Puncture Wounds and Osteomyelitis

General Facts
- Puncture wounds in the feet occur the most in warm weather months (peak in July), and in children and adult males who have a construction related occupation.
- Reinherz et al. – puncture wounds accounted for 7% of lower extremity trauma presenting to ED.
- 3-10% of all puncture wounds to the foot result in complication (as high as 33% in diabetics).
  - Soft tissue infection, osteomyelitis, deep abscess, tendon laceration, nerve injury, significant vascular disruption.

Risk of Developing OM
- Rubin et al. – patients who were diabetic, elderly and with a longer standing injury most likely to develop OM and have less successful treatment outcomes.
  - 1 day increase in duration decreased probability of successful outcome by 26%.

Diagnostic Imaging
- Radiographs – all metal objects and larger (>5mm) non-metal objects like glass and wood, not plastic.
- Ultrasound proven to be better than CT at detecting radiopaque objects, and can also assess extent of complications such as tendon laceration.

Microbiology
- Some conflicts in the literature, but 3 main organisms cultured from puncture wounds:
  - Pseudomonas, Staph. aureus, group A Strep (in no particular order…)
- Laughlin and Armstrong – most common pathogen in soft tissue infections was Staph aureus, most common in OM was Pseudomonas.
- Patzkis – Pseudomonas was grown from 93% of patients with OM who were wearing tennis shoes.
- Eidelman et al. – most common organisms were Staph aureus and group A Strep.
- Rubin et al. – surgical cultures in patients with OM grew Staph aureus in 4:1 ratio to Pseudomonas.
- Deep, contaminated wound – Clostridium tetani
- Marine water environments – Aeromonas hydrophila and Mycobacterium marinum

Antibiotics
- Broad-spectrum to cover gram positives and gram negatives, especially Pseudomonas.
  - Third generation Cephalosporins (ceftazidime).
  - Ciprofloxacin and Clindamycin.
  - Zosyn.
- Tetanus immunization

Summary
- Factors that increase risk of OM – forefoot location, depth, duration (>1wk), comorbidities, age, shoes.
- Treat high-risk cases with broad-spectrum antibiotics to cover S. aureus, Pseudomonas, group A Strep.

References


Laughlin, Armstrong "Soft tissue and bone infections from puncture wounds in children"
- In a review of 44 children admitted to hospital for puncture wounds of the foot, cultures were positive for osteomyelitis in 7 patients (16%), all involving the forefoot (P<.04). The most common pathogen in soft tissue infections was *Staphylococcus aureus*. The most common pathogen in osteomyelitis was *P. aeruginosa*.

M. Eidelman, V. Bialik, Y. Miller et al. "Plantar puncture wounds in children: analysis of 80 hospitalized patients and late sequelae"
- Patients had established infection from plantar foot puncture, did not differentiate if wearing a shoe or not.
- The most common organisms were *S. aureus* or group A Streptococcus
- 10 out of the 80 patients had OM

- 33% had OM
- Patients with punctures involving the forefoot and patients who wore shoes at the time of the injury were more likely to develop osteomyelitis than patients who had rearfoot injury and patients who were barefoot at the time of injury

Nail Puncture Wound Through a Rubber-Soled Shoe: A Retrospective Study of 96 Adult Patients

Guy Rubin,
- The operated group had a longer duration of time from injury to hospital admission than did the nonoperated group (5.0 _ 6.8 days versus 2.7 _ 3.8 days, P < .05)
  - a 1-day increase in the duration of time from injury to presentation to the hospital statistically significantly decreased the probability of successful treatment by 26%
- *Pseudomonas, Staph aureus, Group A beta hemolytic Strept*
- most of the bacteria identified on culture were *S. aureus* (12 cases) and not *P. aeruginosa* (3 cases). We found 8 cultures with gram-negative and 16 with gram-positive organisms. Cultured in surgery, not specific if from bone or soft tissue.
- The current literature and our findings suggest that a diabetic patient, an elderly patient, a patient with a long-standing injury, and a patient in whom the injury failed to respond to antibiotic treatment should be admitted for further investigation and treatment

Diagnostic imaging
- Metal objects such as pins and nails are easily visible. Glass may be visible if it contains lead or if the fragment is large enough, as will wood splinters that are large enough to cast a shadow on the radiograph. Plastic is not seen
- Ultrasound is an accurate test for detection of foreign bodies and to assess potential complications such as tendon laceration. The performance of ultrasonography for visualizing foreign bodies with low radiopacity is better than CT

Microbiology
- The most common gram-positive organisms isolated in these wounds are *S. aureus, alpha-hemolytic streptococci* and *Staphylococcus epidermidis*. Gram-negative organisms isolated from these wounds have included *Escherichia coli, Proteus*, and *Klebsiella species*
- In marine water environments: *Aeromonas hydrophila* and *Mycobacterium marinum*
- *Pseudomonas* is the most common organism responsible for osteomyelitis secondary to puncture wounds
• Clostridium tetani. Infection generally occurs through wound contamination and often involves a cut or deep puncture wound.

Antibiotics
• A broad-spectrum antibiotic for coverage of gram-positive and gram-negative organisms and P aeruginosa should be used. Oral ciprofloxacin 500 mg twice daily or levofloxacin 500 mg daily should be prescribed for a 10-day course.
• Antipseudomonal penicillins, ticarcillin and piperacillin (200–300 mg/kg/d in divided doses, every 4–6 hours), provide excellent gram-positive and gram-negative organism coverage. Third-generation cephalosporins, ceftazidime (1 g intravenously [IV] every 8–12 hours) and cefoperazone (1–2 g IV every 12 hours), also provide Pseudomonas, gram-positive, and gram-negative coverage. Aminoglycosides also provide Pseudomonas coverage and are an option for patients with a penicillin allergy.

References
Laughlin, Armstrong “Soft tissue and bone infections from puncture wounds in children”