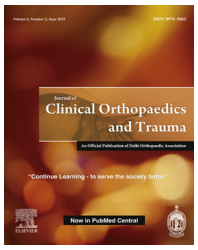
Available online at www.sciencedirect.com
ScienceDirect
journal homepage: www.elsevier.com/locate/jcot



Original Article

Outcome of distraction osteogenesis by ring fixator in infected, large bone defects of tibia

Rajesh Rohilla [a,*], *Karan Siwach* [b], *Ashish Devgan* [a], *Roop Singh* [a], *Jitendra Wadhwani* [b], *Naseem Ahmed* [b]

[a] *Professor, Department of Orthopaedics, PGIMS, Rohtak, Haryana 124001, India*
[b] *Resident, Department of Orthopaedics, PGIMS, Rohtak, Haryana 124001, India*

ARTICLE INFO

Article history:
Received 29 December 2015
Accepted 27 February 2016
Available online xxx

Keywords:
Infected
Nonunion
Tibia
Ilizarov
Distraction osteogenesis

ABSTRACT

Background: Salvage of large, infected bone defects in tibia poses a formidable problem. The present prospective study aimed to evaluate radiologic and functional outcome of ring fixator in infected, large (≥6 cm) bone defects of tibia treated with distraction osteogenesis.
Materials and methods: The study included 35 patients (30 males and 5 females) who had minimum of 6 cm gap after radical resection of necrotic bone and presence or history of active infection. Mean age was 36.1 years. Mean bone gap was 7.27 cm. Mean follow-up period was 25.4 months.
Results: Fracture united primarily in 17 cases and after fixator adjustment with freshening of fracture margins in 15 cases. Fixator adjustment with bone grafting was done in one patient to achieve union. One patient had nonunion and another had amputation. The bone result was excellent, good, and poor in 19, 13, and 3 patients, respectively. The functional results were excellent, good, fair and failure in 14, 19, 1, and one patient, respectively. 24 patients had superficial pin tract infection and 18 patients had ankle stiffness.
Conclusion: Ring fixator systems reliably achieve union in infected, large bone defects of tibia and help in treating infection, shortening, bone and soft tissue loss simultaneously. We advocate early freshening of fracture ends and removal of interposed soft tissue at docking sites to achieve union. Superficial pin tract infection and ankle stiffness are common problems in managing large tibial defects. But good to excellent functional outcomes can be achieved in majority of patients.

1. Introduction

Large defects of bone and soft tissue in the leg may be the result of high-energy trauma or may follow surgical debridement. Salvage of large, infected bone defects in tibia poses a formidable problem. Different modalities of management like extensive debridement and local soft tissue rotational flaps, packing the defect with antibiotic impregnated beads, Papineau type cancellous bone grafting, tibio-fibular synostosis, cancellous allograft in fibrin sealant mixed with antibiotics and or free micro vascular soft tissue and bone transplants, etc. are described to treat infected nonunions.[1–6] Fractures with ≥6 cm bone defect require individualized

* *Corresponding author*. Tel.: +91 09812662814.
E-mail address: drrajeshrohilla@rediffmail.com (R. Rohilla).
http://dx.doi.org/10.1016/j.jcot.2016.02.016

Please cite this article in press as: Rohilla R, et al. Outcome of distraction osteogenesis by ring fixator in infected, large bone defects of tibia, *J Clin Orthop Trauma*. (2016), http://dx.doi.org/10.1016/j.jcot.2016.02.016

treatment. Vascularized fibular grafts have been used successfully to treat large defects. But this procedure requires considerable technical expertise and it is technically challenging[1] and is beyond the competence of average orthopedic surgeon. Patients with large bone defects are often complicated with infection, deformity, shortening, soft tissue loss, osteopenia, muscle contractures and joint stiffness. The distraction osteogenesis principle has the potential to treat these complications simultaneously. Bone transport can be done through many devices like ring fixators, monolateral fixators or intramedullary nail system. Each device has its own advantages and disadvantages. Ring fixators have been in use for many years. But very few studies in literature have focused on outcome of ring fixator in infected, large bone defects of tibia treated with distraction osteogenesis.[6–8] The present prospective study aimed to evaluate radiologic and functional outcome of ring fixators in infected, large (≥6 cm) bone defects of tibia treated with distraction osteogenesis.

