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Dr. Naim Akbar
Post Graduate, Department of Orthopaedics, Shri Sathya Sai Medical College, Ammapettai, Chengalpett, Tamil Nadu, India

Dr. F Abdul Khader
Professor, Department of Orthopaedics, SSSMC&RI, Shri Sathya Sai Medical College, Ammapettai, Chengalpattu, Tamil Nadu, India

Dr. Adhiyamaan RV
Associate Professor, SSSMC&RI, Shri Sathya Sai Medical College, Ammapettai, Chengalpattu, Tamil Nadu, India

Dr. Pratheesh Mohanraj
Assistant Professor, SSSMC&RI, Shri Sathya Sai Medical College, Ammapettai, Chengalpattu, Tamil Nadu, India

Dr. Rupesh Kanna
Post Graduate, SSSMC&RI, Shri Sathya Sai Medical College, Ammapettai, Chengalpattu, Tamil Nadu, India

Dr. Dinesh Ram
Post Graduate, SSSMC&RI, Shri Sathya Sai Medical College, Ammapettai, Chengalpattu, Tamil Nadu, India

Corresponding Author:
Dr. Naim Akbar
Post Graduate, Department of Orthopaedics, Shri Sathya Sai Medical College, Ammapettai, Chengalpett, Tamil Nadu, India

Management of a case of infected non-union tibia with IMIL Nail *in-situ* by antibiotic exchange nailing

Dr. Naim Akbar, Dr. F Abdul Khader, Dr. Adhiyamaan RV, Dr. Pratheesh Mohanraj, Dr. Rupesh Kanna, and Dr. Dinesh Ram

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Abstract
Long bone infection-related non-union is a chronic and disabling condition. Whenever the implants used during the internal-fixation which gradually develops into a potential infection medium due to adherence of bacterial and formation of biofilm which becomes more challenging. This study reports the effectiveness of antibiotic cement-coated IMIL nailing in treating infected nonunion tibia in terms of infection control and bone union. A 22-year-old man came with the discharging sinuses with infected non-union tibia including a nail *in-situ*. Patient was treated with antibiotic cement coated nailing. After 3 months of primary nailing, the patient was admitted for antibiotic nailing exchange. Pre - operative cultures for staphylococcus aureus were positive, indicating clinical infection. After wound healing and suture removal, the patient was discharged after antibiotic nailing. For six months, the patient was monitored and treated on a regular basis. Within three weeks, the infection was cleared, and after three months of antibiotic exchange nailing, the bones had joined. To accomplish infection control and bone union, antibiotic cemented nailing was the only treatment needed. For the treatment of infected tibial nonunion, antibiotic cement coated nailing is a convenient, affordable, and rapid single-stage method.

Keywords: Nailing, nonunion, antibiotic, cement, infected

Introduction
Infected bone nonunion is a debilitating and chronic disorder that continues to pose a difficult problem for surgeons [1]. Several conditions, such as open fractures, the erosion of muscle tissue or bone, infections following internal fixation, persistent osteomyelitis with pathogenic fractures, and surgical removal of infected bone may contribute to infected non-unions. When the implantation used for internal fixation, it develops into a possible infection medium due to bacterial adherence and biofilm formation, it is more challenging to handle. Biofilm-forming bacteria are the main cause of infections following orthopedic injuries. A hydrated protein and carbohydrate matrix makes up biofilm. Once developed, it guards the germ from opsonization, phagocytosis, and antimicrobials, which increases the severity of infection. For infected nonunion of tibia fractures, the application of antibiotic coated cement with IM nailing is well-studied in the literature. Antibiotic cement has fewer side effects than systemic antibiotics [2]. In this case report, we are reporting the use of antibiotic cement coated IMIL nailing for the management of infected tibial nonunion in terms of both infection control and bone union.

Case Report
A 22-year-old man came with the discharging sinuses with infected non-union tibia along with *in-situ* IMIL nail. Patient was treated by antibiotic cement coated nailing (Fig.1). After three months of primary nailing, the patient was hospitalized for an antibiotic nailing exchange. The patient had staphylococcus aureus preoperative cultures that were positive and had clinical signs of infection.
A thorough preoperative evaluation was followed by the collection of informed approval for operation. In previously operated situations, the implant had to be removed first. The contaminated bone and surrounding tissues were then completely debrided, and there was a lot of cleaning. Samples of the bone and soft tissues, as well as any suppurative material were all sent for culture. The intramedullary canal was then completely cleansed with saline after being sufficiently reamed and adjusted to fit a bigger diameter nail.

