Osteomyelistis, Delayed and Non-Unions: How Did I Get Myself into this Mess and How Do I Get Out?

Liz LaFond, DVM, DACVS, CCRP
University of Minnesota
Saint Paul, MN

It is important for a surgeon to be aware of complications that can occur associated with fracture repair so that everything possible can be done to prevent those that are avoidable and to recognize and promptly treat those that are not. The objective of this session is to provide the practitioner with an overview of osteomyelitis and related postoperative fracture complications. We will review the pathogensis, diagnosis, management and prognostic factors for osteomyelitis, and relate it to delayed and non- unions. We will discuss the decision-making process to manage a variety of simple fracture cases that have developed complications and, more importantly, the steps and considerations to have in mind so as to prevent them.

Even in the most complicated cases, patients healing from fracture repair should begin having use of their injured limb within days following definitive fracture stabilization. Steady improvement in the function of the limb should be seen throughout the healing period. In adult patients, clinical union (time until patient can bear weight without pain) should occur within 6-8 weeks. In juvenile patients, clinical union can occur as early as 3-4 weeks. Any fracture patient that has residual pain beyond this time or who is not on track for resolution of lameness may have fracture complications and should be evaluated promptly. Pain during palpation directly over the fracture site later than 4-5 weeks post treatment may be suggestive of instability. Causes of residual instability include infectious or non-infectious causes.

Osteomyelitis

Osteomyelitis is "inflammation of bone" including bone marrow, cortex, and sometimes periosteum. Bacterial infection is the most common cause. The pathogensis of osteomyelitis can be from either hematogenous or exogenous sources, however, in the case of fracture- or trauma-associated osteomyelitis, the source is generally exogenous.

Preventing osteomyelitis – Bone is normally quite resistant to developing infection. Factors required for osteomyelitis to develop include a source of infective agent and a paucity of blood supply to the healing bone. Organisms can be introduced during the original trauma (as with open fractures) or be introduced during surgery. Similarly, blood supply can become compromised to varying degrees during initial trauma, but can also occur or be exacerbated during surgical fracture repair secondary to suboptimal surgical technique. If host defenses are compromised secondary to preexisting systemic illness or to systemic injury associated with trauma, risk for osteomyelitis can be increased.

During initial evaluation, it is important to recognize if a fracture is open so that it can be treated accordingly. Copious lavage and careful debridement are hallmarks of infection prevention. The balance between enough debridement to ensure control of residual bacterial load and conservative enough debridement so as to preserve vital blood supply can be challenging with some fractures. Culture/sensitivity-based or broad spectrum antibiotic treatment is indicated if there is any question about residual organisms at the end of surgery.

The role that surgical manipulation can play in the development of osteomyelitis is often overlooked. Bone fragments with tenuous blood supply can become further compromised if a surgeon is not careful about tissue handling and maintenance of tissue perfusion. Comminuted fractures are usually associated with high-velocity trauma and can include substantial soft tissue damage whether the fracture is open or closed. Retained bone fragments that progress to develop no blood supply secondary to osteomyelitis are termed sequestra. The risk for development of a sequestrum may be increased with tissue damage during surgery, from a failure to remove significantly devitalized bone, inadequate recognition and treatment of osteomyelitis, or all these.

Recognizing osteomyelitis - Patients with well-repaired fractures normally have at least partial limb function within days of surgery and show steady improvement of the operated limb. The first hint that a problem is developing may be recognition of later than expected return to limb function. Rarely, severe, acute, osteomyelitis can be associated with systemic illness. More commonly, osteomyelitis is identified in the chronic stages and associated only with local signs. Radiographic evaluation is the hallmark of diagnosis. Radiographically-apparent changes can begin to develop 10-15 days after onset of infection. Draining tracts associated with osteomyelitis can be identified quite remote from the source. Imaging techniques such as fistulograms can be very helpful to identify the source of drainage. Culture of drainage can direct antibiotic treatment.

Treatment for osteomyelitis - Bone can heal in the face of infection if rigidly stabilized. Considered another way, some degree of instability is often involved if osteomyelitis is present. Therefore, strong consideration for surgical intervention should be made, whether the intervention involves complete revision of the fracture or removal of implants only. In severe cases, treatment may be staged, including surgical revision with later removal of implants once complete stabilization is achieved. For this reason, external

fixation is often elected for revision surgery because subsequent removal does not require open surgery. Regardless of the fixation method used to treat osteomyelitis, the emphasis is on rigid stabilization.

Delayed union, nonunion

Any fracture that is not healed within the expected time frame is, at minimum, a delayed union. Factors that may affect the expected time to clinical union include patient age, general patient health, co-morbidities, location and configuration of the fracture, presence of infection, associated soft tissue damage, and the type and stability of fracture fixation. If no union occurs, it is termed a nonunion. Delayed unions and nonunions may be related to osteomyelitis but can develop under sterile circumstances as well.

Management for delayed union - Union can be delayed secondary to infection or associated with micromotion of the fracture fragments or implants. It has been stated that up to 80% of delayed unions are associated with surgical technique, providing the surgeon with ample opportunity to prevent this complication. Appropriateness of implant choice and placement is often overlooked. An understanding of the forces that need to be counteracted during healing (bending, torsion, shearing, tension, and compression) is necessary to ensure appropriate implant application.

In some less severe cases, delayed union can be managed with additional time and activity modification. Bone healing enhancing agents such as bone morphogenic protein (BMP) and bone graft, placed percutaneously, may be of help, however, the practitioner must ensure that the bone fragments are in an environment that will allow for healing. Therefore, these are often used in conjunction with surgery. Surgical treatment of delayed union includes freshening of the bone fragment ends, opening the medullary canal, and providing rigid fixation with compression of fracture ends.

Management for nonunion - Fracture nonunion can be hypertrophic (viable) or atrophic (avascular or non-viable) and occurs when there is a complete failure of fracture ends to unite. Causes for non-unions can be similar as for delayed unions. Unlike delayed unions, however, nonunions cannot be treated without surgical intervention. The basic principles used during surgery are the same as for delayed unions: extraneous tissue must be removed and the fracture ends freshened to expose normal healthy cortical bone, the medullary canal must be opened, and fixation must be rigid. Oligotrophic or atrophic nonunions especially, may require bone healing enhanceming techniques.

Conclusions

Complications with fracture repair are a reality. By understanding the pathophysiology and etiology of these complications and adhering to sound surgical principles when managing fractures, surgeons can minimize their incidence. Prompt recognition and treatment of developing complications requires diligent monitoring of postoperative patients and can reduce the deleterious effects on patients.