

## ORIGINAL ARTICLE

# External Fixation as a Primary and Definitive Treatment for Tibial Diaphyseal Fractures: a Retrospective Longitudinal Study

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## ABSTRACT

**Aim:** To assess the potency of unilateral external fixation as a proper cure for tibial fractures.

**Study design:** A retrospective longitudinal study

**Place and duration:** This study was conducted at Pakistan Institute of Medical Sciences (PIMS) Islamabad Pakistan from August 2020 to August 2021.

**Methodology:** Treatment of 225 tibial shaft fractures was done, in which closed fractures took 22 weeks and open 26 weeks for complete fusion. All fractures were fixed with AO fixator

**Results:** Data of 210 patients was evaluated. Treatment of 225 tibial shaft fractures was done, in which closed fractures took 22 weeks and open 26 weeks for complete fusion. A total of 17 nonunion patients were observed while there were 22 delayed fusions, 5 malunion, 59 pin infections, and 4 osteomyelitis, 43 patients went through the re-operation process.

**Conclusion:** Four patients had fat embolism while pulmonary embolism was present in six and venous thrombosis in 15 patients. The ultimate treatment in 88.0% of patients was external fixation. If there is a non-formation of callus formation, reoperation should be carried out so unilateral external fixation is the preferred treatment for tibial fractures.

**Keywords:** External Fixation, Tibial Diaphyseal Fractures, treatment

## INTRODUCTION

For closed tibial fractures, IM that is intramedullary fixation is the preferred method. But other studies have doubts about IM fixation for the treatment of soft tissues injuries, compartment syndrome, and multiple injured patients [1]. So, the discussion is still being made whether to choose these treatments (IM fixation, unilateral external fixation) for tibial fractures or not [2]. New internal fixation devices have replaced or made less use of external fixation. External fixation was famous in the 1980s but there were also some associated problems with it [3]. Biomechanical properties and optical frame design of these different fixation techniques were also discussed over a long time to know about the efficacy of unilateral external fixation treatment. The Current study was done to assess the potency of unilateral external fixation as a proper cure for tibial fractures

## METHODOLOGY

This retrospective longitudinal study was conducted at Pakistan Institute of Medical Sciences (PIMS) Islamabad Pakistan from August 2020 to August 2021. Permission was taken from the ethical review committee of the institute. With the use of a steel half pin, the AO external fixators were used. The incorporation criteria for external factors are Twenty-five fractures with soft tissues injuries. In 138 cases Gustilo type 3 open fractures. Twenty-six fractures in many injured patients.

Bone defects, intraarticular fractures, and fracture of the femur were excluded from study.

At the time of injury, the mean age of patients was 35 years. There were 41 female and 169 male patients. Forty-nine patients fell from height and one hundred and sixty-one patients got injured through motor vehicle accidents. The average time of surgery from injury to end was 11 hours. The patterns of fractures were classified into AO/ASIF: type A fractures were 109, type B 76, and type C 35. Fluoroscopy and the radiolucent table were used to check the fracture. To enhance reduction traction table was used. Nerves, tendons, bones, and soft tissue cover of vessels managed open fractures. Muscular exercises were mandatory for patients at an early stage. Loading and axial dynamization was done on patients. In transverse and short oblique fractures only early dynamization was allowed. Within 2.5 months full weight-bearing and partial weight-bearing were allowed in 5 weeks. Patients were examined every month. The use of external fixators over other treatments is based on the healing of fracture followed by the formation of callus. Fusion or union was confirmed by radiography and pins were left at the fracture site while the device was removed after this patient is allowed to bear the weight. If there were no infections pins were removed after a few days.

## RESULTS

Data of 210 patients were evaluated. Due to pulmonary embolism 4 patients died and were not included in the study. The average investigation time was 2.5 years. The operation time was 30 minutes. Assessment of results was done using 6 criteria. If the fusion takes place for six months it is normal healing and if it doesn't take place even after 8 months it indicates the absence of healing. The

mean time for 138 open fractures was 24 weeks, in 85 closed fractures it was 22 weeks. There were 19 nonfusions and 20 postponed fusions.

In comparison with the contralateral leg, valgus malalignment of 4° or more, both anterior or exterior angle of 9° or more, decrease in length of 2cm or more is known as a malunion. Recent investigations showed that were 5 malunion with a decrease in length of tibial and 2 hypertrophic nonunion with a decrease in length of 1 to 2.5cm.

External fixation also faces some inherent issues such as pin track infections which were 60 in number. In open fractures, there were 44 pin track infections. Forty-two pin ailments and four cases of osteomyelitis were cured with antibiotics, while in 14 pins was replaced.

