ORIGINAL ARTICLE

Comparative Study of Management of Open Proximal Metaphyseo-Diaphyseal Tibial Fractures by the Fire Arm and the Road Traffic Injuries Treated with Ilizarov

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ABSTRACT
The objective of this study was to compare the results of open proximal metaphyseo-diaphyseal tibial shaft fractures secondary to high energy road side accident and firearm injury in adults fixed with Ilizarov system in two respective groups (A and B) in terms of union, complications and functional status of the patients.A descriptive cross-sectional study of 30 clinical cases of open proximal metaphyseo-diaphyseal tibial shaft fractures was conducted in Department of Orthopedic Surgery Mayo Hospital Lahore from 2010 to 2012. Patients meeting the inclusion criteria were admitted and were treated with Ilizarov external fixator along with necessary soft tissue procedure as required for coverage of exposed bone. There were 30 patients, 15 in each group. Age was between 16 to 60 years. Both groups showed equal frequency of union. The common complications were pin tract infection (predominantly pain) and infection at the fracture site. Excellent functional results were seen in 80%, good in 10% and fair in 10% of the patients. It was concluded that Ilizarov external fixator is an excellent method of fixation for proximal tibial fractures from high-energy trauma with extensive soft tissue damage as it allows management of infection and soft tissue defects and improves limb circulation through early weight bearing.

Key words: Open proximal metaphyseal tibial fractures, high velocity firearm fractures, high-energy roadside fractures, Ilizarov external fixation.

INTRODUCTION
High-energy open fractures of non-articular part of proximal tibia, whether caused by roadside accidents or firearm injuries, pose more problems of treatment because of extensive soft tissue damage, contamination and bony comminution. Gustilo and Anderson[1]Type-III open fractures require extensive debridement and prompt soft-tissue coverage as soon as possible. Early internal fixation should be avoided in this subgroup because of the high rates of osteomyelitis and subsequent amputation[2]. In such fractures the external fixation has been popular because of the relative ease of application and the limited effect on tibial blood supply.

Both unilateral and Ilizarov type external fixators can be used for the difficult fractures resulting from high energy trauma. Ilizarov external fixator has the advantages of shorter operative time, less blood loss, minimal surgical exposure, lack of periosteal stripping with possible quicker healing time of the fracture, and the greater mechanical stability when compared with monolateral external fixator.Ilizarov circular fixation is an efficient alternative method of fixation of high-energy tibial fractures where internal fixation is contraindicated due to trauma to the soft tissue, deficiency of bone stock, and bony comminution.[3]It is, however, a technically demanding procedure. There is consensus about the need for early soft tissue cover for better results, however, comminution and initial displacement of fragments are poor predictors of outcome [(4,5,6)].

Gavril Abramovich Ilizarov, the inventor of the unique external fixator, also introduced the concept of distraction osteogenesis, for the treatment of segmental defects. Compression distraction is a technique in which shorter gaps may be closed by immediate shortening followed by lengthening at healthy metaphysis. This method, using the Ilizarov technique, is used to deal with complex fractures combined with severe soft tissue injuries. Use of Ilizarov technique is an effective tool for treating large tibial defects. However, the treatment time is lengthy with a considerable risk of complications.[(7, 8)]

The present study is carried out to assess and evaluate the outcome of proximal tibial metaphyseo-diaphyseal fractures secondary to high energy firearm injury and road side accident managed with Ilizarov system regarding time to

union, common complications, duration of external fixation, and functional condition of the limb.

MATERIAL AND METHOD

A prospective, comparative, interventional, analytic study of 30 clinical cases was conducted in the department of Orthopedic Surgery, Mayo Hospital, Lahore from 2010 to 2012. Adult patients with open proximal metaphyseo-diaphyseal tibial shaft fractures secondary to high-energy roadside accident and firearm injury presenting within one week of the injury were included in the study. Whereas, patients younger than 16 years and older than 60 year, having intra-articular fractures and having systemic disease which precluded early weight bearing were excluded from the study. Additionally, neurological deficient and immune-compromised patients were also excluded.

