

# EXTERNAL FIXATOR; FUNCTIONAL OUTCOME IN OPEN TIBIAL FRACTURES

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**ABSTRACT.....Introduction:** Open Tibial shaft fractures are one of the most common fractures of long bones. External fixation is method of choice for the treatment of open tibial shaft fractures. The subcutaneous location of tibia makes it suitable for the application of external fixator. **Patients and Methods:** This study was done on 50 patients at Orthopaedics and Trauma unit "B" at Khyber Teaching Hospital, Peshawar, from Jan 2008 to Feb. 2009 to determine functional outcome of A.O. external fixator in open tibial fractures in terms of knee and ankle mobility, pain and gait on full body weight bearing. The data of all patients was entered in standardized proforma and analyzed on SPSS 10. **Results:** There were 43 (86%) males and 7 (14%) females. There were 17 (34%) type-II and 20 (40%) type IIIA and 13 (26%) type III B fractures. Knee mobility was full (100%) in 49 (98%) cases, 75% in 1 (2%). 43 (86%) cases retained 100% ankle joint mobility while it was 75% in 4 (8%), 50 % in 2 (4%) cases and 25 % in 1 (2%) cases. On full body weight bearing, 42(84%) patients were pain free, and moderate pain was in 4(8%) cases. In 42(84%) cases the gait was completely normal on full body weight bearing while 3(6%) cases showed significant limping. **Conclusion:** The excellent functional results in our series show that external fixation of tibia is safe and effective in terms of restoring functions of tibia.

**Key words:** Open Tibial Fracture, External Fixator, Pain, Gait, Range of Movements.

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## INTRODUCTION

By reason of its superficial location, the tibial shaft represents the most common site of long bone fracture<sup>1</sup>. Open fractures of the tibial shaft remain to be one of the most complex, problematic and controversial orthopaedic injuries<sup>2</sup>. A long period of convalescence is inherent even to an uncomplicated healing course of this notorious fracture<sup>3</sup>.

The etiology of open tibial shaft fracture are road traffic accident, fall from height, fall of a heavy object, fire arm injury and other causes of trauma<sup>4</sup>. Nonetheless, bomb blast injury is emerging as an important and perhaps the leading cause of this fracture in our country<sup>5</sup>.

The goals of open fracture treatment are to prevent infection, achieve bony union and restore function<sup>6</sup>. These goals should be attained as soon as possible with the least expense<sup>20</sup>. Professor Ramon Gustilo, in his landmark study in 1976, has laid down the foundations of open fracture management: thorough debridement and irrigation, fracture stabilization, early

soft tissue coverage and rehabilitation<sup>7</sup>. This management protocol as well as his scheme of open fracture grading that revolutionized open fracture treatment, are now accepted internationally<sup>8</sup>.

However, there still exists a dilemma in certain aspects of treatment decisions where conflict of treatment occurs between an accepted treatment principle and the limitations of local practice<sup>9</sup>. These variations are highly influenced and justified by the socio-cultural and economic factors prevalent in our country<sup>10</sup>.

The management of open tibial fractures remains controversial because the rate of infection and nonunion are higher in Gustilo types III B than in types I, II, and III A open fractures<sup>11</sup>. Preventing infection, obtaining union, and returning the involved limb to normal function often remain elusive goals<sup>12</sup>. Aggressive soft tissue management in conjunction with external fixation has given satisfactory results<sup>13</sup>.

External fixation is a method of immobilization<sup>14</sup> and a valuable clinical treatment option, providing surgeons

with the ability to affect the spatial relationship of tissues, both statically and dynamically, via minimally invasive techniques<sup>15</sup>. The ease and speed of application, adjustability of the frame, and minimization of blood loss with preservation of blood supply at the cutaneous and osseous levels are advantages of the external fixation technique<sup>16</sup>. Care of the trauma patient remains one of the major applications for external fixation<sup>17</sup>. Open fractures with severe soft tissue injuries and/or massive contamination are ideally suited to this technique<sup>18</sup>.

Healing of an open comminuted fracture is dependent, at least initially, on the blood supply from surrounding soft tissues<sup>19</sup>. Fracture and soft tissue stability must be maintained to allow capillary ingrowth<sup>20</sup>.

The aim of this study was to determine the outcome of the use of external fixator in the treatment of open tibial shaft fractures in terms of knee and ankle mobility, pain and gait.

