

Clinical Practice Management Guidelines

Open Fracture Management

I. Classification of Open Fractures (Gustilo Classification)

Type I: Open fracture with a skin wound <1 cm in length and clean.

Type II: Open fracture with a laceration >1 cm in length without extensive soft tissue damage, flaps, or avulsions.

Type III: Open segmental fracture with >10 cm wound with extensive soft tissue injury or a traumatic amputation.

Special categories in Type III include gunshot fractures and open fractures caused by farm injuries.

III_A Adequate soft tissue coverage.

III_B Significant soft tissue loss with exposed bone that requires soft tissue transfer to achieve coverage.

III_C Associated vascular injury that requires repair for limb preservation.

II. Antibiotics for Open Fractures

A. Statement of the Problem

An open fracture, in which the fracture fragments communicate with the environment through a break in the skin, increases the risk of infection and soft tissue complications. It is accepted that the risk of infection and incidence of limb loss correlate with the Gustilo type. The prompt administration of appropriate antibiotics is believed to reduce these complications.

B. Recommendations

- Systemic antibiotic coverage directed at gram-positive organisms should be initiated as soon as possible after injury, within one hour of arrival from the scene, prior to transfer from outlying hospital.
- Cefazolin 1-2 gm every 8 hours.
- Clindamycin 900 mg every 8 hours (Pcn allergy).
- Additional gram-negative coverage should be added for type III fractures.
- Gentamicin 6 mg/kg daily for patients with normal renal function.
- Obese patients require dosing based on Dosing Weight.
- Piperacillin/Tazabactam may be used in place of Cefazolin/Gentamicin in the face of rhabdomyolysis and in impaired renal function.

- High-dose penicillin should be added in the presence of fecal or potential clostridial contamination (e.g., farm-related injuries) and in crush injury.
- Penicillin 2 million units every 4-6 hours.
- Fluoroquinolones offer no advantage compared with cephalosporin, aminoglycoside regimens. Moreover, these agents may have a detrimental effect on fracture healing and may result in higher infection rates in type III open fractures.
- In type III fractures, antibiotics should be continued for 72 hours after injury or not >24 hours after soft tissue coverage has been achieved. Antibiotic duration is at the discretion of the attending with consideration of specific patient circumstances.
- Once-daily aminoglycoside dosing is safe and effective for types II and III fractures.
- The hospital PI program should track timing of the administration of antibiotics.

III. Debridement and Irrigation of Open Fractures

A. Statement of the Problem

Operative debridement and irrigation (D&I) of open fractures has been considered essential to reduce the risk of deep seated infection. This has been challenged based on the availability of more powerful antibiotics and decreasing surgical workforce.

B. Literature

Malhotra, et al.

- Retrospective review of 404 patients with 415 open fractures at a Level 1 trauma center. Patients were stratified based on less than or greater than 8 hours to D&I.
- A delay of greater than 8 hours was an independent predictor of infection for the all-extremity model.
- The rates of infection were 35(11%) of 328 with D&I in less than 8 hours and 17 (19%) of 87 with D&I greater than 8 hours ($p < 0.05$) for all fractures combined.
- For the lower extremity, both a delay of greater than 8 hours and higher Gustilo type correlated with the development of infection.
- In the upper extremity, only higher Gustilo type correlated with rate of infection.
- A delay to the first D&I did not increase the incidence of infection in the upper extremity.
- The time to D&I in the delayed group averaged 11 hours, 4 minutes, so we do not know what effect further delay would have.

Recent Studies Evaluating the Impact of Delay in Operative D&I of Open Fractures

	n	Methodology	Population	Result
Skaggs et al.	554	Retrospective	Pediatric, all fractures	NS
Noumi et al.	88	Retrospective	Adult, femur	NS
Khatod et al.	106	Retrospective	Adult, tibia	NS
Harley et al.	241	Retrospective	Adult, all fractures	NS
Spencer et al.	142	Prospective	Adult, all fractures	NS
Pollak et al.	315	Prospective	Adult, lower extremity	NS
Kreder and Armstrong	56	Retrospective	Pediatric, tibia	p < 0.05
Kindsfater and Jonassen	47	Retrospective	Adult, tibia	p < 0.05
Current study	415	Retrospective	Adult, all fractures	p < 0.05**

*The time to operative D&I was not significant for infection, but the time from injury to trauma center was significant.

**For lower extremity only. NS = not significant.

C. Recommendations

- All lower extremity fractures should have D&I within 8 hours of injury.
- All upper extremity fractures greater than Gustilo Grade 1 should have D&I within 8 hours of injury.
- Gustilo Grade 1 fractures of the upper extremity should have D&I within 12 hours of injury.
- The hospital PI program should track time to D&I.

IV. Fixation of Closed Femoral Fracture

A. Statement of the Problem

The optimal timing for long-bone stabilization in multi-trauma patients is frequently studied and the results are mixed. The reported benefits of early fixation include increased patient mobilization, decreased pulmonary complications, lower sepsis rates, as well as decreased hospital care costs, mortality, hospital length of stay, intensive care unit LOS, and ventilator days. Other authors suggest that early fixation results in increased perioperative hemodynamic complications. Particular concern has been raised regarding operative treatment in patients with head and chest injury. Overall, there seems to be a consensus that early operative intervention benefits.

B. Recommendations (EAST)

- Polytrauma patients undergoing long-bone stabilization within 48 hours of injury have no improvement in survival when compared with those receiving later stabilization;

however, there may be some patients who will have fewer complications. There is no evidence that early stabilization has any detrimental effect. It is preferable to perform early long-bone stabilization in polytrauma patients.

- There is no compelling evidence that early long-bone stabilization in mild, moderate, or severe brain injured patients either enhances or worsens outcome. The timing of long-bone stabilization should be individualized according to the patient's clinical condition.
- There is no compelling evidence that early long-bone stabilization in patients with chest injury alters outcome. The timing of long-bone stabilization should be individualized according to the patient's clinical condition.

C. Other Literature

Cantu, et al.

- Retrospective review of 7,540 patients from NTDB with unilateral femur fracture.
- Surgical delay beyond 48 hours was associated with nearly five times greater mortality risk compared with surgery within 12 hours.
- The association between higher mortality rates and surgical delay beyond 48 hours was even stronger in the elderly patients.

Nahm, et al.

- Retrospective review of all patients at a Level 1 trauma center with operative femur, pelvis, acetabulum, and/or thoracolumbar spine injuries.
 - Patients were stratified based on whether fractures were treated early or in a delayed fashion (less than or greater than 24 hours).
 - Patients were also categorized as low- or high-risk groups using the early appropriate care protocol and as stable, borderline, unstable, or in extremis using a modified clinical grading system.
 - In the EAC analysis, low-risk patients treated early had fewer complications compared with delayed treatment. Among high risk patients, no significant difference was noted.
 - In the CGS analysis, stable patients treated early had fewer complications. No difference in complications was detected for unstable and in extremis patients.
 - Borderline patients treated early had fewer complications compared with delayed treatment, although results were not supported by sensitivity analysis.
- Based on this newer literature attempts should be made to stabilize long bone fractures within 48 hours of injury.
 - The hospital PI program should track time to stabilization of long bone fractures.

References

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