

Outcomes of Infected Non-Union of Femur Treated with Ilizarov Method and Limb Reconstruction System: Retrospective Case Study SeriesMankar S^{1*}, Assudani A², Sakhare R³¹Professor and Head of Department, Department of Orthopaedics, N.K.P Salve Institute of Medical Sciences and Research Centre, Nagpur, Maharashtra, India²Assistant Professor, Department of Orthopaedics, N.K.P Salve Institute of Medical Sciences and Research Centre, Nagpur, Maharashtra, India³Senior Resident, Department of Orthopaedics, N.K.P Salve Institute of Medical Sciences and Research Centre, Nagpur, Maharashtra, India

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Abstract:

Introduction: Several surgical techniques are documented for treating Non-union (NU) of long bone. Due to numerous coexisting complications, infected NU of the femur is prevalent. All of these challenges can be resolved with the Ilizarov Method (IM) as it is reliable, versatile and effective in management of NU of long bones hence, this study was carried out to understand outcome of IM in central Indian population.

Method: A retrospective observational study was commenced by scanning the database after January 1998 to January 2022 for identifying the patients who had infected NU of femur with shorting paley type B and were treated by Ilizarov method means.

Results: The IM of ring fixator was used in eight patients and Limb Reconstruction System (LRS) was used in three patients. Bone union was achieved in 90.9% of patients. A mean bone gap of 6.7 cm, mean external fixator (EF) time of 8.981 months and mean EF index of 1.479 months/cm was observed. The complications mainly involved significant shortening, stiffness of knee, refracture and remnant NU (9%). When patient outcomes using Association for the study and application of methods of ilizarov (ASAMI) scoring system were evaluated the bone results were excellent in 9 patients (81.81%) and poor in 2 patients (18.18%) whereas, functional results were excellent in 2 patients (18.18%), good in 7 patients (63.63%), and poor in 2 patients (18.18%) in the present study.

Conclusion: IM and LRS are good salvage procedures for infected NU of femur. Therefore, as long as the limb is functional, sufficiently innervated, and the patient is motivated to the psychological and financial requirements of this treatment, limb salvage is favoured.

Keywords: Non-Union of Femur, Fracture, Ilizarov Method, Limb Reconstruction System, Bone Grafting.

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Introduction

In previous literatures, the procedure for treating long bone non-union (NU) is thoroughly explained. There are several surgical techniques documented for treating long bone NU like non vascularized cortical or cancellous bone grafts and vascularized bone grafts like fibula with internal fixation for stability in the form of intramedullary nail or plate. Other method like antibiotic impregnated polymethyl methacrylate beads, low intensity ultra sound, electrical and electromagnetic stimulation are also described. Research for the use of bone graft substitutes, bone morphogenic proteins and new materials in treatment of NU of bone is still under process. [1]

With coexisting issues such as constant infection, bone and soft tissue loss, unequal limb lengths,

deformity, and joint stiffness, infected NU of the femur is prevalent. [2] There are numerous restriction methods, such as bone grafting,[3] free tissue transfer,[4] and antibiotic cemented beads.[5] All of these challenges can be resolved in addition to concurrent issues, with the Ilizarov Method (IM). In the IM, distraction bone histogenesis helps to enhance fracture union by filling the bone gap following corticotomy. The use of IM in NU of tibia and femur caused due to infection is reported by various studies. [3-5]

IM is reliable, versatile and effective in management of NU of long bones like tibia and femur but its experience and outcome evidence in central Indian population is lacking, hence this study was carried out to understand outcome of IM

in central Indian population in cases of infected NU of femur.

Material and Methods

A retrospective observational study was carried out in the department of orthopedics in teaching case at a medical college and research centre institute in central India. The study was commenced by scanning the database after January 1998 to January 2022 for identifying the patients who had infected non-union of femur with shorting paley type B and were treated by Ilizarov method means, corticotomy and distraction using Ilizarov ring fixator or limb reconstruction system (LRS). The database was screened to find out the patients who were treated with Ilizarov principle using IM of ring fixator / LRS for infected NU of fracture and the defect was > 2 cm paley type B₃. The study outcomes that involved bone results (BR) and functional results (FR) were assessed as per Association for the study and application of

methods of ilizarov (ASAMI) scoring system. All the data from patient's record that was present in the hospital and identification of demographic, clinical and outcome data which was recorded in a structured proforma were gathered. Demographic data included age of patient and gender whereas, clinical data included etiology details of fracture, details of fracture healing and surgery previously performed. Furthermore, abnormalities in terms of pain, limp, unequal limb length, deformity and knee movement were also recorded. Fracture was graded according to Gustillo-Anderson classification and bone defect measurement was done by radiographic assessment.

The surgical procedure commenced from pre-operative assessment for fitness following which under all aseptic precautions administration of spinal anesthesia was performed (Figure 1 and Figure 2).

Figures



Figure 1: Pre-operative fracture of femur.



