%
- Radius/Ulna - 9.3%
- Humerus - 5.7%
Goals of Open Fracture Management

- Prevent Infection
  - Antibiotics
  - Debridement
  - Irrigation
- Salvage Limb
  - Fixation
  - Soft Tissue Coverage
- Restore Function
Injury Components

- Fracture
- Soft-Tissue Damage
- Neuro-Vascular Injury
- Contamination
Soft Tissue Injury

All Fractures Have Some Degree Of Soft Tissue Injury

Prognosis Determined By:
- Amount Of Energy Transferred To The Soft Tissue And Bone
- Degree Of Contamination & Type Of Bacteria
- Patient Factors
Energy Absorbed

KE = ½ mv²

Energy Transfer

👩‍🚒 Fall from curb
- 100 ft-lbs

👩‍🚒 Skiing
- 300-500 ft-lbs

👩‍🚒 High-Velocity GSW
- 2000 ft-lbs

👩‍🚒 Automobile Bumper @ 20 MPH
- 100,000 ft-lbs
Classification

Attempt To Quantify The Amount Of Energy Imparted And Therefore, The Prognosis

- Skin Wound Size
- Extent Of Contamination
- Extent Of Deep Soft Tissue Injury/Periosteal Stripping
- Fracture Configuration
Type I

- < 1cm, clean, inside to outside, minimal contusion, simple transverse or short oblique
Type II

> 1cm Without Extensive Soft Tissue Damage, Minimal To Moderate Crush, Simple Transverse Or Short Oblique With Minimal Comminution
Type IIIA

- Extensive Soft Tissue Injury With Adequate Bone Coverage, Segmental Fractures, High-energy Gunshot Injuries; High Energy Trauma Despite Size Of Wound
- Primary Closure
Type IIIB

Extensive Soft-tissue Loss, Periosteal Stripping And Bone Exposure, Usually Associated With Massive Contamination

Requires Flap Coverage
Type IIIC

Includes Arterial Injury That Needs Arterial Repair For Limb Salvage
Initial Treatment

- Examine Wound Once
- Remove Gross Contamination
- Apply Sterile Dressing
- Document Wounds
- Photograph
- Assess & Document N/V Status
- Reduce Fx / Dx
- Parenteral
Antibiotics

Early Parenteral Administration
1st Gen Cephalosporin
+/- Aminoglycoside
+/- PCN

Continue IV ATB 24 – 48 Hours After Wound Closure Coverage
Excisional Debridement

Surgical Urgency

 présence

 ? Emergency

 Clinical Studies Have Not Demonstrated Significant Negative Outcome In Delay To OR

 plus

 Depends On Severity Of Injury
All Open Fractures Goes To The OR In A Timely Manner
Excisional Debridement

Technique
- Extend Wounds
- Deliver Bone Ends
- Excise & Debride All Devitalized & Contaminated Tissue
Irrigation

.postMessage("Copious Lavage")
.postMessage("? High Pressure Vs Low Pressure")
.postMessage("? ATB Vs Soap Vs No Additives")
.postMessage("Wash It Until It Is Clean")
.postMessage("Irrigation No Substitute")
Fixation

- Restoration Of Length & Alignment
- Minimizes Inflammation And Repetitive Injury
  - Reduces Risk Of Infection
- Stabilizing Fracture Treats The Soft
Wound Management

+ Early Coverage Beneficial
  - However, Unclear How Early?

+ Wound Closure
  - Traditionally 3 Debridements
  - Reality When Healthy
Wound Management

Dead Space

- VAC
  - Assist In Wound Management
  - Temporizing
  - Possible VAC To Closure

- ATB Bead Pouch
  - Maintains Sterile Environment
  - High Concentration
Lessons Learned from LEAP Study

No one does really well

Scoring systems do not predict outcome (MESS)

Psycho-social issues play important role in long term outcomes

Outcomes continue to worsen with time

Absent plantar sensation not an indication for amputation

Avoid complications regardless of treatment path

Short term-AMP cheaper
Long term-Limb salvage cheaper
Open Fracture - Summary

Aggressive Rx
- Early IV Antibiotics
- Complete Excisional Debridement

Early Bone / Soft Tissue Stabilization

Early (????) Soft Tissue