

# Segmental Tibial Fractures Treated by Naseer-Awais External Fixator: A 5 Years Study

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## ABSTRACT

**Objective:** To evaluate the outcomes of segmental fracture of tibia treated by Naseer-Awais external fixator and to share our experience.

**Study Design:** Descriptive, prospective study.

**Place and Duration of Study:** Department of Orthopedic Surgery & Traumatology, Peoples Medical University Hospital, Shaheed Benazir Abad from 1<sup>st</sup> July 2016 to 31<sup>st</sup> July 2020.

**Methodology:** Twenty three cases segmental tibial fractures with age ranging from 18 year to 50 year of either gender were selected; patients having close or open Gustilo IIIA/B segmental fracture of tibia were included in the study, while Gustilo IIIC, bilateral injuries, with co-morbid, smoker, alcoholic, drug addicted, poly-trauma, compartment syndrome and history of poor compliance, psychiatric disease were excluded. All the cases operated with Naseer-Awais external fixation (NAEF) and variables of patients were assessed radiological and clinically.

**Results:** There were 17 (70.37%) male patients and 6 (29.63%) female patients The mean age was 33.9±9.8 years. Road traffic accident was highest reported mode of injury in 18 (78.26%) patients. Fracture union was gained at both fracture sites in 19 (82.6%) and nonunion observed in 4 (18.4%). Most reported complication of NAEF was pin tract infection 14 (60.86%), followed by nonunion. The average time of follow-up was 55.5±19.6 weeks.

**Conclusion:** Naseer-Awais external fixator is the safe, reliable, unique uniplanar and cost effective device that allows bone healing of segmental tibial fractures. Distal fracture of segment heals late than proximal one. Most reported complication was pin tract infection.

**Key Words:** Naseer-Awais external fixator, Segmental tibial fracture, Union time

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## INTRODUCTION

The yearly rate of long bone fractures is 11.5 per 100,000 with 40% happening at the tibial diaphysis with open fractures of 3.4 per 100,000, while segmental tibia have varied between 3% and 12%.<sup>1-3</sup> Segmental fractures demonstrate the event of two typical fracture lines isolating the cortical and totally isolating a middle portion of the bone.<sup>4</sup>

These types of complex injuries related with extensive soft tissue damage, usually present with the prolonged recovery time, higher complication rates and are hard to deal.<sup>5,6</sup> Literature reports 3-40% infection in open tibial fractures.<sup>7</sup> Segmental tibia being high velocity injuries are classified as Gustilo IIIA whatever the wound size and Gustilo IIIB; if bone is exposed with periosteal stripping and there are not enough soft tissues to cover it and eventually will need flap.<sup>8</sup>

As per Literature compared to simple fractures segmental are associated with high rate of various complications as compartment syndrome, infection, wound necrosis and middle segment complicates into delayed and non-union because of compromised blood supply of that segment.<sup>9,10</sup> Different methods have been described for management of such fractured tibial bones as casting, internal fixation by nailing, plating, and external fixation by

Ilizarov, Taylor spatial frame, AO, NA external fixator or by hybrid technique.<sup>6,10-14</sup>

Naseer-Awais external fixator first ever presented in 1981 by Professor Dr Syed Muhammad Awais. Later on in 2004 T-clamp added to enhance versatility of device.- It has been successfully used in the time of earthquake in Pakistan in 2005 by pioneer.<sup>16</sup> He has achieved limb lengthening by bone transport and filled segmental defects by distraction osteogenesis by use of this frame.<sup>17</sup>

In developing country like Pakistan these fractures are mishandled, mismanaged because of various factors. In our locale the greater part of patients have a place with poor financial status, so NAEF is most ideal decision in these complex fracture. This study is designed to standardize the surgical management of these fractures managed by uniplanar Naseer-Awais external fixator.

## MATERIALS AND METHODS

This descriptive, prospective study was conducted at Department of Orthopedic Surgery & Traumatology, Peoples Medical University Hospital Shaheed Benazir Abad from 1<sup>st</sup> July 2016 to 31<sup>st</sup> July 2020. Twenty three cases segmental tibial fractures with age ranging from 18 year to 50 year of either gender were selected; patients having close or open Gustilo IIIA/B segmental fracture of tibia were included, while Gustilo IIIC, bilateral injuries, with co-

morbid, smoker, alcoholic, drug addicted, poly-trauma, compartment syndrome and history of poor compliance, psychiatric disease were excluded. Included cases dealt according to advance trauma life support protocol, tetanus, fluid/blood replacement, analgesics, empirical antibiotics were started. If wound was there that cleaned, distalvascularity checked, and limb splinted in the back slab. All the cases received standard treatment according to protocols. After needed emergency management, patient was moved to ward. Patient's brief history, examination points, X-rays and routine labs were noted on pro-forma. After taking consent for surgery and publication, all the cases were managed by Naseer-Awais external fixator three blocks or with T clamp, with at least one or two Schanz screw engaged in intermediate fragment. After satisfaction on clinical and radiological aspects, patients discharged and directed for follow-up in outpatient department till fracture consolidation and rehabilitation.

