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Antibiotic cement nail for the treatment of posttraumatic intramedullary infections of the tibia: Midterm results in 10 cases

Marcin Krzysztof Wasko [a,*], Olivier Borens [b]

[a] Department of Orthopaedics and Inflammatory Disorders of Locomotor System, The Medical Centre of Postgraduate Education, Otwock, Poland
[b] Département de l'appareil locomoteur, Orthopaedic Trauma Unit, Centre Hospitalier Universitaire Vaudois and University of Lausanne, Lausanne, Switzerland

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ABSTRACT

Introduction: This is a single, level 1 trauma centre, prospective consecutive patient series with intramedullary infection in the presence of unstable tibial fracture treated using the Kirschner wire-reinforced, antibiotic cement nail.

Patients and methods: A total of 10 consecutive patients (eight males and two females) with a mean age of 42 years (range, 20–59) suffering from infection after intramedullary nailing for tibial fracture, admitted during a period of 4 years, were included. An antibiotic cement-coated nail, handmade at the time of surgery, was implanted in all patients. This was followed by a standardised 6-week treatment protocol, extraction of the nail and definitive fixation.

Results: At 6 years of follow-up, infection eradication and bony union were possible in all of the patients. No further infection treatment was necessary; however, all of our patients underwent additional procedures (mean: four additional procedures per patient) for cosmetic or other non-infectious reasons (bone grafting, muscle flaps, *etc.*).

Conclusions: The antibiotic cement-coated nail seems to be an effective treatment for intramedullary infections of the fractured tibia.

Treatment of infection after nailing presents two simultaneous problems for the surgeon – infection and fracture. In the presence of infection, removal of implant is mandatory to reduce the biofilm load and thus increase the permanent cure probability.[1,2] Unfortunately, it usually results in loss of stability at the fracture site. Additionally, implant removal creates a non-collapsible dead space, which impedes local immunity and delivery of antibiotics.[3,4] However, stability at the fracture site is essential for the promotion of bony growth and resulting union.[5] However, in the presence of infection, repeated nailing or plating is not advisable as it would render a high reinfection rate.[6] The other possibility – external fixation – has numerous disadvantages, for example, pin tract infections and reduced patient comfort and mobility.[7]

To date, various treatment modalities have been described, which address both problems.[8] Most of them include elaborate preparations or require dedicated equipment. Therefore, we were looking for a straightforward, efficient and cost-effective technique that one could apply without the need for special equipment or training. In this article, we present the midterm results of a Kirschner wire (K-wire)-reinforced, antibiotic cement nail for the treatment of posttraumatic intramedullary infections of the tibia. Our hypothesis was that local delivery of antibiotics and filling the dead space with a simple temporary spacer, while adhering to a strict treatment protocol, would result in infection control and would not disturb bone healing.

Patients and methods

Inclusion and exclusion criteria

Between 2004 and 2006 we treated 41 patients referred as cases of implant-related tibial intramedullary infection in a tertiary care, large teaching hospital. To ensure group homogeneity in this consecutive case series, we did not include patients after limb lengthening or cases with chronic osteomyelitis not related to fracture and nailing. Therefore, 10 patients were included in the study, as only these patients were diagnosed with intramedullary infection after nailing for fracture.

* Corresponding author at: Klinika Ortopedii i Chorób Zapalnych Narządu Ruchu, Konarskiego 13, 05-400 Otwock, Poland.
Tel.: +48 606 497 337; fax: +48 22 788 91 96.
E-mail address: m.wasko@cmkp.edu.pl (M.K. Wasko).

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Fig. 1. The photo of the prepared intra-operatively K-wire-armed, antibiotic loaded cement nail with a syringe (for scale comparison). The nail can be bent to obtain the Herzog angle, while the cement is settling in the tube (not shown in this picture).

Study set-up and ethical considerations

There was one senior surgeon and three residents involved in the patient care. All surgeries and follow-up visits have been conducted or supervised by a senior surgeon. We have not been assigned an institutional review board approval, as we used an operative technique and treatment protocol that were standard at our institution and in use before. Before the operation, all patients gave informed consent to the procedure and the treatment protocol.

