

# Uniplanar External Fixator as a Definitive Treatment for Open Fracture of Tibia

MUHAMMAD INAM<sup>1</sup>, WAJID REHAN<sup>2</sup>, OSAMA BIN ZIA<sup>3</sup>, AMAN ULLAH KHAN KAKAR<sup>4</sup>, SYED ABDUR RUB ABIDI<sup>5</sup>, ABDUL REHMAN KHAN<sup>6</sup>, MUHAMMAD TALHA KHALIL<sup>7</sup>, TAUSEEF RAZA<sup>8</sup>, ABDULAKBAR<sup>9</sup>

<sup>1</sup>FCPS, Associate Professor, MTI-LRH, Peshawar

<sup>2</sup>Consultant Orthopedic Surgeon, Type C Hospital, Karak

<sup>3</sup>Assistant Professor, Consultant Orthopedic Surgeon Liaquat College of Medicine and Dentistry, Darul Sehat Hospital, Karachi

<sup>4</sup>Associate Professor of Orthopaedic Surgery, BUMHS and BMC, Quetta

<sup>5</sup>Associate Professor, Orthopaedic Surgery Department, Jinnah Medical & Dental College, Karachi

<sup>6</sup>Assistant Professor, Department of Orthopedics, Dow University Hospital, Dow International Medical College, DUHS, Karachi, Sindh, Pakistan

<sup>7</sup>Consultant Orthopaedic Surgeon Fatima General Hospital, DG Khan

<sup>8</sup>Assistant Professor, Department of Orthopedics, KMU Institute of Medical Sciences, Kohat

<sup>9</sup>MBBS, Trainee Medical Officer MTI-LRH, Peshawar

Corresponding author: Abdul Akbar, Email: [dminamkhan71@gmail.com](mailto:dminamkhan71@gmail.com)

## ABSTRACT

**Aim:** Tibia is exposed to majority of trauma and accidents due to its location in the body. That's why most of time it sustains open fracture in trauma and have high frequency of infected non union due to precarious blood supply. Definitive treatment with ex fix is a very good idea for poor people as one can save money and avoid multiple surgeries as the patient cannot afford it

**Objective:** To evaluate the results of Definitive treatment with uniplanar external fixator in open fracture management of tibia in terms of healing.

**Material and Method:** This Case Series study was conducted from January 2017 to December 2022 in Akbar Medical Center Dabgari Garden Peshawar Pakistan. A total number of 97 patients of either gender having age range of 15 to 60 years with open fracture of tibia were included. All patients were admitted from outpatient department of the center. All the data collected was entered and analyzed with help of SPSS version 23. The results were evaluated using Association for the Study and Application of the Methods of Ilizarov (ASAMI) scoring system.

**Results:** There was total 97 patients having age range of 44(15-59) with mean age 31.23.(Std Deviation 11.58). Male patients were 74(76.3%) while female were 23( 23.7%). Delayed union was noted in 11(11.3%), External Rotation in 3(3.1%) Healed without complication in 72(74.2%), Infection in 4(4.1%), one pin broken in 4 (4.1%) and Shortening of less than 1.5 cm was noted 3(3.1%) cases. In 4(4.1%) cases debridement was done as secondary procedure, in one case NA fixator was applied 1(1%) while in 7(7.2%) case bone grafting was done as secondary procedure.

**Practical Implication:** Definitive treatment with ex fix is a very good idea for poor people as one can save money and avoid multiple surgeries as the patient cannot afford it.

**Conclusion:** External fixator is used as a definitive treatment method for open fractures of the tibial shaft caused by high energy trauma either in war times or in motor vehicle accidents has good bone and functional results.

**Keywords:** Tibia, Fracture, Fixator, Uniplanar, Ilizarov

## INTRODUCTION

Tibia is exposed to majority of trauma and accidents due to its location in the body.<sup>1</sup> Nearly one third of the tibia is subcutaneous and have no muscles all around it like femur<sup>1</sup>. That's why most of time it sustains open fracture in trauma and have high frequency of infected non union due to precarious blood supply<sup>2</sup>. There are multiple ways to treat such fractures. The closed fracture has the advantage to fixed it internally but open fracture is challenging.<sup>3</sup> Some surgeons prefer to do debridement and internal fixation when the fracture presented in first six hours while other prefer damage control only. Some surgeons apply external fixator and do debridement but later one when the wound heals then remove the fixator and fix it internally<sup>4</sup>. There is also another way to treat such fracture with circular ring fixator and debridement as a definitive management which is not acceptable to some patients especially to old age patients.<sup>4,5</sup> The AO uniplanar external fixator is used universally for damage control surgery which is later on exchanged with internal fixation. This is light weighted explants that almost every patient can tolerate.<sup>4,6</sup> It has low cost as compare to Ilizarov or other implants and can easily be fixed in tibia by junior surgeons or residents as well. There are multiple type of national and international uniplanar external fixator like Wagner Apparatus, Naseer Awais (NA) fixator and AO external fixator.<sup>7,8</sup> The first two fixator are used for limb lengthening as well as for fracture fixation but the last one is purely used in fracture fixation only. Original AO external fixator( EX FIX) has clamps that can be connected with each other by Carbon Rods while local version of the same has stainless steel rods which is cost effective as original.<sup>7-10</sup> Depending the size of bone and fracture configuration one can increase the clamps and size of rods as it normally contains only four clamps. Definitive treatment with ex fix is a very good idea for

