ORIGINAL ARTICLE

In the cost-conscious era: Ilizarov circular frame or uniplanar external fixator for management of complex open tibia shaft fracture, retrospective cohort study from a level-1 trauma center

Muhammad Atif,[1] Yasir Mohib,[2] Obada Hasan,[3] Haroon Rashid[4]

Abstract

Objective: External fixation is the most commonly used method for temporary management of open fractures of the Tibial shaft followed by internal fixation. This can also be used as a definitive method of fixation. Ilizarov is more superior and can be the primary and definite option where expertise is available. This study was conducted todetermine the outcome of open tibia shaft fracture treated with either Ilizarov or AO External Fixator.

Methods: Anon-commercial retrospective cohort was conducted at Aga Khan University Hospital Karachi on patients operated for isolated open tibia fractures Gustillo type III (A, B, C) stabilized with external fixation either circular or uniplanar external fixator. These two groups were compared in terms of fracture pattern, healing and complications. For fracture healing, Radiographic union score (RUST) for tibial fractures were used.

Result: A total of 93 patients were included in the study. Mean age 36.7 +/- 17.3 years comprising 83 males and 10 females. Circular Fixator was used for 46 whereas 47 were treated with uni-planar fixator. Mean new injury severity score was 21 ± 3.4 for circular fixator group and 26 ± 7 in uniplanar fixator group. Mean time fur fracture healing was 6±1months in circular fixator group and 9 months in Uniplanar Fixator group. Mean RUST score for circular fixator was 9.5±1.2.and of uniplanar it was 7.3±1.0.

Conclusion: Circular fixator works as a single stage procedure with acceptable outcomes for Gustilo grade III open tibial shaft fractures as compared to uniplanar external fixator.

Keywords: Tibia, Open-Fracture, External-fixator, Ilizarov. (JPMA 70: S-20 (Suppl. 1); 2020)

Introduction

Tibial shaft fracture is a common injury worldwide and management of open tibial fracture remains a challenge for the orthopaedic surgeon. The annual incidence is 26% per 100,000 populations with a mean age of 37 years, male population are affected more due to road traffic accidents and contact sports.[1] Fracture pattern and severity of soft tissue damage varies according to energy of trauma. Tibial shaft fractures usually occur in association of soft tissue damage.[2] Its anteromedial surface is subcutaneous which is responsible for high incidence of open fracture. Insufficient blood flow and lack of soft tissues in antero-medial aspect of tibia contribute to open fracture with increased incidence of non-union and development of infection.[3] Their treatment, prognosis, and outcome are mainly determined by the mechanism of injury, presence of comminution, soft tissue injury and displacement.[4]

Treatment of open tibial fractures has controversy among the orthopedic surgeons.[5] Severe open fractures should be managed in specialist units experienced in the management of such injuries.[6] Treatment option include conservative treatment with cast immobilization, Intramedullary nailing, Open reduction and internal fixation with plate, Minimally invasive plate osteosynthesis (MIPO) techniques with limited periosteal stripping and soft-tissue dissection.

In developing countries, lack of education, poor socioeconomic backgrounds, delay in presentation and appropriate planning for surgery add further to complicate the situation. As open tibial fractures are prone to infection which may end in delayed union, non-union, prolong hospital stay, multiple surgeries and ultimate results in increased morbidity. Currently, external fixation is most commonly used in the temporary management of open fractures followed by internal fixation, but can also be used as a definitive method of fixation.[7] Duration of temporary external fixator is 4 weeks but at least 2 weeks are required for soft tissue healing.[3]

A variety of external fixators are available: simple uniplanar frames that are attached with half-pins and clamps, multiplanar fixator that may improve stability, and the most complex ring fixator with fine wire attachments and Ilizarov techniques.[8] Ilizarov have

[1]Ghurki Trust Teaching Hospital, Lahore, [2-4]Department of Surgery, Aga Khan University Hospital, Karachi.

