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Infected Non-union of tibia shaft treated with Ilizarov external fixator

[1]Emad Sanad, [1]Mahmoud Khalifa Sharaf, [2]Ahmed Ahmed Elsayed Nenaa, [3]Ahmed Ali, [1] Moustafa Mohamed Saad

[1]Department of Orthopaedic Surgery, Benha Faculty of Medicine, Benha University, Egypt

[2]Department of trauma and Orthopaedics, Faculty of Medicine, Cairo University, Egypt

[3]Mersey and west Lancashire trust

Abstract

Tibia is the most common long bone fracture due to its vulnerable subcutaneous location and most often associated with acquired complications of delayed union or non-union due to infection. The objective of this study is to analyze the role of Ilizarov technique in treatment of infected tibial non-union. Total of 13 patients with infected tibial shaft non-union were included in the study. Patients were reviewed for union of bone, bone and functional outcomes and complications. All fractures united and infection eradicated completely. According to The Association for the Study and Application of Methods of Ilizarov (ASAMI) criteria ASAMI classification, bone results were excellent in 6, good in 5, fair in 2, and no poor results. Functional results were excellent in 8, good in 3, fair in 2, and no poor results. The most common complication was pin tract infection. Out of 13 patients, 7 had Grade II, 3 had Grade III, and 3 had Grade IV infection which was managed accordingly. There were no neurovascular complications. We conclude that for management of infected non-union of tibia, radical debridement with Ilizarov fixation give satisfactory bone and functional results. Thus, Ilizarov technique is one of the most successful techniques in the management of infected non-union of tibia.

Keywords: Non-union of tibia, Infection, Ilizarov technique, Bony union.

Full length article **Corresponding Author*, e-mail: dr_emadsanad85@fmed.bu.edu.eg

1. Introduction

Due to an increase in the frequency of high-energy trauma events in recent years, the incidence of complex and compound long-bone fractures is on the rise [1]. Because of its sensitive subcutaneous placement, the tibia is the most commonly fractured long bone. Some of the most common problems are delayed union and non-union due to infection [2]. Tibia fractures are more likely than other bones in the body to fail to heal. Non-union of a fracture is frequently worsened by secondary conditions such as prolonged infection, soft tissue and bone loss, limb length discrepancy, and limb deformity [3]. Orthopaedic surgeons have always had to deal with infected tibial non-union [4]. Extensive debridement with local soft tissue rotational flaps [5], packing the defect with antibiotic cement beads, Papineau-type open cancellous bone grafting [6], tibiofibular synostosis, free microvascular soft-tissue and bone transplants, and the Ilizarov method are some of the treatment options for chronic diaphyseal infections associated with non-union. The Ilizarov procedure has a number of benefits, including the ability to correct for bony abnormalities, allow for bony union through bone histogenesis, and eliminate infection [7]. The primary goal of this research was to look into the role of Ilizarov fixation in infected tibial non-union, as well as infection rates, bony union, functional outcomes, and comorbidities.

1.1. Aim of the Study

The purpose of this study was to see how well the Ilizarov procedure worked in treating infected non-union of the tibia. The study's goals were to eliminate infection and establish bone union while keeping the limb's length and alignment while also allowing for early mobilisation. The findings were examined using the Association for the Study and Application of the Method of Ilizarov (ASAMI) scoring system for bone and functional results [8].

2. Subjects and Methods

This is a single center, retrospective case series study investigating the clinical and radiological outcomes of using Ilizarov technique in patients with infected non- union of tibial shaft. The study was carried out at Benha University Hospital in Egypt between January 2019 and March 2021. A total of 13 patients presented to our outpatient department diagnosed as infected non-union tibia were included in this study. Necessary permission from Institutional Ethical

Committee was taken. Patients with clinical and radiological evidence of infected non-nion of tibia were included. Patients with associated neurovascular injuries or any other conditions which would interfere with postoperative rehabilitation were excluded from the study. Out of 13 patients, 10 were males and 3 were females, 8 patients had age <40 years, 5 patients were between 40 and 60 years. Two patients had infected non-union of the upper third of tibia, 7 patients had middle third tibia involved, and 4 patients had lower third tibia involved. Out of 13 patients, 11 had a road traffic accident and two had a history of fall from height as intial cause of trauma. Initially, 9 patients had open fracture tibia and were managed at other centers. Out of 13 patients, 6 had monoplaner external fixator, 5 had interlocking nail, and 2 had plating done. All patients had clinical and radiological evidence of non-union with signs of infection present. An average of 1.5 surgical interventions (range 1–3) was carried out in all cases before applying an Ilizarov. The mean interval from the initial treatment to application of ilizarov was 12 months.

