

# Effectiveness of External Fixator as A Definitive Treatment for Open Diaphyseal Fracture of Tibia

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## ABSTRACT

**Objective** To evaluate the effectiveness of external fixator in open fractures of the tibial shaft.

**Study design** Descriptive case series.

**Place & Duration of study** Department of Orthopaedic Surgery, Jinnah Postgraduate Medical Centre Karachi, from May 2016 to December 2017.

**Methodology** Patients with open fractures of shaft of tibia (Gustilo type III) of either gender, above 18 year of age, with ASA status I & II were enrolled. All patients were assessed clinically and standard surgical procedure was performed. Postoperatively x-rays were taken every month. Final outcome was assessed by ASAMI (Association for the Study and Application of the Methods of Ilizarov) criteria as excellent, good, fair and poor at the end of 3 months of procedure.

**Results** A total of 70 patients were included. There were 38 (45.7%) males and 32 (54.3%) females. Age was from 18 year to 45 year (mean 38.21  $\pm$  8.39 year). Mean weight, height and BMI of the patients was 60.01  $\pm$  5.11 kg, 1.53  $\pm$  0.06 m, and 27.09  $\pm$  5.02 kg/m<sup>2</sup> respectively. Majority of the patients (n=31 - 44.3%) had good outcome, followed by excellent in 26 (37.1%), fair 10 (14.3%) and poor in 3 (4.3%) patients. Effectiveness of external fixator was observed in 57 (81.4%) patients.

**Conclusions** Uniplanar AO external fixator is a safe and cost effective method for open fractures of the tibial diaphysis.

**Key words** External fixator, Open diaphyseal fracture, Tibia.

## INTRODUCTION:

Complications of open tibial shaft fractures are difficult to handle by any of the established form of treatment.<sup>1</sup> In type II Gustilo injuries with sufficient soft tissue coverage of the bone, any method available can be used to achieve stability including intramedullary nailing, reamed or unreamed, internal plating applied by minimally invasive technique; external fixator or a combination of any of these.<sup>2,3</sup> Skeletal traction

entails some serious hazards because any traction allows motion at the fracture site, how well balanced it may be.<sup>4</sup> For type III fractures, where soft tissue coverage is not possible, only intramedullary device and external fixation can be used.<sup>5,6</sup>

The use of external fixation in Gustilo type III fractures may offer many advantages.<sup>7</sup> In this procedure fracture is reduced by manipulation. Pins and wires are then inserted across the fracture site, and are connected together with external bars or frame.<sup>8</sup> This creates space for dressing or procedures such as skin grafting.<sup>9</sup> It maintains the limb length, helpful in segmental fractures and any angulation, overlapping, displacement or rotation of fragments can be corrected.<sup>10,11</sup> The purpose of the study was to establish the effectiveness and safety of external fixator as definitive treatment method for open tibial shaft fractures as it is easy and quick method to fix

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the open fractures in emergency settings and helps to ease wound management.

#### **METHODOLOGY:**

It was descriptive case series conducted at the Department of Orthopaedics, Jinnah Postgraduate Medical Centre Karachi, from May 2016 to December 2017. For calculation of sample size, effectiveness of external fixator as reported in literature (86%)<sup>12</sup> with absolute precision 8%, confidence level = 95%, was taken as baseline. The sample size obtained was 70 patients with open diaphyseal tibial fracture. Sampling technique used was non-probability consecutive sampling. All patients of either gender, between 18 to 45 year of age, with Gustilo type III fracture of the tibia, not more than 2 weeks duration, having ASA status I and II were included. Patients with intra-articular fractures, infection at the site of fracture, fracture with neurological deficits and multiple injuries were excluded. Effectiveness was assessed by ASAMI and considered positive in the presence of good to excellent results.<sup>13,14</sup>

Excellent result was considered when there was bone union, deformity in the axial direction less than 7 degree measured by goniometer, with less than 2.5 cm length discrepancy obtained by non-stretchable measuring plastic tape. Good result was labelled when one of the criteria of excellent was not met, and fair when two of the criteria not achieved. Outcome was considered poor when there was non union at the end of 3 months of procedure.

Approval was obtained from the ethical review board of the institute prior to the conduct of the study. Informed consent was obtained. In all patients who presented to the emergency department history was obtained. Co morbid were identified and baseline investigations were performed.

Procedure was done under general anaesthesia. After all aseptic measures open wounds were managed by thorough debridement and vital structures like vessels, nerves, tendon and bone were covered by soft tissues primarily. After reduction of the fracture fragments AO uniplanar fixator was applied.<sup>13,15</sup> Three pins were inserted on each side of the fracture perpendicular to the long axis of tibia and parallel to the knee and ankle joints. Predrilling with drill bit was done to avoid bone necrosis and subsequent pin loosening. After insertion, pins were connected to each other with two parallel bars with the pin clamps. Reduction was checked and clamps were tightened to pins and bars. Wounds were dressed. Postoperative check x-rays were done and care of the pin sites started to avoid pin tract infection.

Partial weight bearing was allowed at six weeks and full weight bearing at three months. All patients were assessed clinically and x-rays taken every month postoperatively. Final outcome and effectiveness were assessed at the end of three months of the procedure. Statistical package for social sciences (SPSS) version 17 for windows was used for data analysis.

