ORTHOPAEDICS

FOR PRIMARY HEALTH CARE

LION

LEARNING INNOVATION VIA ORTHOPAEDIC NETWORKS

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Wound debridement

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Learning objectives

1. Describe the pre-, intra- and post-operative principles concerning open fracture management and wound debridement.
2. Discuss a stepwise approach to the intra-operative technique of wound debridement.

Case presentation

A 24-year-old male is brought to the emergency department following a pedestrian-vehicle accident (PVA). After excluding all acute life-threatening injuries, you conclude that he sustained an isolated open fracture of the left tibial diaphysis. The lower limb shows an 8cm x 4cm anterior-medial wound with exposed bone (Figure 1).

Clinical picture showing open fracture of tibial diaphysis with exposed bone fragments

Assessment

History

Obtain a focused relevant surgical and medical history:

- Event, what happened, mechanism of injury.
- Complaints and symptoms.
- Past medical history.
- Medications.
- Allergies.
- Last oral intake or time of last meal.

Examination

- ATLS approach.
- Primary survey: Assess and address all life-threatening injuries involving the patient's airway, breathing and circulation. Stop any external bleeding with direct pressure. Cursory neurological assessment and expose patient as necessary for a full examination. Prevent hypothermia by limiting exposure to the environment.
- Secondary survey: Careful, systematic examination of the head, maxilla-fascial region, spine, chest abdomen, pelvis, perineum (PR/PV examination as indicated), full neurological assessment and musculoskeletal assessment of each limb.

In terms of the local examination of the injured lower leg:

Look

- Site, size and shape of the wound.

- Bleeding.
- Degree of wound contamination.
- Associated injuries including knee, ankle and foot examination.
- Abnormal swelling of individual compartments of the lower leg and foot could indicate compartment syndrome.
- Consider taking a photograph of the wound to prevent unnecessary removal of dressings.

Feel

- Assess individual compartments for signs of compartment syndrome.
- Palpate dorsalis pedis and tibialis posterior pulses and compare to the contralateral limb.
- Examine foot sensation.

Move

- Defer active movement of any fractured or dislocated limb.
- Test active flexion and extension of toes to test motor function (as pain allows).

Special investigations

- Arterial blood gas with lactate as indicated to assess ventilation and perfusion.
- FBC, U and E and creatinine and other blood tests guided by medical history.
- Anteroposterior (AP) and lateral X-ray views of the tibia (Including knee and ankle).
- Chest X-ray if there is any suspicion of chest injury on examination.
- Have a low threshold to obtaining pelvic and cervical spine radiographs.

Management

Pre-operative management

Pre-operative management entails primary management of the patient in the emergency department while undergoing fluid resuscitation. Control of haemorrhage can be obtained with direct compression on the wound as needed. The following steps must be taken:

- Broad-spectrum antibiotics and anti-tetanus prophylaxis (see open fracture management principles).
- Analgesia.
- Remove gross contaminants in the wound.
- Copious irrigation with saline until macroscopically clean.
- Apply sterile moist (saline) dressing, gauze and bandage (do not suture the wound).
- Re-align limb and splinting. Apply above-knee back slab.
- Prepare patient for surgical debridement in theatre.

Surgical or intra-operative management

Surgical debridement entails the sharp removal of all devitalised, damaged or infected tissue and foreign matter from a wound. Devitalised tissue and foreign material promote the growth of microorganisms, constitute a barrier for the host's defence mechanisms and should be removed1. Wound debridement is the most critical aspect of open fracture management and should be done within 24 hours of the injury. Inadequate debridement usually leads to fracture-related infections or chronic osteomyelitis.

