



the small animal surgeon

veterinary surgical specialist for dogs & cats

MANAGING AN OPEN FRACTURE

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An open fracture is one in which there is disruption of the soft tissue envelope that exposes the bone to environmental contamination.

The quality of the emergency care given by the first veterinarian to see the case has a very large impact on the patient outcome.

Managing open fractures can be more challenging. They are (by definition) at least contaminated, and are progressing toward infection. Open fractures are generally regarded as infected if their treatment is delayed past 8 hours. They are often 'high energy' fractures with significant local tissue devitalisation, problems with vascularity, dead space - and therefore have reduced local tissue immunity. The patient has also suffered severe trauma and other body systems are often affected.

1. BEFORE THE CONSULTATION:

An open fracture is an emergency because getting the antibiotics on board early makes a big difference.

Although it is frequently said that open fractures should or must be debrided within 6 hours, it has been difficult to prove a difference in infection rates with a delay. What DOES seem to matter is how quickly intravenous antibiotics are given. Bacteria rapidly multiply in the contaminated soft tissue and bone. Some bacteria (eg Staphylococci) form biofilms within 3 hours that protect them from the hosts defenses and from antibiotics. These biofilms can be mature and stable within 10 hours. If a biofilm forms on the damaged soft tissue, it is often removed with debridement. But it is much harder to debride bone, and bone biofilm is usually left behind. Staphylococci are also internalized within osteoblasts and are rapidly osteointegrated. Many antibiotics cannot penetrate the osteoblast cell membrane. So it is important to eliminate bacteria within the vascularised bone BEFORE biofilm forms, and before staphylococcal osteointegration.

First aid advice for the client might include muzzling the dog or towel wrapping a cat. In some cases, an oversized Elizabethan collar can act both to reduce self-trauma (licking and biting at the fracture) AND can be a useful 'spacer' between sharp teeth and faces and hands. Supporting the injured limb in or on a clean pillow and covering it with a clean dressing or linen might be appropriate. Only rarely is bleeding severe enough to justify the client applying a pressure bandage or tourniquet, but they might need reassurance and advice about this.

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2. INITIAL CONSULTATION:

Remember that many owners are very upset by seeing exposed bone. It might help to cover the injured site or move the patient into the hospital to allow the owner to calm down.

Treat the life-threatening injuries first. Most patients with open fractures will have other injuries - treat the 'ABC's first. By treating for shock you also help to preserve the circulation to the injured bone.

Assess neurovascular integrity distal to the fracture. This is not as easy as it sounds, but warmth, superficial and deep pain perception should ideally be assessed early on. In some cases, you need to give 'the benefit of the doubt' and reassess later if the patient is shocky or depressed.

Treat the pain. Animals in pain are far more likely to contaminate their fracture further and will be more difficult to manage properly.

-drugs (usually opiates)

-immobilisation (sterile dressing or lap pad first, 'soft' splint preferred)

Give IV antibiotics RIGHT AWAY. Early administration of antibiotics is thought to be the single most important factor in reducing infection risk. Broad spectrum cover is preferred, ideally covering for gram positives, gram negatives and anaerobes. However for a Grade 1 or 2 open fracture, IV cephazolin is probably sufficient. If you are not really sure if the bone has really been exposed, GIVE the antibiotics anyway.

The bacterial load in the bone itself might be more important than that in the contaminated soft tissue - this may be why early IV antibiotics are so important. If IV antibiotics are given within 3 hours of injury, the infection rate was reported as 4.7% (similar to a closed fracture). If they were given after 4 hours, the infection rate was 7.4% (nearly double).

Delay orthopaedic radiography until the patient is stable and antibiotics and pain relief have been given.

Client advice. In most cases, we have to tell the client that the full cost and prognosis cannot be assessed well until the patient is stable enough for good quality radiography and debridement. However, it is fair to say that open fractures are usually not amenable to external coaptation and thus will require surgical stabilization which may involve a significant cost.

It is also important to advise the client at some stage that the neurovascular status of the limb can change for the worse during the first week or so - and for all trauma cases it is useful to point out that many internal injuries (eg biliary or urinary tract) can take up to a week from the time of the trauma to show up.

