ORIGINAL ARTICLE

MANAGEMENT OF SEGMENTAL FRACTURE OF TIBIA TREATED BY ILIZAROV EXTERNAL FIXATION

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Background: Tibial shaft segmental fractures are mostly occurring due to a high-energy trauma that produces a severe soft-tissue injury and resulting an excessive frequency of open and closed segmental fractures, and needs effective stable management. The objective of the study was to evaluate the functional outcome and union time in segmental tibial fracture treated with Ilizarov method. **Methods:** This prospective Qausi-experimental study was carried out from March 2014 to February 2018. Total 45 patients were included (36 males, 09 females) with a mean age of 30 years (range 20–50) with segmental tibial fractures either closed or open without any gender bar, were stabilized with an Ilizarov method. Functional outcome and bone union was assessed by ASAMI criteria. Patients were followed up to 18 months. SPSS-21.0 was used to calculate the descriptive statistics and t-test of difference between union time in open and close fractures. **Results:** According to Gustilo classification for open fractures, there were Grade IIIA 21 (67.7%), Grade IIIB 10 (32.2%). According to AO classification for closed fractures; 42-C1 type fractures were 5 (35.7%), 42-C2 was 6 (42.8%), 42-C3 was 3 (21.4%). Based on ASAMI criteria for bone assessment; excellent results in 26 (57.8%), good results in 16 (35.5%) and fair results in 3 (6.6%) and functional outcome was 29 (64.4%) excellent, 12 (26.6%) good and 4 (8.8%) fair was obtained. Union time difference was examined using t-statistics and score of p was greater than 0.05. This result was expected as an average time of union was almost similar in both groups, i.e., 19.83, ±11.92 in close and 20.73, ±9.09 within an open group. Overall, the union time was minimum 10.86, maximum 45.14, and median was 20.29. **Conclusion:** Ilizarov is an effective method for the stabilization of segmental tibial fractures because the method allows close reduction without extensive soft tissue damage and is efficient for the stabilization of short distal segmental fractures of the tibia.

Keywords: Tibia fractures; Segmental; Ilizarov external fixator

Citation: Makhdoom A, Shaikh BJ, Baloch RA, Malah HR, Tunio ZH, Jokhio MF. Management of segmental fracture of tibia treated by ilizarov external fixation. J Ayub Med Coll Abbottabad 2020;32(3):291–4.

INTRODUCTION

Segmental fractures of the tibia indicate the occurrence of two distinctive fracture lines dividing the cortical and entirely separating an intermediate segment of the tibia.[1]

In the management of open segmental fracture of the tibia that needs an attention to contaminated soft tissues, muscles and neurovascular structures. While treating the fracture with comminution and contamination, it is always a difficult process and if the limb salvage is a primary aim then other difficulties with soft tissue coverage, infection control and bone union can result serious disability.[2]

In 1950's, G.A. Ilizarov announced a different device to understand the biology of lengthening and the method that facilitates the correction of angular, rotational and translational osseous deformities.[3,4]

Ilizarov method is helpful in the treatment of the shortening, lengthening and soft tissue defect and is also useful in case of infected non-union of bones that are not amenable with other techniques.[5]

Ilizarov produces excellent results while on contrary, the remaining procedures become unsuccessful. The outcomes of management with Ilizarov are continuously promoting the; restoration of the non-unions, leg length discrepancy correction and also revival of mechanical axis and function of the limb as well.[6]

Experience of managing such patients with Ilizarov technique have been quite encouraging as it is intended to study its utility and to establish efficacy in terms of different aspects such as bone union, correction of malformations and deformities, postoperative complications and rehabilitation issues.[7]

The use of Ilizarov external fixator has brought revolutionary changes in the field of Orthopaedic surgery. The number of amputations, mal-unions and non-unions has reduced considerably with the introduction of external fixation.[8] Ilizarov external fixator is also suggested for segmental

fractures of tibia, due to its advantage for allowing early weight bearing.[9]

MATERIAL AND METHODS

This prospective Quasi-experimental study was carried out from March 2014 to February 2018. A total 45 Cases were collected and an inclusion criterion was either close or open segmental fracture of tibia, without any gender barrier. As per Gustilo classification Type IIIC was excluded from the study. Patient aged between 20–50 years with segmental tibial fractures according to the inclusive criteria were admitted through OPD and emergency. Functional outcome and bone union was assessed by ASAMI criteria[10] in table-1, bone results were assessed (graded as excellent, good, fair and poor), and in table 2, functional results assessed (graded as excellent, good, fair and poor).