In OPD cases assessed thoroughly on clinical and radiological backgrounds every time. Furthermore patient directed regarding muscle strengthening exercises especially of quadriceps, movements at joints assessed and patients explained for rehabilitation, weight bearing as needed on consecutive visits. Patients and their care takers instructed to take meticulous care of pins of fixator by standard methods. Frame dynamization was planned when at least three cortices show trabeculae at both fracture lines of segment, then patient allowed to full weight bear in dynamized frame for 2-4 weeks (Fig. 1], if radiological and clinically no any issue noticed, then the fixator removed. The data was entered and analyzed through SPSS-20.

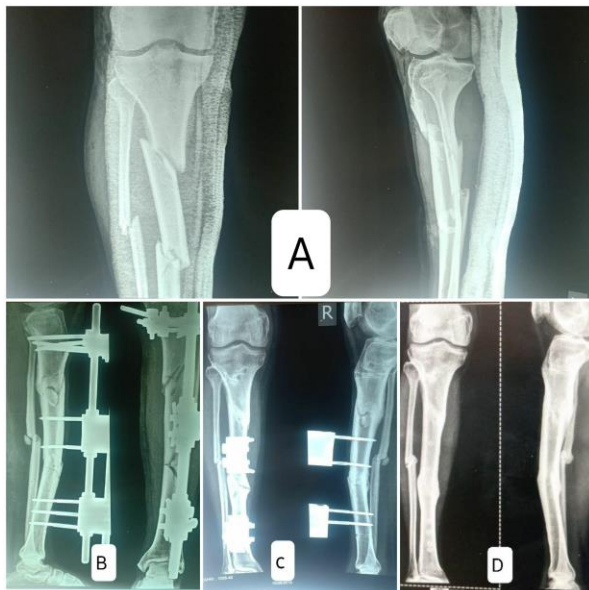


Fig.1: A- Segmental tibial fracture Preoperative radiographs, B- stabilized by NAEF with proximal T clamp, C- After union at proximal fracture NAEF dynamized by removal of T clamp and most distal Schanz pin from distal block. D- X-ray after removal of NAEF and consolidation of fracture at both sites.

**RESULTS**

There were 17 (70.37%) male patients and 6(29.63%) female patients with male to female ratio was 3:1. Minimum

age was of 19 years and maximum of 49 years. The mean age was 33.9±9.8 years. Regarding the mode of injury, road traffic accident was highest 18 (78.26%) patients, 3 (13.04%) had history of falls and assaults in 2 (8.69%). Eleven (37%) cases having left sided while 12 (63%) having right sided injury and none reported bilateral segmental fracture. Three (13.04%) patients had close fractures and 20 (86.96%) open fractures. Thirteen (56.52%) were Gustilo IIIA, while 7 (30.43%) were Gustilo IIIB. NAEF of 3 blocks was applied in 8 (34.78%) while T-clamp NAEF applied proximally in tibia in 13 (56.52%) and distally in 2 (8.69%) of cases. The mean time for proximal fracture union was evident in 26.4±7.4 weeks and 30.9±5.3 weeks for the distal fractures, Fracture union was gained at both fracture sites in 19(82.6%). One case (4.34%) had non-unions of the distal fracture site, and successfully treated with bone grafting from iliac crest. Among them 2 (8.69%;) developed bony infection osteomyelitis that was managed with according to standards of management of osteomyelitis and union achieved by control of infection, compression at fracture site by NAEF. One case (4.34%) of firearm injury Gustilo IIIB went in nonunion at both fracture sites that dealt with removal of frame and application of Iliizarov external fixator. There were 2 (8.69%) cases of mal-union; among them one had valgus deformities of the proximal fracture site of 7° while another had a 6° varus deformity of the distal fracture. Most complications were associated with pins as; mainly Pin tract infection in 14 (60.86%), superficial in 9 (39.13%) while deep in 5 (21.73%). Pin loosening with pin site osteolysis seen in 3 (13.04%) patients was managed with pin site debridement and exchange. Painful walk complaint was brought by 4 (17.39%) that dealt with analgesics and physiotherapy. Joint stiffness of ankle was evident in 3 (13.04%) and of Knee joint in 1 (4.34%). Among 20 open segmental tibial fractures, wound dealt with SSG in 7 (35%), by local rotational fasciocutaneous flap in 5 (25%), by secondary intention in 4 (20%), by delayed closure in 3(15%) and by early primary closure in 1 [5%] (Table 1).