Nursing. Very good patient care will be necessary to ensure the wound is not contaminated by faeces or urine, and that 'strike through' of bandaging does not

expose the bone to nosocomial infection. Nursing staff can also assist by 'pain scoring' or at least making close observations of the patient's welfare needs.

3. DEBRIDEMENT AND LAVAGE:

This should be done as soon as the patient's cardiovascular status allows anaesthesia or sedation.

Local blocks (eg epidural analgesia or brachial plexus block) can be done at this time.

Sterile lubricant is applied as a protective layer over the open wound
Clippers and clipper blades **MUST** be clean. Clipper blades are an important source for nosocomial infection. If the hair is wet and muddy, try a 'wet clip' with chlorhexidine scrub. Nosocomial infections are important and are common with open fractures - and hospital strains can have worse resistance patterns.

Strict aseptic technique. Gloves and sterile instruments are essential. Sterile gloves should be used whenever the wound is treated throughout the entire hospitalization period. Alcohol-based hand gel should ideally be used between patients when an animal with an open fracture is handled to reduce the risk for nosocomial infection.

Debridement should be conservative. Initially the focus should usually be on removing contamination rather than tissue. Do not remove very large pieces of bone, even if they do not have good blood supply. Preserve foot pads wherever possible. 'Tag' ligament and tendon ends. Debridement can be staged and done several times if needs be.

Lavage with sterile isotonic fluids or 0.05% chlorhexidine. Lavage should be copious (usually 1 - 2L), and the recommended lavage pressure is 7 - 8 psi. Without a pressure lavage system, a three way tap, 60 mL syringe, 19G needle and 1L bag of fluids is a reasonable compromise.

Post-debridement culture (commonest isolates are staphylococci, streptococci, klebsiella, E.coli, pseudomonas, clostridia, enterobacter)

Topical antibiotics? (if available - Collatamp G or Septopal beads because the circulation to an open fracture site might be too compromised for antibiotics to reach the bone).

Wound closure should only be attempted if the wound has been converted to a clean wound and if debridement and antibiotics have been administered very early. Avoid drains and avoid excessive skin tension ('tourniquet effect'). Cover the open wound with a sterile dressing - in many cases moist wound management is appropriate. NB Wet-to-dry dressings tend to dry the bone surface, and are prone to strike through so these will require frequent (eg BID) sterile technique bandage changes. Because periosteum tends to dessicate very readily, moist hydrogels and foams could be considered (eg Intrasite, Allevyn).

Support and immobilization - preferably a comfortable well-fitting splint.

AVOID unnecessary delays in fracture stabilization, and avoid prolonged open wound management. Even the higher grade open fractures are usually clean enough for surgery after 1 -3d. The longer the wound stays open the greater the risk for infection. For after the repair, consideration could be given to VAC (vacuum assisted wound closure) or to the use of pedicled muscle flaps if there is poor soft tissue coverage.

4. ASSESSING THE PROGNOSIS:

This usually cannot be done until after the debridement and radiography stage - and might require a specialist opinion. Many open fractures have a prognosis not dissimilar to their closed cousins if they are managed well in the emergency period. Grading systems have been developed to help both with decisions for fractures in general (fracture assessment scoring) and for giving a prognosis for open fractures specifically.

Fracture assessment scoring

Open fractures usually have 'bad' or adverse fracture assessment scores due to their high energy trauma, significant soft tissue damage, and contamination. This demands that they are repaired with more rigid and stable fixation in most cases.

Open fracture grading (see overpage)

The most commonly used open fracture grading system used is based on the Gustilo-Anderson open fracture classification scheme (see table overpage), although this grading has been found to not be overly repeatable between observers.

However, because there is a great deal of clinical variation **within** Grades 2 and 3, a more detailed assessment makes a lot of sense. The Orthopaedic Trauma Association has developed a new scoring scheme that grades the level of injury from 1 (mild) to severe (3) for five categories (skin, muscle, arteries, bone, and contamination). This additive score is not widely in use as yet, but might be more useful for future prospective studies.