Figure 2: Non-union of fracture femur before limb reconstruction system application

The fractured bone ends were freshened after performing the debridement of the infected NU. Any bone sequestrum or loose bone fragments were removed with infected granulation tissue along with the implants like nail, plate or cement beads that were present previously. Ilizarov ring fixator (Figure 3) or LRS (Figure 4) was applied and acute docking was done in cases where it was possible without jeopardizing the blood supply. Bone transport was done at a rate of 1 mm per day after corticotomy. [6-8]



Figure 3: Infected non-union of femur treated with ilizarov method



Figure 4: Infected non-union of femur treated with limb reconstruction system

Barring initial few cases, bone transport was done over intramedullary nails like Ender or Rush nails to guide the transport and achieve proper docking. In cases of Ilizarov ring fixator two distal circular rings were fixed with tensioned wires and proximally full ring / half ring were fixed with the help of Schantz pins (Figure 3) whereas, in cases of LRS the external fixator (EF) was applied on lateral side of thigh with Schantz pins (Figure 4). Frame stability was checked in both the groups. [6-8]

Post operatively all the patients were evaluated for any neuro vascular injury and antibiotics were given as per the culture & sensitivity report. Patients were trained to do pin tract care personally as they were supposed to do it at home after discharge from hospital. During follow up visit, stability of frame, pins, and joint mobility were checked (Figure 5 and Figure 6). However, fracture union and quality of regeneration were assessed radiologically. [6-8]



Figure 5: Fracture of femur united with ilizarov method



Figure 6: Fracture of femur united with limb reconstruction system

Results

Overall, by IM 11 patients underwent surgery for infected NU of the femur, of which three underwent LRS and eight received IM of ring fixator. The age ranged from 4 to 70 years. There were three children and eight adult patients out of which four were females and seven were males. Road Traffic Accident (RTA) cases are the most common cause of fracture femur. Most of the patients were previously treated with nailing, plate or uni-planer EF before they came to the hospital where they were treated with Ilizarov method with Ilizarov ring fixator or LRS.

Signification shorting was found in five out of 11 patients. Restriction of range of movement i.e. stiff knee was another main complaint and was found in 5 patients out of 11. One patient had refracture and one had non-union. In all the patients, etiology of non-union of fracture femur was infective. The size of the bone defect was 3 to 9.5 cm and the time required for bone transport varied from 35 to 110 days. The EF frame lasted between 150 to 425 days and the average EF index was 45 days/Cm. The following period ranged from one to nine years. Outcomes were evaluated as per ASAMI scoring system that showed nine excellent and two poor bone results. Additionally, FR as per ASAMI scoring system demonstrated two excellent, seven good and two poor functional results.

Discussion

The conventional management of infected NU of femur illustrates poor outcomes due to numerous surgeries, infections of bones and soft tissues, decreased vascularity, high velocity primary trauma, osteoporosis, bone loss, late presentation, dystrophy of muscles, shortening, and associated deformities.[4] The IM which uses IM of ring fixator and LRS is a salvage procedure which can take care of the above difficulties. Progressive bone histogenesis helps to fill up bone gaps, reduce infections, and promote fracture union after corticotomy and bone transport.[2]

In our study, a total of 11 patients underwent surgery for infected NU of femur with bone gap more than 2 cms using IM principle. The IM of ring fixator was used in eight patients and LRS was used in three patients. The age ranged from 4 to 70 years that consisted of four females and seven males. Bone union was achieved in 90.9% of patients that is 10 out of 11 patients in our study. Similarly, a systematic literature review done by Yin et al. of 22 studies from January 1995 to April 2013 consisting of a total of 426 patients showed a bone union rate of 96.935% and none of the patients experienced recurrence of infection.[2]

Additionally, when compared to a systematic review that showed mean bone gap to be 6.527 +/-

1.882 cm and mean EF time of 10.845 +/- 5.339 months, this study reported a mean bone gap of 6.7 cm and mean EF time of 8.981 months. Furthermore, mean EF index was 1.479 months/cm as compared to a review which showed it to be 1.579 +/- 0.585 months/cm.[2] The complications mainly involved significant shortening in 5 patients (45%), stiffness of knee in 5 patients (45%), one patient had refracture (9%) and one had remenant NU (9%).

When patient outcomes using ASAMI scoring system were evaluated, the incidence of excellent and good outcomes was 87.38% in a review,[2] however the BR were excellent in 9 patients (81.81%) and poor in 2 patients (18.18%) in the present study. Whereas, compared to 74.18% excellent and good outcomes and 7.89% of poor outcomes mentioned in the review given by Yin et al.,[2] the FR were excellent in 2 patients (18.18%), good in 7 patients (63.63%), and poor in 2 patients (18.18%) in the present study. Ilizarov Method and Limb Reconstruction Surgery (LRS) has been proved beneficial as good salvage procedures for infected non-union of femur and therefore, should be widely used as it will provide an effective and safe management, early recovery, and shorter duration of hospital stay.

Conclusion

IM and LRS are good salvage procedures for infected NU of femur. These procedures usually show better bone results than functional results. As long as the limb is functional, sufficiently innervated, and the patient is motivated to the psychological and financial requirements of this treatment, limb salvage is favoured.

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SM analyzed and interpreted the patient data. AA and RS drafted the manuscript. All authors read and approved the final manuscript.

Author's Contribution

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