All of the patients were given spinal anaesthetic. Ilizarov frame was built based on preoperative radiological and clinical results. The non-union location was debrided properly, with bone ends freshened and any sequestered bone or hardware removed. Following the removal of intramedullary nails, the canal was reamed and thoroughly lavaged. After freshening and debridement, the defect was evaluated. If the defect was less than 2.5cm, docking at the fracture site was performed (Fig 1b); if the defect was greater than 2.5cm, corticotomy at an appropriate location was performed. We employed a 180-200mm Ilizarov rings, 3-4 rings construct most of the time, although it was adjusted as needed. Ilizarov wires, 1.8mm, were employed. When needed, a fibulectomy was performed. The operated limb was elevated and the neurovascular condition was assessed in the immediate postoperative phase. Antibiotics were chosen based on sensitivity and culture results. Frame stability and pin locations were evaluated on the first postoperative day. All nut nuts were tightened, and wires were appropriately tensioned, and the frame was personally examined for stability. On the second postoperative day, patients were urged to begin gentle range of motion exercises of neighbouring joints and to bear weight as tolerated. Out of the 13 patients, ten had a bone defect greater than 3cm, necessitating bone transfer with progressive compression at the docking site, and three had a bone defect less than 3cm, necessitating acute compression of the non-union site. Distraction of 1 mm each day was initiated on the 14th postoperative day in 10 patients [9]. After training patients how to care for the pin site and device, they were discharged on the second postoperative day. Frame stability, pin site condition, and range of motion of neighbouring joints were all evaluated at the follow-up appointment, and any complications were identified and handled. At the right stages, radiographs were collected to assess the union and quality of the regeneration (Fig 1 e). The most prevalent complications were frame loosening, pin track infection, and poor quality bone regeneration. The grading and management of pin track infection were done according to Dahl grading [10].

- Grade I – Normal pin site
- Grade II – Inflamed without discharge
- Grade III – Inflamed with serous discharge
- Grade IV – Inflamed with purulent discharge
- Grade V – Inflamed with osteolysis
- Grade VI – Inflamed with ring sequestrum

Seven of the thirteen patients had Grade II, three had Grade III, and three had Grade IV infections, all of which were treated appropriately. X-rays were used to assess fracture union and regeneration quality using the Fernandez Esteve grading system [11].

- Grade I– Empty space between two fragments without radiopacity
- Grade II – Presence of cloud of bony callus
- Grade III – Presence of periosteal bridge in at least one diaphyseal wall in every X-ray projection
- Grade IV– Presence of periosteal bridge in both diaphyseal walls in every X-ray projection
- Grade V – Structural callus is seen.

2.1. Ethical considerations

The study was conducted after approval of the protocol by the Local Research Committee and the Studies Committee as well as the Research Ethics Committee of Faculty of Medicine, Benha University.
An informed written consent was obtained from all patients. Approval code: Rc 20-1-2023.

2.2. Statistical analysis

Gathered data were processed using SPSS (Statistical Package for Social Science) version 26.0 (SPSS Inc., Chicago, IL, USA). For quantitative data, descriptive statistics were produced in the form of mean and standard deviation (SD), and for qualitative data, frequency and distribution. The significance of difference was examined in the statistical comparison between the groups using one of the following tests:

2.2.1. Paired t test and Willcoxon test (Ztest)

Parametric and non-parametric tests are used to compare the mean of variables over different time periods of quantitative data. The McNemar test was used to compare categorical data between groups.
In all analyses, a P value of 0.05 was considered statistically significant (*) and a P value of > 0.05 was considered statistically insignificant; a P value of 0.01 was regarded extremely significant (**).
Collected data were presented in a suitable tables and suitable graphs after statistically analyzed by computer Software using appropriate statistical methods.
Approval Code :RC 20-1-2023

3. Results

The clinical and radiological follow-up assessment followed the ASAMI procedure. Bone union was accomplished in every patient. Bone transport required an average of 60 days (range 40–140 days), while Ilizarov fixation took an average of 4.5 months [Table 1]. Bone outcomes were outstanding in six cases, good in five, mediocre in two, and poor in none, according to the ASAMI categorization. Functional results were outstanding in eight cases, good in three, acceptable in two, and poor in none. More information can be found in (Table 2). The average period from injury to application of the frame was 12.65 months (SD 3.91, range 7-20). The average follow-up period was 16.2 months (SD 4.35, range 10-24).

