Management of Infected Non-union Fractures of Tibia by Ilizarov External Fixator; Outcome & Complications

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Abstract: INTRODUCTION: Infected nonunion of tibial fractures is common and its management is challenging for orthopedic surgeons. Ilizarov external fixator is widely used for its management as it provides a stable mechanical environment encouraging union by infection removal and bone transport. The point of this examination was to decide the result and related complexities of patients treated with Ilizarov outer fixator for non-joined cracks of tibia muddled by contamination. **Methodology:** A retrospective assessment of medical records of the subjects they undergo treatment of non-united fractures of tibia by Ilizarov methods between January 2015 till December 2019 was undertaken. Patients of either age and gender having non-union tibia fracture for a 06 months period of or more & having contamination at the location of non-union were included. The Association for Study and Application of Methods of Ilizarov (ASAMI) criteria was used for assessing the utilitarian result just as bone outcomes. **RESULTS:** Total 48 subjects were incorporated in this resarch. Mean age of the patients was 33.50 ± 9.33 years. Total 43 (89.6%) were males and 5 (10.4%) were females. Mean bone transport time, mean external fixation time, mean external fixation index and mean bone defect w+ere 80.18 ± 32.48 days, 11.6 ± 3.91 months, 77.41 ± 26.72 days/cm and 5.06 ± 1.53 cm respectively. According to ASAMI criteria, bone results were found to be excellent in 27 (56.3%), good in 11 (22.9%), fair in 6 (12.5%) and poor in 4 (8.3%). Functional outcomes were found to be excellent in 30 (62.5%), good in 11 (22.9%), fair in 4 (8.3%) and poor in 3 (6.3%).**CONCLUSION:** Ilizarov external fixator method is effective in management of infected nonunion by providing a stable mechanical environment encouraging bone transport.

KEY WORDS: Ilizarov apparatus, infected nonunion of tibia, tibia nonunited fracture

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INTRODUCTION:

There has been a recent increase in high intensity trauma resulting in an increased incidence of compound and complex long bone fractures.[1] Due to Tibia's vulnerable location subcutaneously, it is most commonly fractured. It has been reported that 5% to 10% fractures may develop non-union or delayed union.[2] Following a long bone fracture, infected non-union is one of the major complication. Due to high energy trauma, the injured bone as reduced ability to heal and becomes prone to infection.[3] Various strategies have been utilized to treat tainted non-association tibia breaks, for example, Ilizarov outer fixator, induced membrane technique, pulsed electromagnetic fields and

Masquelet technique.[4-8] Among these, Ilizarov external fixator is most widely used.

Surgeon from Soviet Union named Gavril Abramovich Ilizarov first introduced this technique by designing the apparatus that worked on the mechanism called as the theory of tensions.[9,10] This apparatus supports the fractured limb as well as corrects the deformity of the affected limb via distraction osteogenesis.[11] The construction of Ilizarov and its wires provide structural support to the limb thus allowing early weight bearing.[12] The choice in patients suffering from infected non-union tibia fractures is to salvage the limb usually by amputation or by the use of Ilizarov apparatus of external fixation. Non-association of break is typically convoluted by a few issues. These incorporate steadiness of disease, delicate tissue and bone misfortune, disfigurement of appendage and inconsistency of appendage length.13 Its management is a great challenge for orthopedic surgeons.[14] Prompt management is essential to prevent amputation. Ilizarov apparatus allows compensation for bony defects and its union via bone growth and elimination of infection.[15] The point of this examination was to assess the result and related difficulties of patients treated with Ilizarov outside fixator for non-association tibia breaks entangled by contamination.

MATERIALS AND METHODS:

A review audit of clinical records of the patients who experienced situation of Ilizarov outside fixator for infected non-union tibia fractures between January 2015 till December 2019 was undertaken. Both male and female patients aged 18 years or above having non-union tibia fracture for a term of a half year or more and having disease at the site of non-association were incorporated. Patients were excluded if the non-union tibia was not associated with any infection or if the duration of infected non-union was less than 6 months. Patients were also excluded if there was intraarticular fracture or fracture associated with vascular injury. All the procedures of Ilizarov external fixator application were performed under general or local anesthesia with administration of prophylactic antibiotics. Persistent was set recumbent on a radiolucent surgical table. Ilizarov outer fixator was collected before hand as indicated by prerequisites of individual patients by taking area of the non-association fragment and length of the influenced appendage into the thought. Corticotomy and cut locales were stamped. Gathered outer fixator was applied to the pole of tibia according to standard convention. Debridement of the included bone and delicate tissues was performed. Ends of the bones showing bleeding were labeled as vital bones with adequate debridement. For undertaking a subperiosteal transverse corticotomy, a small incision below the tibial tuberosity was given. Sub periosteal fibulectomy was also performed in all the cases. Layered closure of the wound was undertaken. If any wound required flap coverage, it was addressed with the assistance of plastic surgeon.