Table-1: Bone results using association for the study and application of the methods of Ilizarov (ASAMI)

Excellent	Union, no infection, deformity < 7°, limb length discrepancy < 2.5cm
Good	Union with any two of the following: no infection, deformity < 7°, limb length discrepancy < 2.5 cm
Fair	Union with only one of the following: no infection, deformity < 7°, limb length discrepancy < 2.5 cm
Poor	Nonunion / re-fracture / union + infection + deformity >7° + limb length discrepancy > 2.5 cm

Table-2: Functional results using association for the study and application of the methods of Ilizarov (ASAMI)

Excellent	Active, no limp, minimum stiffness (loss of < 15° knee extension / <15° dorsiflexion of ankle), no reflex sympathetic dystrophy (RSD), insignificant pain
Good	Active with one or two of the following: Limp, stiffness, RSD, significant pain.
Fair	Active with three or all of the following: Limp, stiffness, RSD, significant pain
Poor	Inactive (unemployment or inability to return to daily activities because of injury)
Failure	Amputation

Alignment of fracture was assessed with immediate postoperative radiographs and clinical assessment. After discharge from the hospital they were reviewed as an outpatient department weekly for a month and later on twice a month.

The variables related with clinical and radiological assessments like wound healing, fracture union, complications, stay in the hospital, status of weight bearing were included in the proforma and later on were further assessed through SPSS version 21.0, which is used to calculate the descriptive statistics and t-test of difference between union time in open and close fractures.

After the complete workup from emergency to the operation theatre and pre-aesthetic assessment by anaesthetist, patient was enlisted in the operation list to stabilize the fracture with Ilizarov external fixation system.

After anaesthesia and draping, the pre-assembled Ilizarov frame was applied according to segmental fracture configuration. Then transverse Ilizarov wires were inserted near and parallel to joint line in both knee and ankle joint under image intensifier. Afterwards other transverse wire was inserted proximal to the fracture and fastened with the ring and the wire was tensioned with wire tensioner or manually with spanners. Furthermore, additional wires were inserted as per safe zone of the limb at least 45^{o} to the first wire. Then olive tip wire was used for reduction of fracture segment. Firstly, proximal segment was reduced and then was stabilized with an addition of two more K wires holding the fracture segment which is reduced in all plans. Occasionally, drop wires are also used and are attached to the ring, with the help of male post, so that the segment of the fractures was stabilized. Reduction of the intermediate segment was achieved via image intensifier, by distraction of the frame to accomplish normal alignment. In contrary, slow and gradual distraction was carried out to achieve aligned and reduced union outcome in older cases.

Post-operatively, epidural analgesia (2 ml of 0.5% Abocain+ 8 ml of normal saline making 10mls solution and from this solution, 2 mls was given 8 hourlies through the epidural catheter) was given for 2–3 days to relieve the pain, and if required it was switched to oral analgesics. Patients were gradually allowed to bear full or partial weight with support. Parenteral antibiotics was given for three to four days for closed fractures and for open and infected fractures continued till eradication of infection or wound healing. Postoperative radiographs were advised on the very next day and later on required frame adjustments were done. All the patients were instructed for the care of pins, cleaning and mobilization of joints and were trained to continue compression/distraction at home needed.

During the follow up period, frame was checked thoroughly and if any deep pin track infection or pin loosening was found, then immediate admission was advised for wound irrigation and debridement.

To assess the union progress during the follow-up's radiographs were advised. After visible callus formation, the frame was dynamized to promote consolidation. After 3–4 weeks of dynamization the frame was removed mostly without anaesthesia. After the removal of frame, the pin

tracks were cleaned and dressed and then walking cast plaster was applied for 2–3 weeks.

RESULTS

According to inclusion criteria, 45 patients of age ranged from 20–50 years with mean 30±8.7 years age segmental tibia fractures were stabilized with an Ilizarov method. There were 36 (80%) male and 09 (20%) female patients, the ratio of M:F was 4:1.

According to Gustilo classification, from 31 patients with open fractures 21 (67.7%) belonged to Grade IIIA and the remaining 10 (32.2%) were of Grade IIIB.

According to AO classification, from 14 patients with closed fractures 5(35.7%) belonged to 42-C1 type, 6 (42.8%) were of 42-C2 and the remaining 3 (21.4%) were associated with 42-C3.