2. Materials and methods

The present prospective study included patients of posttraumatic, infected defects of tibia presenting to author's tertiary level institute between May 2008 and February 2013. The study was approved by institutional review board. The study included only those patients who had minimum of 6 cm gap after radical resection of necrotic bone and presence or history of active infection. Patient was considered to have active infection if there was a discharging sinus or positive culture swab from the wound. The patients excluded from study were defects of tibia of reason other than trauma, with non-sensate foot, age >65 years, pathological fractures, any medical or skeletal illness affecting bone healing and patients with less than 6 months postoperative follow-up. 35 patients met the inclusion criteria. There were 30 males and 5 females with the mean age of 36.1 (12–60) years. At presentation, a full history was obtained which included details of initial injury and previous treatments. On examination, the presence of shortening, deformity, neurovascular deficiency, and condition of soft tissue was documented. All patients were informed about the approximate duration of treatment and the associated complications prior to reconstructive surgery and informed consent was taken for inclusion into the study. Right side was involved in 27 patients and left side was involved in 8 patients. The fracture site mainly involved proximal third of tibia in 11 patients, middle third in 9 patients, and distal third in 15 patients. 30 patients had open fractures at the time of original injury. The mode of trauma was road traffic accidents in 34 patients and gun shot injury in one patient. The previous treatment was spanning external fixation in 29 patients, intramedullary nail in 3 patients and locking compression plate in 3 patients. Average number of operations performed before application of definitive frame was 1.22. The mean time between injury and definitive frame application was 25.1 weeks (range, 4–98 weeks). Five patients were chronic smokers. At the time of presentation, 6, 1, 19, 5, and 4 patients had type A1, A2, B1, B2, and B3 injury, respectively as per Paley et al. classification.[9] Ten patients already had ankle joint stiffness due to their previous walking inability. Active purulent drainage was present in 20 patients. Pus was sent for culture and sensitivity in patients with active purulent discharge. These patients were started antibiotic according to culture report on the day of surgery. Other patients were given broad spectrum antibiotics for prophylaxis. Operative treatment included thorough soft tissue debridement, removal of implant, exposure of fracture site, radical resection of necrotic, or sclerotic bone so as to obtain healthy bleeding bone on either side of nonunion, and opening of medullary canal. The bone ends were cut transversely to provide broad surface for achieving union. The transporting bone fragment end was cut till coverage of skin was possible so that transporting bone fragment carried skin over it during distraction. After thorough debridement and adequate lavage, the patient was draped again with fresh autoclaved sheets and whole of the operative team rescrubbed. The ring fixator frame was applied and corticotomy was done. Cultures of the infected bone, obtained at the time of debridement procedure, dictated the choice of antibiotic treatment postoperatively. The mean bone gap was 7.27 cm (range, 6–12 cm). The mean size of wound was 5 cm × 2.5 cm. The standard ring fixator frame included four rings, with four rods and on an average of 10 wires per patient. During insertion of wires the muscle being penetrated was stretched at the time of transfixion to ensure maximum joint movement. The frame was applied according to the technical principles reported by Ilizarov.[10] The limb was kept in normal frontal, sagital, and rotational alignment during the frame application. All patients had corticotomy at one level. All patients had compression osteosynthesis at fracture site with distraction osteosynthesis at corticotomy site. Proximal metaphyseal corticotomy was performed in 21 patients; distal metaphyseal corticotomy in 13 patients, and mid-diaphyseal corticotomy was done in one patient. No patient had acute docking at fracture site at the time of frame application. The fibular osteotomy or resection was performed wherever needed for deformity correction or to achieve union later at the time of fixator adjustment. Closure of the wound was attempted by giving relaxing incisions. Split-skin grafting or flaps were done in two patients before index operation and in two patients at the time of frame application. In the post-operative period, joint motion and partial weight bearing mobilization with crutches or walker was encouraged depending on patient's compliance and status of pain. Distraction at an initial rate of 1 mm per day in four increments was started on day 7. The broad spectrum antibiotics were given for 5 days and thereafter choice of antibiotic (for another 10 days) was determined by the culture sensitivity report. Pin site care and hygiene were taught to all patients before discharge. All patients were seen in out patient department on regular monthly follow-up. Assessment of complications like muscle contractures, axial deviations, premature consolidation, delayed consolidation, refracture, and pin tract infections was done at each follow-up. Pin tract infections were classified according to Paley's classification[11] into grade 1, grade 2, and grade 3. Grade1 and grade 2 infections were labeled together as ''superficial pin tract infections''. Grade 3 infections were labeled as ''deep pin tract infections''. Superficial pin tract infection was treated by local care, incision and drainage, and oral antibiotics. Deep pin tract infection was treated by local care, incision and drainage, intravenous antibiotics, and pin removal if necessary. The clinical and radiographic assessment was done at each

Please cite this article in press as: Rohilla R, et al. Outcome of distraction osteogenesis by ring fixator in infected, large bone defects of tibia, *J Clin Orthop Trauma*. (2016), http://dx.doi.org/10.1016/j.jcot.2016.02.016