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Original Article

A Hospital-Based Clinical Study on Ilizarov Technique in the Treatment of Distal Fractures of Tibia

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Abstract

Background: In spite of many advances in the surgical management of fractures of long bones, the management of displaced distal tibial fractures remains controversial. The various internal fixation techniques often described are burdened by relatively high complication rates. Alternate to these minimally invasive techniques with ring fixators has been introduced, allowing immediate reduction and stabilization and also avoiding a staged protocol in the surgical treatment of tibial shaft injuries.

Aim of the Study: The aim of this study is to analyze the clinical and functional outcome of the Ilizarov technique in patients with distal metaphyseal tibial fractures, with or without intra-articular involvement.

Materials and Methods: A total of 67 consecutive patients with isolated fractures of the lower end of tibia were included, treated with the Ilizarov technique, and followed prospectively for 1 year. 4 or 5 rings were used depending on the type of fracture; fracture; in some cases additional foot extension was used. Post-operative unrestricted weight-bearing was allowed in all patients. Pre- and post-operatively, X-rays of the fracture sites, post-operative pain, and complications were evaluated. The movement at the ankle was evaluated clinically at the end of 1 year.

Observations and Results: The common complication encountered was pin tract infection which was superficial and was treated with antibiotics and/or the removal of isolated pins. No patient developed compartment syndrome or deep venous thrombosis. Six patients required regular debridement. Two of these six patients had a deep infection and developed a residual deformity which was corrected and healed after reoperation. One patient had a severe residual deformity. The fixators were removed after a median period of 16 weeks (range 11–30). The final outcome was fair to good in 66/67 patients.

Conclusions: The Ilizarov method allowed early definitive treatment with a low complication rate and a good clinical outcome.

Key words: External fixators and internal fixation, Ilizarov, Tibia, Fracture

INTRODUCTION

The primary goal of any orthopedic surgeon in the management of distal fractures of tribia is to achieve normal axial alignment of tibia and to reduce articular displacement if present, thereby regaining a stable, mobile, and painless joint simultaneously avoiding infections and wound complications.[1] The fractures of the lower end of tibia remain a challenge to the orthopedic surgeons as it is difficult to assess their potential complications due to variations in the clinical findings. Hence, the injury may be more serious than expected even in patients without articular involvement.[2-5] The aim of the surgeon in lower tibial fractures is to maintain the length of the limb with joint bridging fixators or a fibular plate when the soft-tissue injuries permit; the definitive step is traditionally performed with screws and plates.[6-8] McFerran *et al.*[4] reported a 54% risk of major complications in less comminuted intra-articular fractures. Few authors recommend staged protocol to reduce the number and severity of complications.[9-12]

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Due to the presence of vulnerable soft,tissue in the distal region of the leg, there is an increased risk of complications in lower end compared with mid-shaft tibial fractures. When an Ilizarov technique is used, it is always possible to treat the patients with a single-stage procedure and avoid multiple-staged operations.[13,14] It has an added advantage being less invasive and less soft tissue exposure required, minimal blood loss. The external fixators allow for adjustment of the alignment and for compression/distraction of fracture ends, both during and after surgery; the fixation is stable enough to allow early weight-bearing.[15,16] In this context, the present study was conducted in a hospital-based setting to analyse the advantages and complications of fractures of lower end of tibia treated by using Ilizarov technique.

Period of Study

The study duration was from April 2011 to March 2014.

Institute of Study

This study was conducted at Kannur Medical College hospital, Anjarakandy, Kannur, Kerala.

Type of Study

This was a prospective, cross-sectional clinical study.

MATERIALS AND METHODS

A total of 67 consecutive patients with fractures of lower end of tibia with or without articular involvement, attending the orthopedic department of a tertiary teaching hospital, were included in the present study.

Inclusion Criteria

(1) Patients aged 18–75 years were included. (2) Patients with displaced distal metaphyseal tibial fractures with angulations of more than 10 degrees in any plane were included. (3) Patients with intra-articular fractures were included if the incongruence of the articular surface was more than 2 mm. (4) Patients with isolated fractures and without other disorders affecting gait were included in the study.