The mean time for proximal fracture union was 34.4 (range 12–76 weeks) with SD ±14.4 and 38.9 (range 14–80 weeks) with SD±15.3 for the distal fractures. Statistical method, t-test was computed to see the difference between two group's union time (1=open, 2=close). Results reveals that $p>0.05$, which states that there was no clear difference either open and close fracture union time. This result was expected as an average time of union was almost similar in both groups, i.e., 19.83, ±11.92 in close and 20.73, ±9.09 within an open group.

The mean union time within close fracture was 19.83, ±11.92 in weeks for different age groups. Overall, the union time was minimum 11.43, maximum 59.29, and median was 16. In contrary, the union time within open fracture of different age groups was 20.73, ±9.09 in weeks. Overall, the union time was minimum 10.86, maximum 45.14, and median was 20.29. According to ASAMI scoring system, bone results were excellent 26 (57.8%), good 16 (35.5%), Fair 3 (6.6%) and functional results were excellent 29 (64.4%), good 12 (26.6%), Fair 4 (8.8%). The postoperative complication was pin site inflammation 20 (44.4%), pain during walking 18(40%), pin site over granulation 15 (33.3%), pin loosening during follow up 12 (26.7%), superficial pin track infection 6(13.3%) and Deep pin track infection 1 (2.2%).

DISCUSSION

In segmental tibial fractures, there is always a soft tissue interposition which may cause non-union, perhaps it is a very complex problem.[11] These fractures are infrequently appropriate for the non-operative management, but for fractures with insignificant displacement. Manual reposition can be achieved by providing stability to both the fracture fragments. It can be achieved in a single focal point of fracture, and while performing the reposition of the second fragment, a displacement may occur in the previous one and it also damages soft tissues of the leg if done repeatedly. As the oedema at the fracture site subsides the chances of the secondary displacement of the fragment increases, even though a satisfactory repositioning of the fragment under radiograph and plaster immobilization has occurred. Hence, the majority of segmental tibial fractures require operative intervention as soon as possible.[12,8] Therefore, our choice of treatment in segmental fracture tibia is Ilizarov external fixator. Because this method is providing more stability and as closed reduction is possible to reduce the fragments with minimal surgical intervention.

In this study, the union time was 10.86 weeks to 45.14 weeks with average of 20.06 (i.e., open=20.73, ±9.09 and close=19.83, ±11.92). Kumar & Whittle reported, that the treatment of segmental fractures of the tibia with Ilizarov external fixation fractures were united within 24.71 weeks (173 days).[13] According to Behrens & Searls study, the external fixation of the tibia presented an average union time of 26.57 weeks (186 days).[14] In another study, 41 unstable tibial fractures with loss of bone were treated with simultaneous compression of the fracture site and adjacent lengthening of the affected bone with Ilizarov external fixator by Tucker, Kendra & Kinnerbrew (1992). According to them, all the fractures were united without bone grafting and time for the union was 12–47 weeks (mean 25.6 weeks).[15] Sultan S conducted a study on, 32 open Grade III tibial fractures were managed with AO (Arbeitsgemeinschaft fur Osteosynthesefragen) tubular external fixator and time for the union was 32 weeks (24–62 weeks). Bonnevialle P *at el*; reported 49 patients in the retrospective study for segmental tibia fractures with the indications for three surgical techniques; interlocking intramedullary nailing with or without reaming, and external fixation.[16]

CONCLUSION

We conclude that Ilizarov external fixator is a successful and more effective method for the treatment of segmental fractures of tibia because it is minimal invasive and versatile that provide multilevel stability at fracture site. There is an excellent union time, functional outcome and early rehabilitate patient.

Informed consent: The study was performed in obedience with the relevant rules and university research guidelines, and also the advanced studies and research board Liaquat University of Medical & Health sciences Jamshoro Sindh Pakistan, vide resolution No. AS&RB-32.2 of its 32nd meeting held on 30.03.2012 has approved the experiments.

AUTHORS' CONTRIBUTION

AM: Study designed & Writing of the Article up to proof reading. Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. BJS: Data Collection & search of literature review. RAB: Drafting the work or revising it critically for important intellectual content. Data collection & compile. HRM: Data collection and analysed. ZHT: Acquisition. MFJ: Interpretation of the data for work

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Submitted: October 7, 2019	*Revised: November 4, 2019*	*Accepted: March 24, 2020*

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