Correspondence: Obada Hasan. Email: Obada.husseinali@gmail.com

advantage to allow early mobilization, weight bearing with decreased morbidity and hospital stay as compared to temporary stabilization which ultimately requires a second procedure for definitive fixation with Intramedullary nailing or plate fixation.[5] This study was conducted todetermine the outcome of open tibia shaft fracture treated with either Ilizarov or AO External Fixator in terms of Fracture healing. Time of fracture union, need for secondary procedures till union achieved, weight bearing and hospital stay.

Material and Methods

A retrospective cohort was conducted at Aga Khan University Hospital Karachi on patients operated for isolated open tibia fractures between 1st January 2008 and 31st December 2014. Patients with open tibia shaft fracture type III (A, B, C) as per Gustillo classification of open fractures stabilized with external fixation either circular or uniplanar external fixator were included.All closed and type I and II open tibia shaft fractures according to Gustillo classification of open fracture, Intra-articular fracture extending to knee and ankle joints were excluded. All the information regarding patients ER management governed by ATLS protocols, local wound care, splint, tetanus prophylaxis, antibiotic prophylaxis, mode of injury andclassification of open tibia shaft fractures based on Gustillo classification on presentation in Emergency, retrieved from the medical records.

All the patients were operated by the consultant orthopedic surgeon and choice of operative technique was based on the general recommendations at the time of treatment. Formal wound debridement and stabilization of tibia either with circular or uniplanar external fixator done. Pin site daily dressing was advised and followed in clinic on monthly basis until fixator removed as per standard practice.

These patients were divided into two groups according to the External Fixator used; Circular and Uniplanar. These two groups were compared in terms of fracture healing, mechanism of injury, fracture classification, patient ambulation at discharge, New Injury Severity Score (NISS), duration of hospital stay, duration of fracture union, need for secondary procedures and complications. Radiographic union score (RUST) for tibial fractures for assessment of tibial fracture healing was used for fracture healing.[9] Union was defined fracture healing after 6 months and delayed union after 9 months later on non-union. Data were analyzed by SPSS software (version 20). The student t-test was used to compare continuous variables.

Results

A total of 110 files were reviewed of which 17 did not meet the inclusion criteria hence excluded. Remaining 93

Table-1: Characteristics of patients with open tibia fracture (Gustillo type III=93).

	Frequency	Percentage
Gender		
1. Male	83	89.20%
2. Female	10	10.75%
Gustillo type III		
A.	65	74.70%
B.	7	7.50%
C.	7	7.50%
Mechanism of Injury		
1. Road Traffic	65	72.30%
2. Fall from height	7	7.40%
3. Gun Shot	12	12.80%
4. Bomb blast Victim	8	
	6	6.40%

Table-2: New Injury Severity Score (NISS) and Mechanism of Injury between the two groups.

	Circular Fixator	Uniplanar Fixator
NISS (mean ± SD)	21 ± 3.4	26 ± 7
Mechanism of Injury		
1. RTA	35 (76%)	33 (70 %)
2. Fall from height	3 (7%)	4 (8 %)
3. Gun Shot	6 (13%)	6 (13%)
4. Bomb blast Victim	2 (4%)	4 (9%)

Table-3: Outcomes of Tibia Fracture between the two groups.

	Circular Fixator	Uniplanar Fixator
Mean time of fracture healing (months)	6	9
Hospital Stay (days)	7	17
Ambulation (on Discharge):		
1. Bed rest	None	1(2%)
1. Non weight bearing	None	44(94%)
2. Partial weight bearing	3(6.5%)	2(4%)
3. Full weight bearing	43(94.5%)	None
Need for additional surgical procedure (Conversion)	3(6%)	25(53%)
1. Ilizarov	Not Applicable	10(21%)
2. IM Nailing	None	3(6.3%)
3. ORIF with Plate	None	2(4.2%)
4. Cast or splint	None	8(17%)
5. Readjustment of hardware	3(6.5%)	2(4.2%)
RUST Score	9.5	7.3
Complications:		
Pin Site Infection	3(6.5%)	1(2.1%)
Delayed Union	1(2.2%)	3(6.4%)
Others	None	1(2.1%)

Figure-1: Young man presented to Emergency Department with history of high energy trauma (Bike Vs Bus run over). Bilateral lower limb injuries. Unfortunately he had mangled extremity of left leg for which he had amputation. Right lower limb in figure above showing severe degloving injury and fracture of femur shaft. It was managed by uniplanar external fixator and soft tissue coverage. Patient can walk with support.