Treatment protocol

The first step included implant removal, thorough debridement (including excision of existing sinus tracts to the bone), brushing of the canal and copious lavage with sterile saline. During the debridement, samples from bone, soft tissues, interlocking screws and any purulent material were taken for culture and sensitivity studies. After the last specimen was taken, wide-spectrum intravenous antibiotics were started. Following debridement, the cavity was filled with an antibiotic-impregnated, K-wire-armed cement nail prepared at the time of surgery. Typically, the nail was prepared using two batches of Palacos cement (Heraeus Kulzer, Hanau, Germany) with 2 g of added gentamycin per batch with the K-wire inserted into settling cement. For the formation of the nail, we use plastic chest tubes 3 mm larger than the initial medullary canal diameter (this allowed for the compensation of the re-reaming during debridement and tight dead-space filling). The preparation technique was similar to the ones described before and the photograph of the construct is shown in Fig. 1.[9–11]

Postoperative care and follow-up

Perioperative care was kept uniform in all cases. An infectious disease specialist supervised antimicrobial therapy. The large-spectrum antibiotics were administered after surgery until the results of culture were available. Afterwards, based on culture reports, we prescribed an intravenous regimen for 1 week, followed by oral antibiotics (if possible) for 5 weeks. Partial weight bearing (10–15 kg) was started on the first day postoperatively. In all cases, the nail was removed after 6 weeks. Follow-up included regular visits at 1, 3, 6, 12, 24, 36, 48 and 60 months and was performed by the senior operating surgeon. It included clinical, radiological and laboratory control. Laboratory tests included leucocyte count, sedimentation rate and C-reactive protein levels. Infection control was defined as the absence of both clinical symptoms and normalisation of laboratory inflammatory markers throughout the visits. The presence of bony union was determined if a bridging bone was shown on three out of four cortices on two orthogonal radiographic views. A single senior radiologist, who was blinded to the clinical history (including the length of treatment and previous procedures), assessed the images for the presence of bridging bone.

Results

Two female and eight male patients with the age range of 20–59 years (mean age of 42 years) were included in this study of the 41 referred as intramedullary infections. All of them were available for a follow-up of minimum 5 years (average 5.8 years, range 5–7 years). The cause of the infection was attributed to intramedullary nailing for open fractures in six patients and closed fractures in four patients. Two of the patients presented with chronic nonunions, each of them having undergone at least two procedures for obtaining union before. All of our patients were preoperatively staged using the Cierny–Mader classification for osteomyelitis.[3] All were classified as category B hosts in this classification. The mean time between fracture and index operation was 26 months (range 4–84 months). The diagnosis of infection was confirmed with the results of intra-operative specimens' cultures in all cases except for one patient, who was culture negative in spite of gross purulence seen at the time of surgery. This was attributed to suppressive antibiotic treatment before the operation. Four patients had a polymicrobial infection. Table 1 shows the organisms cultured, demographical data, definitive fixation and follow-up duration for each of the patients, together with definitive fixation method and outcome. The primary goal of infection control was achieved in all patients and there was no re-infection throughout the follow-up time period. Stable union either by armed antibiotic-loaded cement

Table 1
Patient demographic and microbiological information.

Pt.	Age (years)	Sex	Preoperative diagnosis	Organism	Bony union	Infection control	Follow-up (months)	Definitive stabilisation
1	51	M	Infected nonunion of tibia	None	Yes	Yes	49	ORIF
2	55	F	Posttraumatic osteomyelitis of tibia	*Staphylococcus* C − and *Staphylococcus lungdunsis*	Yes	Yes	52	T2
3	43	M	Posttraumatic osteomyelitis of tibia	*Staphylococcus* C− and *Staphylococcus aureus*	Yes	Yes	65	None
4	36	M	Posttraumatic osteomyelitis of tibia	*Pseudomonas aeruginosa*	Yes	Yes	59	None
5	41	M	Posttraumatic osteomyelitis of tibia	*Staphylococcus aureus*	Yes	Yes	52	None
6	44	F	Posttraumatic osteomyelitis of tibia	*Bacillus cereus*, *Staphylococcus* C−, *Streptococcus oralis* and *Propionibacterium acnes*	Yes	Yes	59	ORIF
7	33	M	Posttraumatic osteomyelitis of tibia	Alpha haemolytic *Streptococcus*	Yes	Yes	60	None
8	20	M	Posttraumatic osteomyelitis of tibia	*Staphylococcus aureus*	Yes	Yes	58	None
9	59	M	Posttraumatic osteomyelitis of tibia	*Staphylococcus* C− and *Staphylococcus xylosus*	Yes	Yes	53	T2
10	33	M	Infected nonunion of tibia	*Raoultella ornithinolytica*	Yes	Yes	60	T2

ORIF, open reduction and internal fixation; *Staphylococcus* C−, coagulase negative *Staphylococcus*; MRSA, methycylline resistant *Staphylococcus aureus*; M, male; F, female; Posttraumatic osteomyelitis, Posttraumatic osteomyelitis after nailing for the fracture.