poor people as one can save money and avoid multiple surgeries as the patient cannot afford it.<sup>11</sup> This may also decrease the unemployed days to the patients which is an extra burden on the family. Definitive treatment with ex fix can also decrease the work load on surgeon as well as on hospital<sup>11</sup>. We have conducted this study to evaluate the results of Definitive treatment with ex fix in open fracture management of tibia in terms of healing. There is no local data which has done on monolateral external fixator for open fracture of tibia as a definitive treatment method, so this will increase our trust in the locally made low cost implant in such type of fracture.

## MATERIAL AND METHOD

This Case Series study was conducted from January 2017 to December 2022 in Akbar Medical Center Dabgari Garden Peshawar Pakistan. A total number of 97 patients of either gender having age range of 15 to 60 years with open fracture of tibia were included. All patients were admitted from outpatient department of the center. After taking the informed written consent a thorough preoperative preparation was done and these patients were either operated under general or spinal anesthesia. In all patients debridement was done and loose bone fragments were removed and sent for culture sensitivity. Locally made uniplanner External fixator was applied. This is a external fixator consists of Schanz screws 5 to 7 mm which fix bone fragment. These Schanz screws are held together by clamps and clamps are interconnected by two stainless steel rods.

First the most proximal and distal Schanz screws were passed. After aligning the tibia and maintaining the length clamps and rods were applied to the pins. Rests of screws were passed in the proximal and distal clamps and the rods tightened.

Postoperatively all the patients were treated by empirical antibiotics (cefoparzone +Sulbactam) which was later on changed according to culture sensitivity. Screws sites were cleaned with pyodine solution twice a day and patients were instructed to continue pin site care. Ankle and knee joint physiotherapy was started on the first post operative day. They were discharged home on the third post operative day and were called to outpatients department after two week. Then patients were followed monthly, radiographs were taken to see callus quality and wound condition. Full weight bearing with support was allowed immediate after surgery and after seing the full bridging callus weight bearing without support was started. After one month of full weight bearing without support dynamization was done and again patient was allowed to walk without support for another month. After that fixator was removed under general sedation or without sedation, Cast was applied for two weeks and patient was allow to walk with cast. If there was no pain then the cast was remove after weeks and patients was allowed to walk with a stick for one month. All the data collected was entered and analyzed with help of SPSS version 23. The results were evaluated using Association for the Study and Application of the Methods of Ilizarov (ASAMI) scoring system. (Figure I) <sup>12</sup>

**RESULTS**

There was total 97 patients having age range of 44(15-59) with mean age 31.23.(Std Deviation 11.58) (Table No 1). Male patients were 74(76.3%) while female were 23( 23.7%)(Table No 2). Right side was involved in 46(47.4% while left side in 51(52.6%)(Table No 3). Bomb blast injury BBI was 7(7.2%) Fall in 38(39.2%) Road Traffic Accident in 72(73.6%) cases were noted(Table No 4). Orthopedic Trauma Association classification was used in this study in which type A injury was noted in 43(44.3%), type B in 36(37.1%) and type C was noted in 18(18.6%) cases (Table No 5). Delayed union was noted in 11(11.3%), External Rotation in 3(3.1%) Healed without complication in 72(74.2%), Infection in 4(4.1%), one pin broken in 4 (4.1%) and Shortening of less than 1.5 cm was noted 3(3.1%) cases ( Table No 6). In 4(4.1%) cases debridement was done as secondary procedure, in one case NA fixator was applied 1(1%) while in 7(7.2%) case bone grafting was done as secondary procedure ( Table No 7). At final follow up at nine moths the ASAMI score bone result was Excellent for 72(74.2%) and good for 24(24.8%) and fair for 1(%) cases while it was excellent in all case for functional results. Figure 2,3.

Table 1: Statistics (n=97)

		Age of patient
N	Valid	97
	Missing	0
Mean		31.23
Median		29.00
Std. Deviation		11.158
Range		44
Minimum		15
Maximum		59

Table 2: Gender of patients (n=97)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	F	23	23.7	23.7	23.7
	M	74	76.3	76.3	100.0
Total		97	100.0	100.0	

Table 3: Side of injury(n=97)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Right	46	47.4	47.4	47.4
	Left	51	52.6	52.6	100.0
Total		97	100.0	100.0	

Table 4: Mechanism of injury(n=97)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	BBI	7	7.2	7.2	7.2
	Fall	38	39.2	39.2	46.4
	RTA	52	53.6	53.6	100.0
	Total	97	100.0	100.0	

Table 5: Type of fracture (n=97)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	A	43	44.3	44.3	44.3
	B	36	37.1	37.1	81.4
	C	18	18.6	18.6	100.0
	Total	97	100.0	100.0	