To achieve fusion, open tibial fractures go through repeat processes. These proceedings include anesthesia (general and spinal). Due to 19 nonunion, 11 postponed fusions, 3 malunion, and 6 half pin revisions, reoperation was performed (Table 2). Primary fixation devices were changed 2 were broken. To allow axial interfragmentary compression 11 devices were changed. Bone graft was used for 8 postponed fusions. In 10 cases device was changed to Ilizarov circular frame and for 6 cases 2 or 3 pins were changed (table 3). Fixation devices were changed in 27 fractures. The mean time of fusion was 3 months. In 4 patients, pulmonary embolism and in 2 young patients fat embolism was indicated. Suspected DVT was observed in 38 patients but Doppler ultrasonography confirmed it in 14 patients.

## DISCUSSION

Due to issues associated with ailments and the presence of malunion and nonunion, surgical techniques for the treatment of fractures remains doubtful [1]. Even it is accepted that for initial care of open fractures, emergency irrigation is used but there is still no best method found for the stability of the tibia. Many techniques with low good outcomes such as IM and external fixation have been proposed [2-6]. Preference is being given to type 3B to handle open fractures over a long time [7]. The use of external fixation in the treatment of open fractures which later on shifted to MI has both pros and cons [8, 9]. The shift from external fixation to MI has problems associated with it like infections, nonunion, and delayed fusions so there is no suitable answer present for the best to convert an external fixator to an MI nail [10, 12]. To avoid bacterial infections, the patient's defense mechanism should be activated which will be done by knowing the exact time of replacement pins into nails [13, 14]. Within the average time of 37 weeks fusion was achieved 91% by using external fixation in course with reamed MI nailing. When the pin track is healed completely, external fixation is converted into reamed MI nailing in 25 days. Despite all of the advantages, there were 3% cases of osteomyelitis and 15% of deep ailments [4]. There is not sufficient information about stabilizing the plates to draw a specific opinion, but soft tissue proceedings are performed early by surgeons which give good results [2, 15]. Due to external fixation being a popular technique, it is mentioned in recent studies to use it in injuries associated with the military [14, 16, 17]. So, many articles highlight mixed results of external fixation

[4, 18, 20]. If we compare external fixation with intramedullary nailing, external fixation has more negative results such as reoperations, malunion, and nonunion. To be more specific, a metaanalysis of various studies was done to compare unreamed IM nail and external fixators. This metaanalysis showed that there is no such significant difference between these two. Increased implantation failure was observed in unreamed nailing while external fixation was related to increased malunion and reoperations [4]. An indirect comparison of reamed and unreamed IM nails with external fixators was done by Bhandari et al. It was evaluated that reamed nails have advantages over external fixators like no reoperations and nonunion [3]. The occurrence of nonunion and postponed fusions was 8% and 10% in this study which is less than that are present in recent studies. When open tibial fractures were cured with external fixators Kimmel [21] observed that there is 12% nonunion and 38% postponed fusions. In a report given by Fleming and Velasco [22], postponed fusions were 13%. In current literature, the malfusions were 2% while there was a 1cm decrease in length of the tibia. Twenty-five and nineteen percent malfusions have been observed by Kimmel [21] and Giannoudis et al. [23]. The occurrence of osteomyelitis was 2% and that of pin track ailments was 25%. In recent studies, the pin track ailment ranges from 30 to 78% and the occurrence of deep ailments is 17% [23]. The reoperation rate noted by Velazco and Fleming was 3% [24] while in this study it was 19% and in recent studies, 65% of fractures need a further operation before fusion is acquired. The occurrence of bone grafting in recent studies is 44% [23, 24] while in this study it was 3%. So this study gives better results with external fixators than other previous studies because this study includes usage of the stable device, dynamization, and reduction of side to side and axial compression. It is tough to achieve the secondary reduction if the primary reduction is not successfully achieved. Fracture reduction can be neglected when the frame is long. Half pins in an external fixator are made up of stainless steel. To increase fixation HA coating of pins is a good option.

Pin tract infection can be lowered by HA-coated pin and this was given by Moroni et al. [24]. However, HA coating makes difficult removal of pins which can be painful. Healing is enhanced by movement around the fracture site. So this movement is only possible in external fixation. There was low bone healing in IM nailing than external fixators [25] and this was noted by Klein et al. External fixators have many advantages such as fracture alignment, no metal implant, and less vascular damage. This study gives more detail to surgeons so they can carry out external fixation techniques more accurately. Type of external fixators known as unilateral external fixators gives more optimal results. It should also be noted that if there is a delay in callus formation then surgeons should go towards reoperation. For trauma surgeons, bone pins have various advantages over all other techniques due to advancements in medical fields.

## CONCLUSION

Four patients had fat embolism while pulmonary embolism was present in six and venous thrombosis in 15 patients.

The ultimate treatment in 98% of patients with external fixation had no complication. In our study we conclude that unilateral external fixation is the preferred treatment for tibial shaft fractures, specially for open fractures.

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