## MATERIALS AND METHODS

This cross sectional descriptive study was carried out at Department of Orthopaedics and Traumatology, Khyber Teaching Hospital, Peshawar during the period from Jan 2008 to Feb. 2009 including 50 patients who were selected by convenient (non probability) sampling technique.

Open fractures of tibia were classified according to Gustilo classification<sup>7</sup> as follows:

- Type I: Tibial fracture with clean wound and shorter than 1 cm.
- Type II: Tibial fracture with wound longer than 1 cm and does not having extensive soft tissue damage.
- Type III:
  - IIla: Tibial fracture associated with a wound with extensive soft tissue damage larger than 10 cm with periosteal coverage.

IIlb: Tibial fracture with periosteal stripping requiring coverage with no vascular injury.

IIlc: Tibial fracture with periosteal stripping requiring coverage and vascular repair.

The inclusion criteria was; patients with age between 18 to 65 years, who were independently mobile prior to fracture and having normal cognitive function (a mini mental score of >6). Patients with a pathological fracture, closed fractures, type IIlc open tibial fractures and those who were presenting two weeks after injury were excluded from the study.

All patients were admitted and written informed consent was obtained in all cases. Patients received in emergency were fully resuscitated and all other life threatening injuries were excluded. Complete history was taken to determine the mode of injury and thorough physical examination was done to rule out chest, abdominal or pelvic injuries. After preoperative preparation patients were shifted to Operation Theater. All open wounds were irrigated copiously with normal saline followed by debridement of all the devitalised bone and soft tissue. Antibiotic (Ceftriaxone, 2gram, I.V OD) was given intravenously for all open fractures and additional gentamycin for Grade III open fractures. Fracture was stabilized with A.O. external fixator. Tension free primary closure using interrupted polypropylene 2/0 sutures was attempted wherever appropriate. If safe closure could not be accomplished, the size of the wound was minimized by mobilization of the adjacent tissues over the bone with or without additional split thickness skin grafting. All Grade IIIA fractures were closed successfully with no wound complications. A thorough debridement of all the devitalized bone, soft tissue and the infected material was done with primary approximation of bone and soft tissues. The wounds however were not primarily closed, but allowed to heal by secondary intention.

Pin insertion site hygiene was meticulously taught to the patients. Immediate postoperative regimen consisted of range of motion exercises of ankle and knee. Partial weight bearing was commenced as soon as possible progressing to full weight bearing within the limits of pain. The patients were assessed clinically and radiologically for alignment, bone contact, and later, callus formation, in the outpatient clinic. If in three to six weeks time no callus response was evident, compression at the fracture site was performed. The frames were removed under analgesia and sedation in the outpatient clinic. The leg was protected in a patellar-tendon bearing (PTB) cast for further 4-8 weeks. Then finally Patients were assessed for knee and ankle mobility, pain and gait on full body weight bearing. The range of movements of knee and ankle were measured and compared bilaterally. Knee and ankle mobility were assessed taking full range of motion (ROM) as 100%. Pain intensity was measured by visual analogue scale (VAS) and the outcome was categorized as excellent, good, fair or poor, with VAS values scoring 0, 1–3, 4–6, and 7–10, respectively. A grade of “excellent” meant no pain, “fair” meant that pain had caused some sleep disturbance, and “poor” described pain beyond the patient's tolerance. Gait was assessed by the presence of limp and no limp.

Data was entered into computer software program SPSS version 10.0. Mean and standard deviation were calculated for age, duration of fixator, duration of PTB and fracture union time. Frequency and percentages were calculated for all categorical data. Data was presented in the form of tables and figures.

## RESULTS

Fifty patients with tibial shaft fractures were managed with external fixator. There were 43 (86%) males and 7 (14%) females. The range of age was from 17-64 years with a mean of 38.72 years  $\pm$  12.33 years. There were 17 (34%) type-II and 20 (40%) type IIIA and 13 (26%) type III B fractures.

The mean  $\pm$  SD of external fixator was 4.25 months  $\pm$  0.71SD and on PTB was 4.48 months  $\pm$  0.95SD. The mean  $\pm$  SD of fracture union was 4.41 months  $\pm$  0.71SD.