Post operatively, appropriate intravenous (IV) antibiotics were administered for duration of 2 weeks as indicated by the way of life and affectability. In patients with negative culture, wide range anti-toxins for gram positive and gram negative microbes inclusion were given intravenously for duration of four weeks.

Patients were encouraged to bear full weight from first post-operative day. Movement exercises were also initiated. The dormancy time frame before bone vehicle was around multi week and the pace of bone interruption following that was 1 mm for each day (0.25 mm each 6 hourly interim). After the bone vehicle was finished, the docking parts of the bargains packed 0.25 mm every day until the agony was felt by understanding at the site of docking. The Association for Study and Application of Methods of Ilizarov (ASAMI) criteria was used for assessing the practical result just as bone results.16 ASAMI criteria for bone outcome is condensed in Table 1 and for utilitarian outcome is outlined in Table 2. Other measures of outcome such as external fixation time, bone transport time and associated complications were also recorded. Statistical Package for Social Sciences (SPSS) version 22.0 was utilized for information passage and examination. Outcome measures were calculated by application of various descriptive statistics.

RESULTS:

Total 48 subjects were incorporated in this reasarch. Mean age of the patients was 33.50 ± 9.33 years. Total 43 (89.6%) were males and 5 (10.4%) were females. Out of 48 patients, 38 (79.2%) suffered road traffic accidents, 9 (18.8%) suffered from fall and 1 (2.1%) suffered firearm injury. Mean bone transport time, mean external fixation time, mean external fixation index & mean bone defect were 80.18 ± 32.48 days, 11.6 ± 3.91 months, 77.41 ± 26.72 days/cm and 5.06 ± 1.53 cm respectively. Among bacteria isolated from cultures, 28 (58.3%) had Staphylococcus aureus, 9 (18.8%) had Methicillin resistant staphylococcus aureus (MRSA), 6 (12.5%) had Escherichia coli and 5 (10.4%) had Pseudomonas aeruginosa. Every one of these attributes are outlined in Table 3.

Table 1: ASAMI scoring for bone results

Excellent	Union, no infection, deformity less than 7° and limb length discrepancy less than 2.5 cm
Good	Union and presence of any two of the following No infection Deformity less than 7° Limb length discrepancy less than 2.5 cm
Fair	Union and presence of any one of the following No infection Deformity less than 7° Limb length discrepancy less than 2.5 cm
Poor	Non-union / again fracture Union with infection, deformity greater than 7° or limb length discrepancy > 2.5 cm

Table 2: ASAMI scoring for functional outcome	
Excellent	Active, no limp, minimum stiffness (loss of <15° knee extension / <15° ankle dorsiflexion), no reflex sympathetic dystrophy, insignificant pain
Good	Active with any one or two of the following Limp Stiffness Reflex sympathetic dystrophy Significant pain
Fair	Active with three or all of the following Limp Stiffness Reflex sympathetic dystrophy Significant pain
Poor	Poorly inactive (unemployed, inability to perform daily tasks due to injury)
Failure	Amputation

Table 3: Baseline characteristics of the patients (n=48)		
	n	**%**
Age, years	33.50 ± 9.33‡	
Gender		
Males	43	89.6
Females	5	10.4
Bone transport time, days	80.18 ± 32.48‡	
External fixation time, months	11.6 ± 3.91‡	
External fixation index, days/cm	77.41 ± 26.72‡	
Bone defect, cm	5.06 ± 1.53‡	
Cause of injury		
Road traffic accident	38	79.2
Fall	9	18.9
Firearm	1	2.1
Organism isolated from culture		
Staphylococcus aureus	28	58.3
Methicillin resistant staphylococcus aureus	9	18.8
Escherichia coli	6	12.5
Pseudomonas aeruginosa	5	10.4
‡mean±SD, n: number		

As indicated by Association for Study and Application of Methods of Ilizarov (ASAMI) criteria, bone outcomes were seen as superb in 27 (56.3%), great in 11 (22.9%), reasonable in 6 (12.5%) and poor in 4 (8.3%). As per ASAMI criteria, functional outcomes were found to be excellent in 30 (62.5%), good in 11 (22.9%), fair in 4 (8.3%) and poor in 3 (6.3%). Among complications in our patient population, 32 (66.7%) had no complication whereas 16 (33.3%) had complications. Out of 16 patients 7 (43.75%) had pin tract infection, 7 (43.75%) had limb length discrepancy, 1 (6.25%) had re-infection and 1 (6.25%) had wire loosening. No mortality was observed in our case.