#### **RESULTS:**

A total of 70 patients were managed. Mean age of the patients was 38.21±8.39 year (from 19 year to 45 year). Majority of the patients (n=55 - 78.6%) were more than 38 year of age. There were 38 (45.7%) males and 32 (54.3%) females. Mean weight, height and BMI of the patients was 60.01±5.11 kg, 1.53±0.06 m, and 27.09±5.02 kg/m<sup>2</sup> respectively. Obesity was observed in 41 (58.6%) patients. Mean duration of fracture was 3.85 ±0.72 days (from 3 days to 5 days). There were 56 (80%) patients with <4 days of duration of fracture. ASA status I was observed in 34 (48.6%) while ASA status II in 36 (51.4%) patients. Frequency of smoking was observed in 20 (28.6%), diabetes mellitus in 27 (38.6%), and hypertension in 25 (35.7%) patients.

Gustillo Anderson type IIIA fractures were observed in 42 (60%) patients and type IIIB in the remaining 28 (40%) patients. Out of these, 11 (15.70%) required myocutaneous flap, 12 (17.15%) patients needed split thickness skin grafting and in the remaining four (5.7%) patients skin release with secondary suturing was performed. Bone grafting was required in five patients who had delayed fracture healing (Table1). Most common complication of pin site infection was noted in 16 (23%) patients followed by osteomyelitis (n=7, 10%), malunion (n=6, 8.6%) and delayed union (n=5, 7.15%). Non union and pin breakage was found in 3 (4.3%) and 2 (3%) patients respectively.

Majority (n=31 - 44.3%) of the patients had good outcome followed by excellent outcome in 26 (37.1%), fair 10 (14.3%) and poor in 3 (4.3%) patients. Effectiveness of external fixator was observed in 57 (81.4%) patients.

#### **DISCUSSION:**

Open fractures of the tibia are difficult fractures to treat due to extensive soft tissue damage, loss of blood supply, infection, malunion and non union. External fixator is an acceptable method of treatment in such cases which provide many advantages like wound management, skin grafting procedures, easy application, lower cost, avoiding periosteal damage and excessive removal of adjacent soft tissue,

**Table I: Secondary Procedures According to Gustillo Anderson Open Fractures**

Procedure	Gustillo type IIIA (n=42)	Type IIIB (n=28)
Myocutaneous flap (n=11, 15.70%)	01	10
Split thickness skin grafting (n=12, 17.15%)	05	07
Skin release (n=4, 5.7%)	03	01
Bone grafting (n=5, 7.15%)	03	02

**Table II: Complications With Relation to Outcome**

Outcome According to ASAMI Criteria				
Complications	Excellent (n=26 37.1%)	Good (n=31, 44.3%)	Fair (n=10, 14.3%)	Poor (n=3, 4.3%)
Pin site Infection (n=16, 23%)	02	04	08	02
Osteomyelitis (n=7, 10%)	Nil	01	03	03
Delayed union (n=5, 7.15%)	Nil	01	04	Nil
Malunion (n=6, 8.6%)	Nil	02	04	Nil
Non union (n=3, 4.3%)	Nil	Nil	Nil	03
Pin breakage (n=2, 3%)	Nil	Nil	01	01

and shorter surgery time in comparison to nailing specially in open fractures.<sup>12</sup> A study on patients with diaphyseal tibial shaft fracture managed by external fixator, showed excellent and good results in 86%.<sup>12</sup> A meta-analysis showed that the external fixation group has a tendency of better results compared with the intramedullary nailing group. However, statistically no significant difference was found between the two groups in terms of nonunion rate. Malunion was the only problem with external fixator which gave an inherent statistical advantage to intramedullary nailing.<sup>1</sup> We found malunion in six (8.6%) of our series.

In another study of patients with open tibial fractures treated with immediate tibial nailing without reaming, 18 complications occurred in 143 fractures. This included cellulitis, superficial infection, deep infections, loose or broken hardware, malunion more than 5 degrees, and reduced ankle range of motion when compared with the uninjured side. Eleven (8%) patients were found completely disabled.<sup>2</sup> A mean time of union of 32.8 weeks was noted in patients with open tibial fractures treated with external fixator in comparison to 38.4 weeks in patients with unreamed intramedullary nailing in a comparative study.<sup>4</sup> The mean time of hospitalization was also less in external fixator group (17.6 days) in comparison with intramedullary group (21.6days) which is similar to our study.<sup>4</sup>

In analyses of open tibial fractures treated with

intramedullary nailing showed that nailing after external fixation (especially in the presence of pin site infection) was at high risk of deep infection which favors external fixation as a definite management of open tibial fractures.<sup>5</sup> In a study of 37 patients external fixator was used as final treatment for tibial fractures with open wounds. A total of 36 tibial fractures healed in an average time of 16 weeks (10-24weeks).<sup>16</sup> They found pin site infection in 22.2% of the cases which is near to our results (23%). However they did second surgery of flap coverage in three cases (8.10%) whereas we did myocutaneous flap in 11 (15.70%) cases. Also split thickness skin grafting was done in more cases (n=12, 17.15%) in our series in contrast to three cases by Kumar et al.<sup>16</sup>

National data also supports external fixator as effective in open tibial shaft fractures where union rates can be achieved in more than 80%.<sup>17</sup> These results are in agreement with our findings. However the fracture union time is variable with an average of up to 28.5 weeks. Non union rates were reported high; 12% in contrast to our results in which we found nonunion in only three patients. Although international literature also suggests higher non union rates of up to 15% while using external fixation in open tibial fractures, still many of the fractures (73.5%) were united without any serious complications.<sup>18</sup>

In our study, majority of the patients treated with external fixator had good and excellent outcome which proves this technique as an easy and effective method in emergency settings. However we did not compare this method with other treatment modalities used for open tibial fractures to establish the efficacy of each method.

### CONCLUSIONS:

Uniplanar AO external fixator is a safe and easy method of treating open fractures of the tibia used in emergency settings without any special equipment and good to excellent results can be achieved.

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