Posttraumatic Reconstruction of the Foot and Ankle in the Face of Active Infection

Brandon Jonard, MD[a], Erin Dean, MD[a,b,*]

KEYWORDS

• Posttraumatic • Reconstruction • Osteomyelitis • Antibiotic spacer • External fixator

KEY POINTS

- Many options exist in the treatment of posttraumatic infection in the foot and ankle.
- Making the diagnosis often requires combining laboratory and radiologic testing, patient examination, and history.
- Antibiotic and surgical treatments should be tailored to individual patients based on the nature of their injury, extent of infection, comorbidities, and overall functional expectations.

INTRODUCTION

Posttraumatic infection of the foot and ankle is a challenging issue for orthopedic surgeons. Whether infection sets in as a result of the initial severe soft tissue injury or as a postoperative complication, clearing infection to allow successful reconstruction can be frustrating. Patient factors must be taken into account to determine the best approach for treatment. Thorough debridement is paramount followed by appropriate antibiotic treatment to clear the infection. Reconstruction can then be individualized based on host factors, type of injury, extent of bone or soft tissue loss, and patient expectations. Despite appropriate surgical and antibiotic treatment, the long-term recurrence rate for chronic osteomyelitis is about 20%.[1]

PATIENT EVALUATION: MAKING THE DIAGNOSIS

Often the presence of infection is clear with draining sinuses or wounds, erythema, or radiographic evidence of osteomyelitis. Other times the diagnosis may be more elusive. Imaging and laboratory studies as well as tissue cultures are included in the standard workup for infection.

Laboratory Testing

Laboratory values can be helpful but are nonspecific. Erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), and white blood cell (WBC) levels should be obtained first. These tests are nonspecific but have been reported to have a sensitivity and specificity greater than 90% for the diagnosis of osteomyelitis, especially when used in combination.[2] Serum procalcintonin is a newer additional test with a high specificity for bacterial infection, which can be helpful for both diagnosing infection and monitoring treatment. Procalcitonin has been studied in acute osteomyelitis and septic arthritis in all age ranges and has been found to be a sensitive and specific marker at a cutoff of greater than 0.4 mg/mL.[3]

Imaging Studies

Radiographs

Plain radiographs are generally obtained first. In the presence of acute osteomyelitis, radiographs

Disclosure statement: The authors have nothing to disclose.

[a] Summa Health System, Department of Orthopedic Surgery, 444 North Main Street, Akron, OH 44309, USA;
[b] Crystal Clinic Orthopedic Center, 1310 Corporate Drive, Hudson, OH 44236, USA
* Corresponding author.
E-mail address: erindean@crystalclinic.com

Orthop Clin N Am ■ (2017) ■–■
http://dx.doi.org/10.1016/j.ocl.2016.12.012

may be negative because radiographic signs of infection are not visible for about 2 weeks after the onset of infection.[4] With more chronic infection, sclerotic bone may be present surrounding an infectious sequestrum.[4] Cortical destruction may also be present.[4] In the setting of posttraumatic infection, radiographs can be helpful to evaluate the traumatic bone injury, presence of nonunion, and extent of bone resorption to plan for surgical debridement and reconstruction. Comparing current radiographs to past and future radiographs can help to follow the progression of treatment as well.

Computed tomography

Computed tomography (CT) scans best demonstrate cortical destruction, periosteal reactions, and sequestrum.[4,5] Limitations include image degradation by streak artifact when metallic hardware is present and poor soft tissue and bone marrow resolution.[5,6] CT scans can be helpful when planning reconstruction, however, due to their 2- and 3-dimensional imaging capabilities that allow for better defining bone injury, presence of nonunion, and spatial relationships.

MRI

MRI is often the imaging option of choice for diagnosing osteomyelitis due to its early diagnostic capability. MRI can show bone marrow edema after only 1 to 2 days of onset of bone infection.[7] MRI has a sensitivity in diagnosing osteomyelitis of 82% to 100% and a specificity of 75% to 96%.[5] MRI can be helpful in showing abscess formation, sinus tracts, and soft tissue inflammation as well. MRI, however, is less helpful in the posttraumatic patient due to signal changes from the injury itself and susceptibility artifact from hardware.

Nuclear imaging

Nuclear imaging can provide a more specific evaluation for osteomyelitis without being compromised by the presence of hardware. The standard triple phase bone scan has a high sensitivity for identifying osteomyelitis in nonviolated bone.[4] However, increased osseous tracer uptake is noted in trauma or previous surgery, which decreases the usefulness of this test in the posttraumatic setting.[4,5] The nuclear medicine test of choice for these patients is a white cell scan in which the patient's WBCs are labeled with either Indium-111 or Tc^{99m}-HMPAO, before being intravenously returned to the patient.[4,5] These labeled white cells have increased uptake in infected bone. The WBC scan is combined with a standard bone marrow scan to differentiate from normal physiologic marrow uptake.[8] When a WBC tagged scan is combined with a bone scan, the specificity is 80% to 90%.[5] Chronic or partially treated osteomyelitis can have false negative results.[5]

Deep Tissue or Bone Culture

The best way to diagnose osteomyelitis remains a deep bone biopsy. A positive culture provides a high level of specificity in the diagnosis of osteomyelitis. However, cultures have a low sensitivity with only 40% to 60% of patients with infection showing positive culture results.[9] Multiple intraoperative tissue samples encompassing the entire zone of infection should be obtained at debridement.[10]

INITIAL TREATMENT

1. Thorough debridement(s) to remove all nonviable tissue
2. Effective antibiotic treatment
3. Address patient-specific factors that may impede healing

Debridement

Upon diagnosis of infection, the patient should undergo thorough debridement to remove all evidence of necrotic tissue. Bone should be debrided until healthy-appearing bleeding bone remains and all sequestrum is removed. Multiple debridements may be required until no macroscopic sign of infection is present.[10] If hardware is present in the infected area, it should be removed if loose or unstable or if the bone is well healed. If the hardware is stable and the bone is nonunited, then the hardware may be left in place until the bone is healed.[11] Retaining hardware can reduce cure rates, however, due to biofilm formation.[12] In the presence of retained hardware, greater treatment success can be expected for patients infected with a single, less virulent organism compared with a more aggressive or multiple organisms[13] (**Fig. 1**).

Antibiotic Treatment

With extensive deep infection or osteomyelitis, obtaining the assistance of an infectious disease specialist can be very helpful for optimizing antibiotic treatment. Antibiotic treatment options and duration should be patient specific and culture directed. Polymicrobial infections are common in the foot and ankle, especially in those with diabetes, vascular disease, or immunocompromised patients.[10] *Staphylococcus aureus* is a very common pathogen in the foot and ankle, occurring in around 80% of infected patients in