Patients were divided into two groups depending upon cause of injury. Among these 15 were from roadside accident (Group A) and 15 were from firearm injury (Group B).After initial resuscitation, the wound was examined and pre-operative investigations were done. Initial debridement was done in the emergency after prophylaxis with first generation cephalosporins and aminoglycoside antibiotics. Dead and necrotic soft tissues were excised along with bone fragments without soft tissue attachment. Wound was irrigated with abundant amount of saline and dressings were applied and patients shifted to ward with POP back slab in place. Wound was re-examined after 24 hours and serial debridements were done as and when required. Ilizarov fixator was applied within two weeks of injury in all cases. Soft tissue procedures like split skin grafting, delayed primary wound closure, fasciocutaneous flap, or myocutaneous flaps were done as early as possible during treatment.

The follow up record of every patient was maintained at an interval of one month for 12months including clinical and radiological evaluation. At each follow up visit:

- Patients were examined and x-rays (A-P, Lateral, Oblique and additional, when required), were taken to assess union.
- Functional status of the patient and range of movement at ankle and knee joints were noted.
- Complications like infection, delayed and non-union were assessed and treated.

All data was collected by filling a standard Proforma during hospital stay using the hospital record and supplemented by continuing follow up.

The criteria used in our study were that used by Paley to declare the results as excellent, good, fair, and poor[9]. Results were compiled and presented as proportions (%) for categorical variables and means for continuous variables with their standard deviation. The proportions were compared using a Chi Square test. Means were compared using a t-test to obtain the p value. The computer program SPSS 10 was used to analyze and process the data.

Fig. 1: A-P Radiograph of a 28 yrs old male with proximal metaphysealtibial fracture from high velocity firearm injury.

Fig.2: A-P Radiograph of a 45 yrs old male with proximal metaphysealtibial fracture from roadside accident fixed with Ilizarov external fixator.

RESULTS

Group A: Among the 15 patients, 12 patients had comminuted fracture of proximal metaphysis, 2

had segmental fracture of diaphysis and one had segment loss of 4 cm of the metaphyseo-diaphyseal region. 5 patients needed split skin grafting, 2 needed fasciocutaneous flap and one needed myocutaneous flap. Fixation was done after an average 7 days after injury. 7 were treated with compression distraction, 5 needed bone grafting at 12 weeks. Three needed no additional procedure. Dynamization was done after assessing the clinical and radiological union. It was followed by removal of fixator and POP cast application. The cast was discarded after one month. All patients had union with the average time period of 135 days (4.5 months). The most common complication during the period of fixator application was found to be pin tract infection. Two patients had range of motion up to less than 90º, one patient reported significant ankle stiffness, which was dealt with aggressive physiotherapy.

Group B: Among the 15 patients, 10 patients had comminuted fracture of proximal metaphysis, 3 had segmental fracture of diaphysis and 2 had segment loss of 5 cm of the metaphyseo-diaphyseal region. 3 patients needed split skin grafting, 1 needed fasciocutaneous flap and one needed myocutaneous flap. Fixation was done after an average 6. 5 days after injury. 10 were treated with compression distraction, 5 needed bone grafting at 12 weeks of fixation. Distraction was started at a rate of 5 mm twice a day 10 days after corticotomy. Dynamization was done after assessing the clinical and radiological union. It was followed by removal of fixator and POP cast application. The cast was discarded after one month. 14 patients had union with the average time of 170 days. The clinical results were compared with those of Group A. The most common complication was again pin tract infection with complaint of pain at pin sites, which was managed with analgesics. One patient had nonunion at compression site, which was managed, with bone grafting. Four patients had range of motion of less than 90 at knee. This and the ankle stiffness in three patients were dealt with aggressive physiotherapy.