Early adequate surgical debridement is best done by an experienced team of healthcare workers, including an orthopaedic surgeon, in the following stepwise manner:

- Pre-surgery soapy solution wash of the affected limb and a tourniquet is applied but not inflated.
- Limb prepped with chlorhexidine solution as per standard technique.
- The wound edges are extended as needed to expose the whole zone of injury. This needs to be done in consultation with a plastic surgeon not to jeopardise any future soft tissue flaps.
- Surgical debridement is done systematically using forceps, tissue scissors, scalpel, diathermy and curettes, from superficial to deep. Starting with skin, followed by fat, fascia, muscle and, lastly, bone from the periphery of edges to the centre of the wound to encompass the whole 'zone of injury'. All devitalised soft-tissue and bone (using the 'tug-test') are removed until only viable tissue remains. Both the proximal and distal bone fragments are delivered through the wound to clean the medullary canals.1

- Viability of muscle tissue is assessed according to the 4 Cs:
  - Colour (viable muscle is bright red).
  - Consistency (ischaemic or necrotic muscle becomes soft and friable).
  - Contractility (viable muscle tissue contracts when stimulated with diathermy or pinched with forceps).
  - Capillary bleeding (ischaemic or necrotic muscles has minimal bleeding).
- The following factors are assessed to evaluate if a bone fragment is viable:
  - Attachment to soft tissue (tug test).
  - Punctate bleeding of the bone when the tourniquet is released.
  - Necrotic bone becomes white or ivory and brittle, while viable bone has a slight pink hue and texture similar to living wood.
- Remain relatively conservative with the resection of skin and bone as these structures can be difficult to reconstruct. However, all non-viable tissue needs to be excised. If in doubt, consult a senior or re-examine tissue at wound inspection in theatre after 48 hours.
- Following this, copious, large volume, saline irrigation is used to lavage the wound to remove most microscopic contaminants. At least three to 9 litres or more are recommended until clean. High-pressure, low-pressure or ultra-low pressure lavage systems are all acceptable methods2.
- The debridement aims to turn a contaminated wound as close to possible to a sterile wound allowing the insertion of internal or external fixation, if appropriate, with the least risk of sepsis.
- At the end of the debridement, the wound is classified using the Gustilo-Anderson classification3.
- Moist, non-stick saline dressings or a bead-pouch technique could be used

post-debridement for wound coverage4.

- The wound is usually not primarily closed, especially in Grade III fractures, and a delayed re-look and wound closure is performed after 48 hours post initial surgery. The wound should not be left open for more than five days post-injury.
- The fracture is then stabilised using internal or external devices. See open fracture management.

Post-operative management

- Limb elevation to decrease swelling.
- Duration of antibiotic therapy is controversial. One to two days post definitive wound closure is a safe practise5,6.
- Mobilisation of the patient with physiotherapy can be commenced once soft tissue allows.

Essential takeaways

- Meticulous pre-, intra- and post-operative principles need to be adhered to for the prevention of fracture-related infection.
- The stepwise approach to intra-operative surgical debridement will yield the best possible outcome.
- Adequate soft tissue and bone debridement are reliant on surgical exposure, and the delivery of the fracture/bone ends through the wound to enable removal of foreign material.
- Adjuncts such as antibiotics, fracture stabilisation and irrigation should always be used.

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ABOUT THE BOOK

Informed by experts: Most patients with orthopaedic pathology in low to middle-income countries are treated by non-specialists. This book was based on a modified Delphi consensus study* with experts from Africa, Europe, and North America to provide guidance to these health care workers. Knowledge topics, skills, and cases concerning orthopaedic trauma and infection were prioritised. Acute primary care for fractures and dislocations ranked high.

Furthermore, the diagnosis and the treatment of conditions not requiring specialist referral were prioritised.

* Held et al. Topics, Skills, and Cases for an Undergraduate Musculoskeletal Curriculum in Southern Africa: A Consensus from Local and International Experts. JBJS. 2020 Feb 5;102(3):e10.

THE LION

The Learning Innovation via Orthopaedic Network (LION) aims to improve learning and teaching in orthopaedics in Southern Africa and around the world. These authors have contributed the individual chapters and are mostly orthopaedic surgeons and trainees in Southern Africa who have experience with local orthopaedic pathology and treatment modalities but also in medical education of undergraduate students and primary care physicians. To centre this book around our students, iterative rounds of revising and updating the individual chapters are ongoing, to eliminate expert blind spots and create transformation of knowledge.

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