Knee mobility was full (100%) in 49 (98%) cases. One (2%) case retained only 75 % range of motion and lost 25% of its mobility. However this did not result in any significant limitation of function. 43 (86%) cases retained 100% ROM of the ankle joint while ROM was 75% in 4 (%), 50 % in 2 (%) cases and 25 % in 1(2%) case. Patients with ankle and knee stiffness were all treated with prolonged physiotherapy and they did show some improvement. (Table I & II)

ROM retained	Frequency	Percent
75% of original	1	2.0
Normal (full ROM)	49	98.0
Total	50	100.0

Table-I. Knee joint mobility after treatment of open tibial fracture with AO external fixator

ROM retained	Frequency	Percent
>75% of original	1	2.0
50% of original	2	4.0
<75% of original	4	8.0
Normal (full ROM)	43	86.0
Total	50	100.0

Table-II. Ankle joint mobility after treatment of open tibial fracture with AO external fixator

No pain was felt in 42(84%) patients. Moderate pain was present in 4(8%) cases whereas occasional pain was in 4 (8%). Oral NSAID's were used in these patients for around one month. Two patients had to take NSAID's for longer time to alleviate their pain. (Table III)

In forty-two (84%) cases the gait was completely normal. Three (6%) cases observed occasional limp. In 2 (4%) cases the limp was insignificant. Three (6%) cases showed significant limping. (Table IV)

Pain severity	Frequency	Percent
Occasional	4	8.0
Moderate	4	8.0
None	42	84.0
Total	50	100.0

**Table-III. Pain at tibia on full body weight bearing after treatment of open tibial fracture with AO external fixator**

Severity of limp	Frequency	Percent
Insignificant limp	2	4.0
Occasional limp	3	6.0
Significant limp	3	6.0
No limp	42	84.0
Total	50	100.0

**Table-IV. Gait after treatment of open tibial fracture with AO external fixator**

## DISCUSSION

The external fixator in open tibial fractures not only solves the problem of managing soft tissue injuries but at the same time provides a reasonable fixation for the bone to heal. With the AO external fixator it is possible to adhere to safe and effective external fixation techniques, avoid damage to vital structures, have access to wound and adopt the fixator so that it is biomechanically compatible with the fractures. As there were 25 type III-A & -B fractures, mostly as a result of bomb blast and fire arm injuries, so great attention was given to the care of soft tissue injuries. A higher incidence of open tibial fractures was noticed between 30-50 years of age (60%). This together with the higher male to female ratio of 6.14:1 could be attributed to their increased activities. Females in our society are held back at home whereas males being breadwinner (in majority of cases) for the family spend more time outside and are thus more prone to bomb blasts, fire arm injuries and vehicular accidents. Our male to female ratio was well consistent with other series of similar fractures treated by external fixator<sup>21,22</sup>.

Our data reveals that type IIIA was the commonest type followed by type II and IIIB. These figures are different

from the series of Cole et al (1995) documenting type IIB as the commonest type followed by type IIIA and then type IIIC<sup>23</sup>. The difference in the percentages can be attributed to the fact that that Cole et al did not include type II in their study (hence the percentage is unknown) and similarly we excluded type IIIC fractures (our exclusion criteria). Nonetheless our Gustillo type's distribution is comparable to local studies<sup>21</sup>.

We kept the EF applied for mean time of 4.25 months. This is close to the data available in the literature. Demiralp B and Atesalp AS removed the EF after a mean framing time of  $14.1 \pm 1.8$  weeks (range, 12 to 19).<sup>24</sup> In our series mean duration on PTB (patellar tendon bearing cast) was  $4.48 \pm 0.95$  weeks. This tallies well with an Indian study<sup>25</sup>. Our mean fracture union time was  $5.4 \pm 0.71$  months. This is consistent with local and international studies available in the literature<sup>21,26,27,28</sup>.

Tucker et al reported 26 tibial fractures in 23 patients treated with external fixator. The average union time was 25.6 weeks<sup>26</sup>. Schatzker reported 32 open tibial fractures treated with a similar apparatus<sup>27</sup>. Healing time was 21.9 weeks in patients with a single injury and 25.7 weeks with multiple trauma similar to the results reported by Schwartzman et al<sup>28</sup>.

Joint stiffness was 16% (collectively for both knee and ankle). Court Broun and Hughs recorded it to be 18.75%<sup>29</sup>. Our joint stiffness rate was slightly less. It was because we maintained proper follow-up, encouraged early mobilization and ROM exercises, and physiotherapy when needed.

As for as functional outcome like pain, gait and the ability to perform strenuous activities are concerned our results agree with other Asian studies<sup>25,30</sup>.

## CONCLUSION

The excellent functional results in our series show that external fixation of tibia is safe and effective in terms of

restoring functions of tibia.  
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*Our greatest glory is not in never falling,  
but in rising every time we fall.*

*Confucius*