DISCUSSION

Non-articular proximal fractures are distinguished from the more distal tibial shaft fractures as these are situated at metaphyseo-diaphyseal area and are particularly difficult to treat because of danger of compartment syndrome and arterial injury. The open fractures from high-energy trauma also have a very high infection, non-union and amputation rate. The reasons are multifold. Firstly the precarious blood supply of tibia along with its subcutaneous location makes it loose its nutrition more frequently after injury as compared to bones, which are covered with abundant soft tissues. Secondly it is the most frequent bone fractured in trauma. Thirdly the high-energy injuries in themselves are highly damaging to soft tissues and bone causing its comminution resulting in severe damage to the blood supply. The healing process therefore in these kinds of fractures is very slow demanding a lot of patience, care and cost of treatment. The outcome of fractures because of the factors mentioned above is difficult to predict. The goal of treatment in such cases is the restoration of anatomy and function as early as possible.[10,11,12]

The high-energy trauma from roadside accidents differs from that of high velocity firearm injuries in many respects. Trauma of roadside can have contamination of wound of wide range of intensity depending upon the accident scenario. It also commonly involves injuries at multiple sites and organ systems as compared to firearm injuries. The firearm trauma on the other hand has a factor of cavitations at injury site with devitalized tissue. The comparison therefore in our study has revealed interesting results.

The eradication of infection took more time and more attempts at debridement in firearm injury group probably because of the well known factor of extensive soft tissue damage at quite a distance from the missile tract leading to more devitalization of tissues which is difficult to predict in such cases because of the smaller skin wound. The union was found to be delayed in firearm injury group probably because of loss of blood supply at the fracture site resulting from revitalization of tissues in these injuries. Similarly one fracture could not unite and needed further management. Similarly other additional procedures were required and complication rate was also slightly more in fire arm injury group. While the functional result were comparable in both treatment groups.

The comparison of results with other studies has shown a better mean union time, probably provided by early eradication of infection and improved limb circulation provided by weight bearing and ambulation. A high infection rate is seen in comparison specially pain at pin sites.[13]

Authors	Number of fractures + Gustilo grade	Treatment	Mean union time (weeks)	Failed treatment (%)	Infection rate (%)
Velazco and Fleming (1983)	40 mixed type II/III	External fixation	85% at 78	12.5	12.5
Chan et al (1984)	17 mixed type III (80 % with bone loss)	External fixation	50% at 64	6	35
Edwards et al (1988)	202 mixed type III (83 % with bone loss)	External fixation	38	7	15
Christian et al (1989)	9 IIIB (all with bone loss)	External fixation	38	NR	22
Blick et al (1989)	53 mixed open and closed	External fixation	45	4	28
Robinson et al (1995)	30 IIIB (all with bone loss)	Intramedullary nailing	53	3	20
Present study	30 mixed type IIIA & B	External fixation	97 % at 37	0	15

(Comparison of results with reports of the use of external fixation for severe open tibial fractures[13].)

The largest number of complications is associated with wire tract including pain and pin loosening as seen in study by Green et al.[14] The pain associated with this fixation method was the most common factor, which precluded weight bearing and led to the knee and ankle stiffness in some patients. The total period of external fixation was more in Group B because of the factors discussed in the earlier section.

CONCLUSION

The fractures resulting from high-energy trauma whether from roadside accidents or from firearm, although a difficult problem to solve, have been shown to be manageable with high success rate with the circular external fixator. Firearm tibial fractures present a more complicated scenario as compared to roadside trauma fractures in all aspects of management like eradication of infection, time to union and rate of union. Ilizarov external fixator, however, has improved the functional outcome of both types of fractures. Ilizarov external fixator being a multiplaner fixator is an excellent device for the management of high-energy tibial fractures as these types of fractures need minimally invasive techniques to prevent further insult to the soft tissues. Furthermore it allows management of fractured bone by techniques like compression distraction, distraction compression and bone grafting. The weight bearing persistently encouraged early in treatment helps in early eradication of infection and improved bone quality.

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