**Antibiotic Nail Placement for Infected Unstable Long Bone Nonunions**

Clifford B. Jones¹,², Debra L. Sietsema³, Matthew R. Karek⁵

¹Grand Rapids Medical Education and Research Center, Michigan State University, Grand Rapids, MI; ²Orthopaedic Associates of Grand Rapids, Grand Rapids, MI; ³College of Human Medicine, Michigan State University, East Lansing, MI
dsietsema@oagr.com

**Introduction:** Intramedullary nailing is a common treatment of long bone fractures. Even though closed fracture nailings have low rates of infections, open fractures have higher rates of nonunions and infections. A treatment dilemma exists when both an infection and nonunion are present. Treatment requires nail removal to rid the infection and nail insertion to stabilize the fracture.

**Materials and Methods:** Over a 5-year period, 2002-2007, 19 consecutive patients with infected unstable long bone nonunions were treated with an intramedullary antibiotic (IABX) nail. All IABX nails were prepared with a pressurized mixture of 2 units polymethylmethacrylate (PMMA), 2 grams vancomycin, and 2.4 grams tobramycin inserted into a 32 French chest tube. The nail was stabilized with a 3.2 mm guide pin through the center. The chest tube was removed when the IABX nail was hard. A retrospective evaluation of parameters was performed. Patients were followed until the infection was alleviated and the nonunion was healed.

**Results:** The gender was 10 male and 9 female patients. Age averaged 45 years old (range 17-71). Tobacco consumption was prevalent (21.1% current smokers of 1-2 packs per day, 21.1% reformed smokers, 57.8% nonsmokers). The long bone fractures were 13 tibia and 6 femoral fractures. 63.2% (12/19) were open fractures initially. 57.9% (11/19) acute fractures were initially treated with a nail. 52.9% were initially polytrauma injuries. 36.8% were referral patients. 36.8% (7/19) were debrided before initiating IABX nail insertion. 26.3% (5/19) failed antibiotic bead insertion. 31.6% (6/19) infections were refractory to all prior attempts of infection eradication. Culture results revealed methicillin resistant Staphylococcus aureus (5), Streptococcus (3), methicillin sensitive Staphylococcus aureus (2), Enterobacter (2), Pseudomonas aeruginosa (1), Serratia marcescens (1), Aspergillus (1), diphtheroids (1). Infections were isolated bacteria (15), two bacterium (3), and three bacterium (1). Average hospital stay for the IABX nailing was 10.2 days (range 4-19). The number of surgical debridements before final IABX nail insertion were 1 (n=6), 2 (n=3), 3 (n=7) or ≥ 4 (n=3). Average IABX insertion duration was 16.4 days (range 2-49). No IABX nail complications (breakage, removal problems) were noted. All nonunions were eventually treated with a stainless steel nail. Postoperative antibiotics were given orally (n=2), intravenous (n=9), or none (n=8). Eleven nonunions did not require any stimulus to heal while 2/19 required iliac crest bone graft and 7/19 bone morphogenetic protein for segmental defects. All nonunions were treated until union.

**Discussion:** Infected long bone unstable nonunions are costly complications in terms of time and resources. Local delivery of high concentrations of antibiotics via IABX nailing achieves infection control while avoiding systemic intolerance and complications of antibiotic use. Systemic antibiotics usage is diminished which decreases costs and avoids the development of resistant strains of bacteria. IABX nailing reduces repeated debridement surgeries and provides stability for weight bearing and earlier return to physical functioning. In this population, temporary intramedullary antibiotic nail insertion removes intramedullary infection, stabilizes the nonunion, and prepares the environment for definitive long bone nailing.