Average time from injury to hospital arrival was 15.5±7 hours. Average hospital stay was 14±3 days. Partial walking as tolerated achieved in 11.7±3.44 weeks, full weight-bearing in 25.3±4.1 weeks, duration of NAEF was 30.74±4.1 weeks. The average time of follow-up was 55.5±19.6 weeks ([Table 2).

**DISCUSSION**

Males are predominant in high velocity injuries as evident in our study 73.91%, also supported by study by Teraa et al<sup>10</sup> reported 73%, Makhdoom et al<sup>12</sup> reported 80%. Average age reported by O'Connor et al<sup>6</sup> was 34 years similar to our findings 33.9±9.8 years. Our data witnesses road traffic accidents 78.26% as most common mode of trauma for these complex injuries also supported by Tomić et al.<sup>18</sup>

We received most open fractures 86.96%; among them 56% were in the category of Gustilo IIIA. On contrary 28.12% open segmental tibia received in study by Milenkovic et al.<sup>19</sup> On other hand study by O'Connor et al<sup>6</sup> supported our data by 82% of open fractures, among them Gustilo IIIA and IIIB were equal in number of 50%, while on

contrary we had 56% of Gustilo IIIA and 30% of Gustilo IIIB.

Our patients stayed in hospital averagely 14±3 days, while 4.57 days seen by Gamal and Shams.<sup>20</sup> Nonunion was frequent complication witnessed by Sohn et al<sup>21</sup> in 18.84%, Corey et al<sup>22</sup> in 10% of cases, that supports our data which we experienced same in 17.39% of cases. Pin tract infection was the leading complication in our study in 60% of cases, as most of our cases were illiterate and not followed proper care of pins, also supported by inventor of the fixator<sup>16</sup>, while Milenkovic et al<sup>19</sup> reports same in 21.85% cases by use of Mitkovic-type external fixator and another study done in Pakistan showed 23% and 14% pin tract infection at proximal and distal aspects of tibia respectively using T-clamp NAEF.<sup>23</sup> Superficial and deep infection of pin was 39% and 21% respectively in our data while by use of Ilizarov 13% superficial pins infected and 2% deeply shown in the study of LUMHS.<sup>12</sup>

Table 1: Descriptive statistics of the patients (n=23)

Variable	No.	%
Gender		
Males	17	73.91
Females	6	26.09
Fracture side		
Right	12	52.17
Left	11	47.83
Wound healing		
Close	3	13.04
Open	20	86.96
Gustilo Type		
IIIA	13	56.52
IIIB	7	30.43
NAEF Procedure		
NAEF 3 block	8	34.78
NAEF T-clamp proximal	13	56.52
NAEF T-clamp distal	2	8.69
Wound healing (n=20 Open Fractures)		
Early closure	1	5
Delayed closure	3	15
Secondary intention	4	20
SSG	7	35
Flap	5	25
Complications (n=23)		
Pin tract infection superficial	9	39.13
Pin tract infection deep	5	21.73
Nonunion	4	17.39
Pin loosening	3	13.04
Pin breakage	1	4.34
Chronic osteomyelitis	2	8.69
Ankle joint stiffness	3	13.04
Knee joint stiffness	1	4.34
Flap marginal necrosis	1	4.34
Malunion	2	8.69

Table 2: Frequency of functional results

Functional outcome	Mean±SD
Average age (years)	33.9±9.8
Hospital stay (days)	14±3
Time from injury to hospital arrival (hours)	15.5±7
Time of bone union proximal (weeks)	26.4±7.4
Time of bone union distal (weeks)	30.9±5.3
Time of partial weight-bearing (weeks)	11.7±3.44
Time of full weight-bearing (weeks)	25.3±4.1
Duration of NAEF (weeks)	30.74±4.1
Duration of follow-up (weeks)	55.2±15.6

Vasudevan and Singh<sup>24</sup> has observed union in 25-30 weeks by treating segmental tibia with nailing, Kim and Song<sup>25</sup> compared nailing with MIPO and found healing of fractures averagely in 27.1 weeks in MIPO group and 23.2 weeks in IMILN group respectively, Tomić et al<sup>18</sup> achieved same in 25 weeks, while we observed union in 26.4±7.4 and 30.9±5.3 weeks in proximal and distal fracture site respectively.

**CONCLUSION**

Nasser-Awais external fixator is the locally made, safe, reliable, stable, unique uniplanar and cost effective external fixator that facilitates the bone healing of complex fracture like segmental tibia. Addition of T-clamp in NAEF makes it more versatile and useful in variety of fracture fixation. Distal fracture of segment heals late than proximal one. Most reported complication was pin tract infection.

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