5. FRACTURE FIXATION:

There has been a change in thinking regarding timing of fracture repair (historically much was made of using a staged approach with open wound management to 'clean' the fracture site before a definitive repair was done).

The fracture is ready for stabilization as soon as the patient is stable enough for general anaesthesia and when there is a level of confidence about the circulation and sensation distal to the injury, and the wound has been debrided - this might be as early as day 1.

Early stabilization will preserve the existing blood supply and will promote the ingrowth of new vasculature - thus helping to prevent (and treat) infection.

Because stabilization is probably THE most effective way of reducing fracture pain, early fixation can often be justified on welfare grounds as well. Bandage changes with an unstable fracture hurt!

Most grade 1 and 2 open fractures can be treated very similarly to closed fractures of the same configuration, whereas grade 3 fractures may present a strong case for rigid external fixation.

OPEN FRACTURE GRADING (modified from Gustilo-Anderson scoring)

Grade	Features	Infection rates (human)	Delayed or non-union rate (human)
1	<ul style="list-style-type: none"> • 1cm or less • wound comes from the 'inside out' (sharp bone lacerates skin) 	approx. 6%	< 5%
2	<ul style="list-style-type: none"> • wound larger and or can be from the 'outside in' • no extensive soft tissue damage, flaps or avulsions 	approx 6%	< 14%
3	<ul style="list-style-type: none"> • any larger wound • 'outside in' wound • more soft tissue injury <p>3A: no major skin reconstruction needed to cover bone or close wound 3B: inadequate soft tissue for closure - reconstructive procedures needed 3C: arterial injury requiring vascular repair</p>	up to 30%	2 - 37%
(4)	severe neurovascular injury and soft tissue damage - usually near amputation	NA	NA

External coaptation is rarely practical due to wound management and stability requirements - with the possible exception of minor toe injuries.

External fixation (both linear and circular) is usually a good choice, but the frames used must provide adequate stability. The fact that metal implants are not left at the fracture site is thought to be an advantage, and they are usually applied with an 'open but do not touch' approach to preserve blood supply.

Very good results have been reported in the literature using external fixation both for 'fresh' and infected open fractures (see refs) although in cats IM pin fixation of the ulna as well as the radius has been recommended for antebrachial fractures where smooth EF pins are often used due to size constraints.

Intramedullary pins or interlocking nails can be used but there is a theoretical concern that the implant might seed the entire medullary cavity with infection.

Plate fixation provides good stability and the advantages of good stabilization probably outweigh the disadvantages of metal implants at the fracture site. However, a more extensive approach is usually required, and this might affect vascularity.

Bone grafting can be used for certain cases where infection is controlled. Cortical graft should be avoided because of the risk for sequestrum formation. Although there have been reports of cancellous bone being applied under petroleum gauze dressings, cancellous graft is more likely to survive if there is an adequate soft tissue covering, and in many cases grafting is delayed until there is adequately vascularized granulation tissue over the fracture. Separate gloves and instruments should be used for collecting cancellous graft to ensure the donor site is not contaminated.

6. MANAGING A FRACTURE THAT IS ALREADY INFECTED:

Patients often go AWOL for more than 8 hours after an accident, and infection is often well established by the time we see them for care. The initial management is similar, with debridement and wound cultures, good radiographs, and broad spectrum antibiotics intravenously (pending the culture results). However, antibiotics can't get to the fracture site until the circulation is re-established. Antibiotics will penetrate the fracture site more completely if it is rigidly stabilized and re-vascularising - meaning surgery should not be unduly delayed. External fixation can be an excellent choice for these patients, provided very rigid frames, threaded pins, and good technique are used.

IN SUMMARY:

Not all open fractures get infected or 'end in tears' - many cases deserve a specialist opinion if there is uncertainty.

Open fractures are likely to need maximum stability for a good outcome.

Early administration of IV antibiotics is very important.

Surgical stabilisation should not be unduly delayed.

EXCELLENT PRE-OPERATIVE CARE IS KEY TO SECURING A GOOD OUTCOME - this is an area where you can make a big difference.

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