Table 6: Complications

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Delayed union	11	11.3	11.3	11.3
	External Rotation	3	3.1	3.1	14.4
	Healed without complication	72	74.2	74.2	88.7
	Infection	4	4.1	4.1	92.8
	one pin broken	4	4.1	4.1	96.9
	Shortening of 1 cm	2	2.1	2.1	99.0
	Shortening of 1.5 cm	1	1.0	1.0	100.0
	Total	97	100.0	100.0	

Table 7: Second Procedures(n=97)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bone Graft	7	7.2	7.2	7.2
	External Fixator	1	1.0	1.0	8.2
	Debridement	4	4.1	4.1	12.4
	No procedure	85	87.6	87.6	100.0
	Total	97	100.0	100.0	

Table 8: Association for the Study and Application of the Methods of Ilizarov (Asami) Scoring System <sup>12</sup>

Bone results	
Excellent	Union, no infection, deformity<7°, limb length discrepancy<2.5 cm
Good	Union + any two of the following: no infection, deformity<7°, limb length discrepancy<2.5 cm
Fair	Union +only one of the following: no infection, deformity<7°, limb length discrepancy<2.5 cm
Poor	Non union / re-fracture / union + infection + deformity>7° + limb length discrepancy>2.5 cm
Functional results	
Excellent	Active, no limp, minimum stiffness(loss of <15° knee extension/<15° dorsiflexion of ankle),no reflex sympathetic dystrophy, 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



Figure 2: Post operative picture of patient at 2 months.



Figure 3: Post operative Radiograph of patient at 2 months.

**DISCUSSION**

Alhammoud M et al<sup>13</sup> did a study on 955 patients with open fracture of long bone fractures in Aleppo, Syria in which he applied uniplanar and some multiplanar external fixators as a primary and definitive procedure for bone Healing. In his study only 404 (42.3%) were followed up until bone healing till removal of the external fixator while rest of patient were lost to follow up. The age range was 27.5 ± 11 years, with 91.6% males and 8.2% females. The overall bony union rate was 68.3% (276), with 60.9% (95/156) in open femur, 70.3% (137/195) in open tibia, and 83% (44/53) in open humerus fractures. There was 16.7% (67) overall infection rate, 18.6% in femur, 18.1% in tibia, and 5.8% in humerus fractures.

Wang X et al<sup>14</sup> studied 31 patients with complex tibia shaft fractures who received unilateral external fixator combined with lateral auxiliary frame. Twenty three patients had poor soft tissue coverage and 8 patients had Gustilo Anderson type 1 fractures. The mean hospital stay was 7.3 ± 2.3 days. The mechanism of injury were motor vehicle accidents(MVA) in 15(48.4%), fall from height in 7(22.6%), crush injury in 5 (16.1%), and other causes in 4 (12.9%) Patients. This is comparable to our study which has 53.6% MVA. Average bone healing time was 3.0 ± 0.85 months. Additionally, the pin-tract infection rate and reoperation rate was 12.9% and 3.2% which is almost comparable to our study. In his study all patients achieved bone healing well without any joint stiffness. The Johner-Wruhs scores showed excellent results in 27 cases (87.1%) while good results in 4(12.9%) cases.

Atif M et al<sup>15</sup> studied 93 patients with Mean age 36.7 +/- 17.3 years comprising 83 males and 10 females. Ilizarov was used for 46patients while 47 were treated with uniplanar external fixator. The average injury severity score was 21 ± 3.4 for Ilizarov fixator group A and 26 ± 7 in uniplanar External fixator group B. Average time for bone healing was 6±1months in group A and 9 months in group B. He conclude his study that both fixator can work for open fracture healing but the ring fixator has less time to heal.

Dai J et al<sup>16</sup> studied pediatric cases having 19 patients with a age range of 3.8-12.0 years) who had tibia fracture. All patients achieved a good bone healing obtained at 8 weeks post-operatively on average. There was no case of delayed union or nonunion. However one patients had pin tract infection and other three had pin loosening. This study is comparable to our study in which there was no complication in 87.6% pin breakage in 1% and bone grafting in 7.2% patients.

MA H et al<sup>17</sup> studied 74 patients with open fracture tibia (43 cases, fixed with Taylor Spatial Frame(TSF) group A) and uniplanar group B (31 cases, fixed with unilateral external fixator). He followed all patients for 8-22 months, with a median of 12 months. All fractures healed, and no complication such as delayed union, nonunion, or osteomyelitis occurred. This is comparable to our study that all patient in our study had been healed at final follow up. After removing of external fixator, the functions of limb were evaluated according to the Johner-Wruhs standard. In TSF group, 41 (97.67%) cases were excellent, 1 case was good, and 1 case was fair, while in group B, 30 (96.77%)cases were excellent and 1 case was fair. They did not find any significant difference between the two groups ( P=0.666). This study testify our current study that result of circular ring multiplanar fixator are equal to uniplanar external fixator.

**CONCLUSION**

External fixator is used as a definitive treatment method has good functional results for open fractures tibial shaft caused by high energy trauma either in war times or in huge motor vehicle accidents. The unilateral external fixator is an effective option for ultimate treatment of the tibia and fibula shaft fractures with poor soft tissue conditions.

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