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The principles and practice of open fracture care, 2018

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ABSTRACT

The principles of open fracture management are to manage the overall injury and specifically prevent primary contamination becoming frank infection. The surgical management of these complex injuries includes debridement & lavage of the open wound with combined bony and soft tissue reconstruction. Good results depend on early high quality definitive surgery usually with early stable internal fixation and associated soft tissue repair. While all elements of the surgical principles are very important and depend on each other for overall success the most critical element appears to be achieving very early healthy soft tissue cover. As the injuries become more complex this involves progressively more complex soft tissue reconstruction and may even requiring urgent free tissue transfer requiring close co-operative care between orthopaedic and plastic surgeons. Data suggests that the best results are obtained when the whole surgical reconstruction is completed within 48–72 h.

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Introduction

Major fractures are a massive epidemiological problem around the world, and while very severe injuries can occur in an intact soft tissue envelope, the management of an open injury is much more difficult as the wound exposes the fracture haematoma to contamination and adds a potentially complex soft tissue component to the required reconstruction. It is well established that the most serious open injuries should be dealt with by specialists but these injuries present to any surgeon providing emergency care so a universal understanding of their management essential (see Figs. 1–4).

Important concepts

The guiding specific principle in the management of the open fracture is the prevention of infection. The presence of a wound implies contamination but not primary infection, it is the key to treatment to prevent this contamination becoming established infection. In simple terms, bacterial multiplication will produce

infection and its likelihood will be increased by the size and virulence of the inoculum and susceptibility of the host. Factors that make progression to infection more likely include the presence of shock, local haematoma, dead space, fracture instability, none viable tissue and major co-morbidities including diabetes, reduced immuno-resistance and ischaemia. Bacterial factors include the size and nature of the initial inoculum and there are specific situations where the nature of any bacterial contamination is critical. However, in the majority of situations the importance of the initial inoculum has become much reduced and today if infection develops, it is usually due to hospital acquired organisms in the more modern world and reduced or delayed access to “modern” care in the developing world.

Discussion of systems of fracture care are beyond this article but the principles of clinical management involve the application of basic surgical fracture management principles to reduce the chance of infection. These are; appropriate primary assessment, wound management, gross fracture reduction and splintage, tetanus cover and early antibiotics followed by early effective surgical management. The surgical principles of open fracture care involve wound debridement to remove any dead or doubtful tissue, profuse lavage of the wound to reduce the size of the inoculum, fracture stabilisation to allow good soft tissue healing and reconstruction of the soft tissue envelope to protect the zone of injury from infection.^{1–4}

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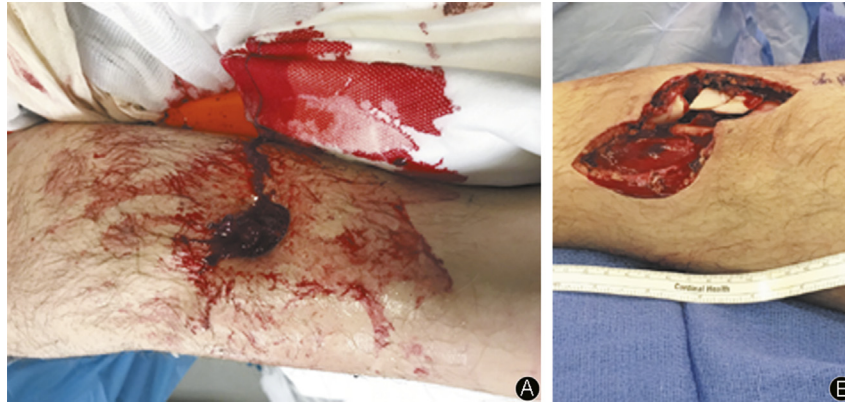


Fig. 1. A grade IIIA tibial fracture. The initial open wound (A) is small but needs extension (B) to display the zone of injury. There is a comminuted segmental fracture with one clearly devitalised fragment requiring debridement. After debridement direct healthy closure with adequate soft tissue was possible allowing classification as IIIA.



Fig. 2. After nailing there is a complex soft tissue defect over the distal tibia with exposed hardware (A). This is only suitable for coverage with free tissue transfer. Here a free muscle flap was used (B) and the surface subsequently covered with a split skin graft. A grade IIIB injury. The final result is excellent (C).



Fig. 3. The final result after a free fasciocutaneous (lateral thigh) flap to the distal leg for a grade IIIB injury.

Surgical principles of open fracture management

Debridement and lavage
Fracture stabilisation
Healthy soft tissue closure

Primary assessment and management

Assessment, tetanus, antibiotics and splintage

All patients presenting after major trauma should be fully assessed following a system such as ATLS which ensures a comprehensive primary clinical assessment, identifies specific injuries and allows prioritization of the care of each injury.⁵ Subsequent discussions in this paper will assume that there are no more significant life threatening injuries and that there are no clinical issues that will compromise management of the limb injury. In practise there are often general or local co-morbidities that

complicate the decision making and additional injuries that affect prioritization. The limb injury should always be assessed on the background of general patient care but equally major open fractures are limb threatening injuries and should not be under-prioritized.

The limb should be assessed for the signs of fracture and the severity of the wound assessed visually. Distal neurovascular function and simple digit motion should be assessed and recorded. Gross contamination may be removed but probing the wound, attempts at debridement in the emergency department or partial closure should not be done. A primary photograph of the wound is very useful and should be taken if possible and the wound should be covered with a sterile dressing. The fracture should be grossly realigned and the limb splinted.¹

Tetanus and antibiotics should be given urgently.^{6,7} It is accepted that the earlier the antibiotics are given the better but it must be emphasised that this is an adjuvant to surgical treatment and does not provide an increased window allowing surgical treatment to be delayed. Today for minor wounds a cephalosporin is given while for more major wounds, severe crush injuries, or agricultural injuries a Penicillin, and gram negative coverage perhaps with Gentamycin and anaerobic cover with Metronidazole can be added. It must be emphasised that while the provision of early anti-biotics is essential it does not allow excessive delay in surgical management.¹

Surgical management

Wound debridement and lavage

The patient should be taken promptly to the operating room for adequate wound assessment, debridement and lavage. We consider good tissue assessment and adequate debridement the most critical and most difficult element of open fracture care.

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