Figure-2: The same patient in figure one. Note the severe degloving injury and skin loss. Follow-up picture showing the good healing and uptake of the graft.

patients (Table-1) represented the study sample with mean age 36.7 ± 17.3 years comprising 83 males and 10females. Out of 86 patients, 44 were treated with circular fixator and 42 with uniplanar fixator. Out of total 86Gustillo type III tibia shaft fractures 79(91.8%) were Type III A and 7(8.1%) Type III B fractures. The overall mechanism of injury (Table-2) wble1as road traffic accident 35 (76.1%) followed by fall from height 3 (6.5%), gunshot injuries include 6 (13.0%), bomb blast were 2 (4.3%).

Mean new injury severity score was 21 ± 3.4 for circular fixator group and 26 ± 7 in uniplanar fixator group. (Table-3) summarizes the outcomes of both groups. Mean duration of hospital stay is 7 days in circular fixator group and 17 days in Uniplanar Fixator group which is significant. Mean time of fracture healing was 6±1 monthsin circular fixator group and 9±1.5 months in Uniplanar Fixator group. Mean of RUST score for circular fixator was 9.5±1.2 and of uniplanar it was 7.3±1. In circular external fixator group 43 (94.5%) patients were ambulated as full weight bearing and 3 (6.5%) partial weight bearing while with uniplanar fixator group 44 (94%) were mobilized non-weight bearing, 2 (4%) were partial weight bearing and 1 (2%) was on complete bed rest.

In the uniplanar group, 25 (53%) patients had secondary procedures bone grafting, fixator readjustment, conversion to plate, intramedullary nail or circular fixator. Complications in circular fixator were reported in 4(15%) patients while they were found in 5(17 %) patients of the uni-planar group (pin site infection 2%, readjustment of fixator 4%, delayed union 6% and others (fat embolism 2%). Figures-1 and 2 illustrating the complex severity of such fractures.

In circular fixator group, reconstructive procedure included Flap coverage in 1(2%) of patients and bone grafting was needed in 2(4%) patients (iliac crest and fibula transport) while in Uniplanar fixator, split thickness skin grafting was done in10 (21%) patients, Flap coverage in 4(8%) and bone grafting in5(10 %) patients (Bone graft substitute and iliac crest).

Discussion

Open high energy tibia shaft fractures are notorious for complications including infections, non-unions, soft tissue coverage and involve large volume of young active individuals.

Inan et al. in 2007 compared ilizarov with un-reamed intra-medullary tibia nailing, and reported 21.5% malunion with Ilizarov the rate of pin site infection 27.4% which was higher than our results.[10] Ganji et al in 2011 observed no differences regarding the mean time for union, malunion and re-fracture either with Ilizarov or AO external fixator for the treatment of open tibia fractures.[11]

Our study confirms excellent results with ilizarov; 6 months mean fracture healing time better than 9 months mean fracture healing time as with uniplanar external fixator. Forty nine percent patients treated with uniplanar external fixator required additional procedures including conversion to ilizarov as compared to 6% additional procedures with ilizarov. The treatment with ilizarov provides promising results for treatment of open tibia shaft fractures.

Strength of the Study: Cohort design with comparison group studying the radiological and functional outcomes of these 2 procedures. Moreover our focus on the severe complex tibial open fracture grade 3 which is very notorious to management may reduce the confounding effect of other types of open fractures which are managed by different techniques and have different results.

Limitations and Future Study Recommendations: The sample size of our study was relatively small and the design was retrospective from single centre. Hence we could not derive strong associations. Further research, including randomized clinical trials, should be done to study the differences between different procedures and to establish firm guidelines.

Conclusion

Circular fixator application has favourable outcomes for Gustilo grade III open tibial shaft fractures in terms of duration of fracture healing, union, hospital stay, single stage procedure with fewer complications and need of adjustment of fixator as compared to uniplanar external fixator.

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