Exclusion Criteria

(1) Patients aged below 18 years and above 75 years were excluded. (2) Patients not willing to be included in the study were excluded. (3) Patients with skin infections or eczema were excluded. (4) Patients with bleeding tendencies were excluded from the study. All the patients underwent surgery without a tourniquet and without any traction table. Arthroscopy or arthrotomies were not used. A "C" arm was used to monitor the reduction, pin insertion, and assembly of the frame. The fractures were reduced with traction and manual external pressure. When it failed to get acceptable anatomical repositioning, the joint surfaces were reconstructed with percutaneously inserted elevators and/or a reduction forceps and/or wires with olives. The proximal ring was placed at the level of the fibular head. Additional stability was achieved using extra wires parallel to the articular surface with posts fixed on the distal ring (drop-wire technique). The syndesmosis and malleolar fragments could be stabilized with olive wires fixed to the ring on the lateral side or the medial side. All the wires were assembled and tensioned to a minimum of 120 kg. Steel rings connected with steel rods were used. Bone grafts were not used. Suitable I.V. antibiotic was administered at the start of the surgery and continued till 24 h. Low-molecular heparin prophylaxis was given from the day of admission until 10 days after leaving the hospital. Physiotherapy was started immediately post-operatively to maintain knee and ankle motion, and the patients were allowed to start unrestricted weight-bearing. The fractures were regarded as healed when anteroposterior and lateral radiographs showed a bridging callus in three of four cortices and/or the fracture was stable when stressed manually and the patients were able to walk without pain after the connecting rods had been removed. The patients were followed up clinically, and regular X-rays of the fractured site were taken whenever necessary 12 weeks and 1 year. At the end of 1st year, ankle movements were assessed using standard orthopedic protocol. All the data were analyzed using standard statistical methods.

OBSERVATIONS AND RESULTS

Among the 67 patients included in the present study, males were 48 (71.64%) and the remaining 19 (28.35%) were females. The mean age was 38.45 ± 4.15 years in males and 32.56 ± 2.10 years in females. Majority of the fractures were observed in the age group of 25–40 years followed by 18–24 years age group. Road traffic accidents accounted for 49/67 (73.13%) patients followed by other injuries. High energy force was responsible in 48/67 (71.64%) patient's injury. The distance from the distal articular surface was 95–135 mm in 23/67 (34.32%) patients followed by 135–175 mm in 19/67 (28.35%) patients. The bone defect was found to be 35–55 mm in 29/67 (43.28%) patients followed by 15–35 mm in 21/67 (31.34%) patients. Foot extension was good in 55/67 (82.08%) patients and fair in 11/67 (16.41%) patients [Table 1].

Among the 67 patients, 35 patients (52.23%) had distal tibial fracture without distal articular involvement and 32/67 (47.76%) patients had articular involvement. The mean time lapse before surgery, mean operation time, mean hospital stay, and mean duration of external applicator were recorded and analyzed are shown in Table 2. There

was no significant difference in the mean times between the extra- and intra-articular involvement cases of tibial fractures at lower ends in this study. The similarity was no significant difference in the mean times between the extra- and intra-articular involvement cases of Tibial fractures at lower ends in this study $p < 0.05$ (P taken as statistically significant at <0.05).

At the end of 1 year, the range of ankle joint movements was analyzed in all the patients using standard clinical methods. It was observed that there was no significant difference between the two types of Tibial fractures (with either intra- or extra-articular involvement), with Ilizarov method of external fixators application; $p < 0.05$ (P taken as significant at <0.05) [Table 3].