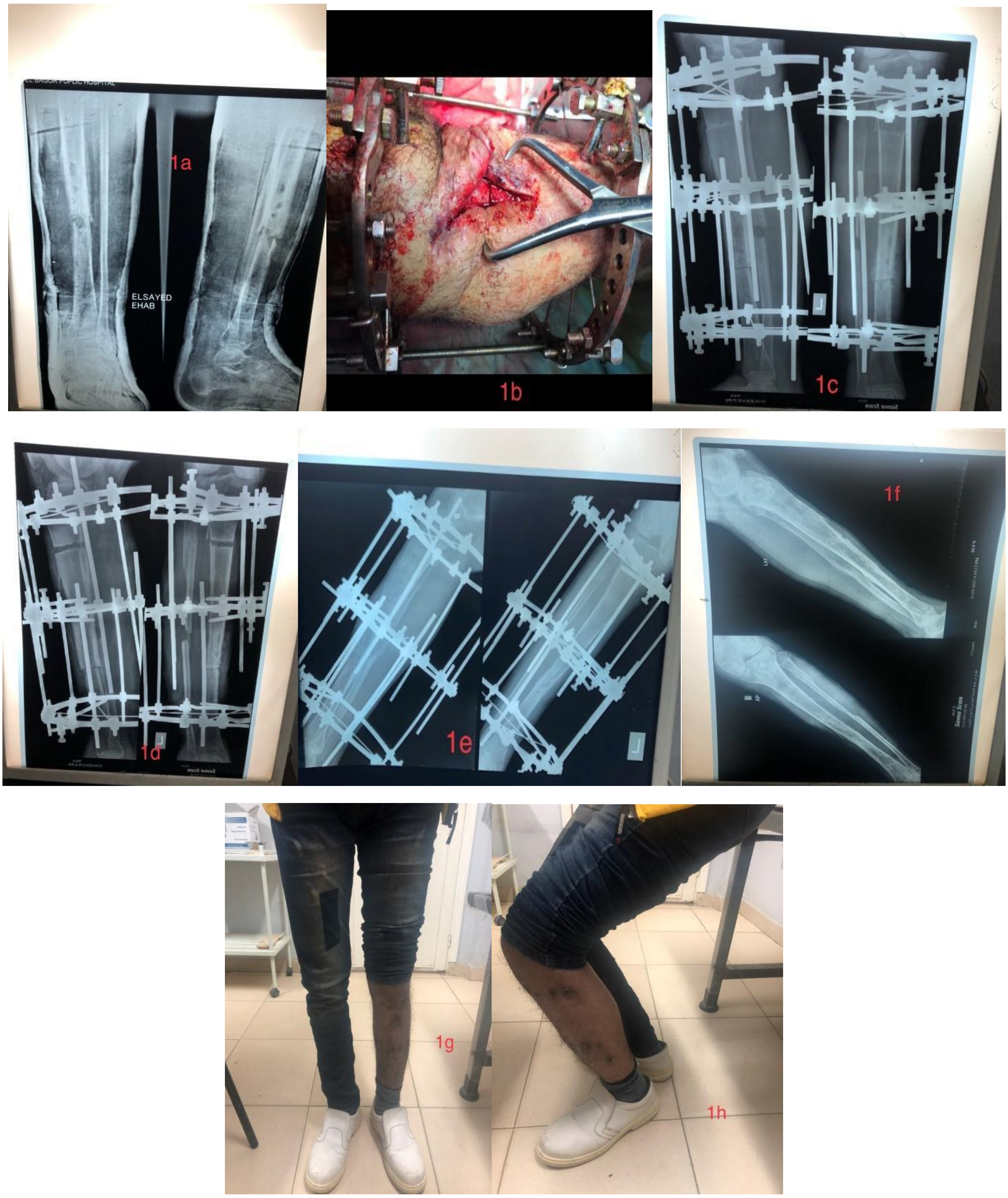

Figure (1): Radiographs of a Patient. (a) Pre-operative anteroposterior and lateral views showing infected atrophic tibial non-union.(b) Intraoperative clinical photo showing acute compression after non-union debridement. (c) Post-operative antero-posterior and lateral views after Ilizarov application. (d) Antero-posterior and lateral views during bone transport. (e) Antero-posterior and lateral views at the time of final follow-up showing bony union. (f) Anteroposterior and lateral views after frame removal showing complete union. (g and h) Clinical photos showing ROM and limb length equality.