DISCUSSION

In clinical practice, infected nonunion of tibia is common following trauma[17] and its management is challenging for orthopedic surgeons.Factors such as loss of normal bone and soft tissues, formation of multiple sinus tracts, deformities in the limb, discrepancy in the limb length and infection by multiple organisms can complicate the infected nonunion fracture. Literature has many methods for treatment of infected nonunion, such as application of bone graft or by utilization of free tissue move and anti-infection establishing, anyway these techniques convey the confinements of giver site horribleness, danger of stress break or size limitation of hard defects.[17] Method described by Ilizarov cause infection eradication, compensate bony defects and aid in bone union by progressive histogenesis.[18] It can also correct any bone deformities and discrepancy in limb length during the bone transport duration. The methods described by Ilizarov work on the principle of distraction osteogenesis. The treatment by this technique relies upon degree of disease, state of adjoining delicate tissues and the sort of contaminated non-association. Resection of necrotic bone and neighboring contaminated fragments is fundamental for complete disease eradication.[17] Later on, the inside bone exchange is used to recreate the remaining segmental defect.[19] Right now, share a creating nation point of view in regards to use of Ilizarov outside fixator for treatment of tainted nonunion tibia breaks. The mean age of the patients was 33.5 in our investigation which is slightly lower than the mean of the patients in other local studies. Inamet al[20] reported mean age of 40,whereas 45.65 mean age was reported by Fahad et al.[4] However, another local study reported a slightly lower mean age of 32.58.[21] Male preponderance was higher in our study cohort and similar high male preponderance has been reported by other studies.[4,20,21] Our study had 89.6% males which was higher than the study conducted by Inam et al[20] as well as Fahad et al.[4] Another local study reported male population of 94.64% which was higher than the one reported in our study.[21] International studies have also reported a higher male preponderance.[15,22] Mean bone transport time in our study was 80.18 days which was higher than 70.10 reported by Bakhshet al.[21] Mean bone defect in our study was 5.06 cm. It was higher than the one reported by Fahad et al[4] and Bakhsh et al.[21] Among most common infective organism involved, Staphylococcus aureus was most commonly isolated in cultures and similar organism was also commonly involved in tibial infection in previous studies.[4,21] Regarding bone results as per ASAMI criteria, excellent results were

found 56.3% and good results in 22.9%. Previous study by Khan et al[23] reported higher excellent results of 64.4% as compared to our study where as good results were reported to be 20%.[23] Another local study reported higher excellent results of 66%.[21] Among results of bone outcome internationally, mixed results were reported. A higher excellent result was reported by Meleppuram et al[15] and Lalit et al[24] whereas lower percentage of excellent results were reported by Madhusudhan et al.[25] Another local study by Fahad et al reported higher percentage of excellent and good bone outcome results.[4] As per ASAMI criteria, excellent functional outcomes were reported in 62.5% in our study and good functional outcomes were reported in 22.9% of the cases. Khan et al reported a higher excellent functional outcomes of 71.11% and good functional outcomes of 17.77%.[23] This difference could be attributed to difference in study criteria. We studied infected nonunion in tibia whereas Khan et al[23] also studied other long bones such as femur, humerus and radius/ulna. Bakhsh et al reported excellent functional outcomes in 66% and good functional outcomes in 16% of the cases.[21] As compared to our study and other local studies, international studies have reported a lower excellent functional outcomes.[15,24,218] Pin tract contamination was the most widely recognized inconvenience saw in our populace accomplice and comparative outcomes have been accounted for by other neighborhood examines.[4,21] Small sample size was a limitation of our study. Another constraint of our investigation was this was a solitary establishment review study. In cases of infected nonunion, the adequate union can be achieved after effective infection control, compete removal of necrotic bone and establishment of stable environment for union to occur. Despite the aforementioned limitations, we believe that present study provides the effective use of Ilizarov methods for management of infected nonunitedtibial fractures in a population of developing country where the resources are limited. It is recommended that further multicentric studies should be carried out on a larger sample size to validate the results of the present study.

CONCLUSION:

In our study, a high rate of excellent and good bone results and functional outcomes were observed in our population cohort. Ilizarov external fixator provides a mechanical environment that is stable for effective management of non-united tibial fractures. This technique offers a surgical opportunity to salvage the affected limb with avoidance of amputation.

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