After that, the surgical team put over their gloves and gowns. The limb was once more cleaned and draped. On a different sterile surface, an adequate size antibiotic-impregnated nail was made. The needed size of the nail was calculated using the same accepted approach as the interlocking nail length.

Bone cement was applied to an IMIL nail that was 9 mm in diameter and 36 cm long, covered to a depth of up to 1 mm less than the last reamer employed. After properly combining 40 g of cement with 2 g of vancomycin and 2 g of teicoplanin, the polymer was poured. The pastry composition of antibiotics and cement was then poured into an endotracheal tube whose internal diameter matched with an IMIL nail of a 2 mm smaller diameter was inserted through endotracheal tube. The IMIL nail that was uniformly covered in antibiotic cement was then removed by cutting the endotracheal tube open with a surgical knife. To make eventual removal simple, the nail eyes were left exposed. A nail was then placed in the tibia anterogradely. By giving the cement enough time to dry and solidify, nail-cement delamination during insertion was prevented.

Following surgery, the patient received intravenous antibiotics for 2-4 weeks while the wound was examined every 48–72 hours and treated according to culture and sensitivity reports. Afterwards, based on the patient report for the state of the wound, and the organism at concern, the patient would be released with an oral antibiotic medication for a period of time.

After the wound had healed, a cast that supported the patellar tendon was put on, and then moderate weight bearing was allowed. On the basis of clinical and radiological evaluations, the plaster was removed every six weeks until union was determined. In order to reestablish ankle and knee mobility, active physiotherapy was started and continued until the range of motion was sufficient. Following discharge, patient was monitored weekly for the first month, once a month for the next three, and finally once to every two to three months until the last follow-up. The typical follow-up time was 13 months.

Fig 1: (a) Pre-operative and Postoperative radiograph of a patient with infected nonunion of tibia

Fig 1: (b) Intra operative Photograph during exchange antibiotic IMIL Nailing

Fig 3: (c) Postoperative radiograph after debridement and antibiotic cement coated nailing

Fig 4: (d) Radiograph showing bony union achieved at 28 weeks

Discussion

Procedures are necessary for the cure of infected nonunion in order to manage the infection and create stability for union [3, 4]. Currently, there is no single method of treatment that is universally recommended for the treatment of infected nonunion. In the past, infected nonunion were treated using a two-step approach that involved first controlling the infection and then treating the nonunion.

Antibiotics must be administered locally or systemically to the infected area in order to prevent infection. Excessive fibrosis forms surrounding the nonunion site as a result of persistent infection and recurrent debridement, which reduces the permeability of antibiotics [5]. Therefore, local antibiotic distribution is far more advantageous than systemic antibiotic therapy. For the treatment of infections and open fractures, the application of antibiotic impregnated poly-methylmethacrylate cement bead for local antibiotic administration with no systemic toxicity is well documented [6]. However, due to fibrous ingrowths, these antimicrobial cement beads cannot be inserted in the intra - medullary canal and do not offer any stability across the fracture site. Vancomycin and gentamicin or tobramycin were typically employed in research studies in the past [7, 8].

External or internal fixing can establish stability across the fracture site. External fixation has been linked to a high rate of joint stiffness, muscle contractures, and infections at the pin sites [9, 10]. Ilizarov fixator is a great treatment option for infected nonunion, but it requires a laborious assembly, is difficult to use, and is not well-liked by patients. When internal fixation implants are employed, they behave as foreign bodies and may become a source of infection through the development of biofilms. The removal of infection with systemic antibiotics is made more challenging by the existence of foreign bodies and biofilm [11, 12].

Conclusion

A two-stage technique for treating nonunion is reduced to a single stage with the use of antibiotic cement impregnated nails, which supply a large proportion of antibiotic at the local site without generating any systemic toxicity and also provide stability at the nonunion site. Since the patient can be mobile sooner, antibiotic cement nails can help prevent problems including pin point infections, joint stiffness, and muscle contractures.

An easy, affordable, and efficient single stage technique for treating infected tibia nonunion is antibiotic cement impregnated nailing. The procedure is technically simpler and may be carried out in any general orthopedic facility because it uses materials and instruments that are widely accessible.

Conflict of interest

No conflict of interest.

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