The average length of time in the frame was 8.1 months (SD 2.34, range 5-12). In all of the cases, bony union was accomplished.

3.1. Complications

Pin site infection is the most prevalent complication. Seven of the thirteen patients had Grade II, three had Grade III, and three had Grade IV infections, all of which were treated appropriately. During the distraction period, all of the patients experienced pain and required oral analgesics. Four patients had minor complications such as pin loosening, which was treated with modest realignment and removal of the old pins before reinsertion of new pins. There were no neurovascular or compartment syndrome problems.

4. Discussion

Treatment Infected tibia non-union is difficult to treat and necessitate careful planning and execution of sophisticated, time-consuming operations. The Ilizarov procedure has been used to treat infected non-union of long bones with great success and reliability [12]. In non-union with active or quiescent infection and a bone gap of 4 cm or more, investigation of infected non-union revealed that distraction histiogenesis is the preferable treatment [13]. One-stage debridement and bone translocation utilising the Ilizarov frame led in union in 70% to 100% of cases [14,15]. When we compare our findings to those of other research, In a study of 25 infected tibial non-unions, 19 (76%) had outstanding outcomes, five (20%) had good results, and one (4%) had poor results, while functional results were excellent in 15 (60%) cases, good in eight (32%) cases, one fair (4%) case, and one terrible case (4 percent) [16]. These findings were comparable to ours. Because of limited physiological reserve, osteopenia/osteoporosis, and lower healing powers, treating an infected non-union in the elderly is considerably more difficult. Two of the 13 individuals in our study were between the ages of 40 and 60. Traditional fixators fail to provide sufficient purchase in older patients; however, using tensioned Ilizarov wires for fixation in them caused no serious issues. The frame was well tolerated by all of these patients, and there was no higher incidence of pin/wire loosening in this group. The ability to bear weight is especially important for the elderly, since recumbency has a detrimental impact on overall physiology and can raise the risk of thromboembolic disease and infections [17]. Another study evaluated the efficiency of the Ilizarov procedure in treating such instances using the ASAMI score.The excellent and good rates for bone results using the ASAMI score totaled 80 percent (41/51) and 88 percent (45/51) for functional outcomes, respectively [18]. Bone score was higher than the functional score in a single study (76 percent >60 percent and 58.9% >56.9%, respectively) [19]. A prior study found that the functional score was higher than the bone score (64 percent >60.8 percent) [20]. Previous research has also shown that a longer time between damage and surgical intervention leads to higher infection rates [21].Pin site infection developed in nine patients and was treated by changing the dressing on a regular basis [18]. In the management of pin site infections, such daily pin site care is critical [22]. Investigations of the clinical and radiological results of tibial infected non-unions treated with the Ilizarov procedure with antibacterial bioactive glass had been done in another study [23]. Pin-tract infections, as well as wire and/or screw breakages, were discovered as minor problems. Because cables and screws may be cleaned or replaced, these issues could be readily resolved. In addition, the Ilizarov technique's efficiency was established in multiple literature studies, which found that 90 percent of persons who underwent the treatment had optimal consolidation, adequate pain control, and speedy return of daily activities [24-26]

5. Future perspectives and limitations

This study's weakness is the lack of a control group. Furthermore, there is no direct comparison with any other treatment option due to the tiny number of patients. As a result, large-scale prospective and multi-center investigations are still needed to back up the findings of the current study.

6. Conclusions

Because it may offer a stable mechanical environment, rectify abnormalities, equalise the length, and allow weight bearing during treatment, the Ilizarov approach is more suited for infected non-union of the tibia. We propose using the Ilizarov external fixator for infected non-union of the tibial shaft because of its excellent success rates and the possibility of saving the limb without having to amputate it.

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