DISCUSSION

The present study is a clinical analysis of 67 patients who had lower end tibial fracture with or without joint involvement. The study was found to be satisfactory with Ilizarov method of treatment independent of the fracture pattern. The surgical protocol used was identical for both intra- and extra-articular fractures. All the patients were operated without delay irrespective of the status of soft tissues, bone defect, the size of the distal fragment, and the intra-articular fracture lines, whether a staged protocol should be used. There was the absence of clinically important differences in the present study in terms of the results between the intra- and extra-articular fractures. Among the 67 patients, 35 (52.23%) patients had distal tibial fracture without distal articular involvement and 32/67 (47.76%) patients had articular involvement. The mean time lapse before surgery, mean operation time, mean hospital stay, and mean duration of external applicator were recorded and analyzed as shown in Table 2. There was no significant difference in the mean times between the extra- and intra-articular involvements in this study. There was no significant difference in the mean times between the extra- and intra-articular involvements in this study. The similarity was statistically proved with $p < 0.05$ (P taken as significant at <0.05). The extra-articular fractures observed were 35/67 (52.23%) of the patients could possibly have been treated with open reduction and internal fixation using intra-medullary nails or plates. The use of intramedullary nails in extra-articular distal tibial fractures is technically correct because of the widening medullary canal in the metaphysis, but it raises the concern regarding the biomechanical stability and the subsequent increased risk of malunion.[15] Review of literature shows that early aggressive debridement of non-viable tissues, stabilization with Ilizarov external fixators, and either primary or delayed primary closure followed by early mobilization and weight bearing is a sound treatment method for tibial shaft injuries.[16] Acute shortening, using the Ilizarov technique followed by progressive lengthening, is one of the methods used to deal with complex fractures combined with severe soft tissue injuries.[17] The most frequent complication was pin-tract infections.[18] In the present study, the pin-tract infection was observed in 4/67 (5.97%) patients. Review of literature shows that the incidence of pin site infections varies from 4.5% to 7.1%.[19] Parameswaran *et al.*[20] found

Table 1: The observations made on the study group (*n*=67)

Observation	Number (%)
Age	
18–24	15 (22.38)
25–40	34 (50.74)
41–55	10 (14.92)
56–75	8 (11.94)
Injury	
Traffic	49 (73.13)
Work	7 (10.4)
Riding	6 (08.95)
Fall	5 (07.46)
Energy	
High	48 (71.64)
Low	19 (28.35)
Extension from the joint/mm	
55–95	11 (16.41)
95–135	23 (34.32)
135–175	19 (28.35)
175–215	14 (20.89)
Bone defect/mm	
15–35	21 (31.34)
35–55	29 (43.28)
55–75	17 (25.37)
Ilizarov rings	
3	13 (19.40)
4	38 (56.71)
5	26 (38.80)
Foot extension	
Good	55 (82.08)
Fair	11 (16.41)
Bad	1 (01.49)
Pin infection	4 (05.97)

Table 2: The timing of the Ilizarov applicator (*n*=67)

Type of fracture tibia	Extra articular 35	Intra articular 32	*P* value
Mean time lapse before surgery	6.5±1.32	4.8±0.96	0.342
Mean operation time (min)	154±7.40	179±6.32	0.410
Mean hospital stay (days)	8.37±2.10	7.50±1.70	0.215
Mean duration of external applicator (weeks)	16.35±1.10	18.73±1.40	0.389

Table 3: The range of movements at ankle at the end of 1 year (*n*=67)

Range of movement	Extra articular-35	Intra articular-32	*P* value
Ankle dorsiflexion	18–20°	17–22°	0.210
Ankle plantar flexion	30–37°	29–38°	0.351

that ring fixators had the lowest incidence of infection compared with unilateral and hybrid fixators. Functional results were better in upper fourth and distal fourth tibial fractures and in Type VI tibial plateau fractures only. Kumar and Whittle compared with other series, and they believed that it is appropriate for the treatment of these complex tibial fractures (Schatzker Type VI), especially those with a poor soft-tissue envelope.[21] In the present study, the range of ankle joint movements was good in 55/67 and fair in 11/67 (16.41%) patients. At the end of 1 year, the range of ankle joint movements was analyzed in all the patients using standard methods. It was observed that there was no significant difference between the two types of tibial fracture (with either intra- or extra-articular involvement), with Ilizarov method of external fixators application. It was observed that there was no significant difference between the two types of Tibial fracture (with either intra- or extra-articular involvement), with Ilizarov method of external fixators application; $p < 0.05$ (P taken as significant at <0.05), [Table 3]. The present study had patients with clinical features of complications of fracture such as soft-tissue injuries and diaphyseal fracture extension [Table 1].

CONCLUSIONS

A satisfactory outcome was possible in lower end metaphyseal tibial fractures with the Ilizarov technique allowing early definitive treatment and good allowing early definitive treatment and good functional recovery in the ankle joint. This was irrespective of the nature of injury, soft-tissue damage, and articular involvement. The complication rate was low in both the extra-articular and the intra-articular fractures. The entire period of treatment was compliant with all the patients.

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