EXTERNAL FIXATOR IN THE TREATMENT OF OPEN FRACTURES OF TIBIA

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ABSTRACT

Objective: *To evaluate the outcome of external fixator used as a definitive mean of fixation in open fracture of tibia.*

Methodology: *This cross sectional study conducted at Orthopaedics Unit District Headquarter Hospital Timergara from December 2005 to September 2008 included 40 patients with grade II, grade IIIA and IIIB open fractures of tibia. Patients with grade I, grade IIIC open fractures and the patients who needed amputation for their injuries were excluded from the study. Patients with insufficient follow up were also excluded. In all these patients an aggressive approach of early initiation of treatment, radical debridement and irrigation was adopted. All the fractures were stabilized with AO external fixator, and early soft tissue coverage was provided in these patients. On removal of the external fixator Sarmiento functional brace was used till the time of union in all these patients.*

Results: *The mean age of the sample was 28.80±9.87. The most common mechanism of injury in these 40 patients was road traffic accidents. Pin tract infection the commonest complication, noted in 10(25%) patients, deep wound infection in 4(10%) patients, delayed union in 4(10%) patients, and mal union, non union in none of them. Dynamisation of the fixator was done in 12(30%) patients and prophylactic bone grafting was performed in 4(10%) patients. The average time of fracture consolidation was 18 weeks.*

Conclusion: *External fixator can be effectively used as definitive mean of fixation in open fractures of tibia with extensive soft tissue damage.*

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

INTRODUCTION

Open fractures are an important cause of morbidity, mortality[1], and tibia is the most commonly affected site in an open fracture.[2,3] Certain anatomical factors, the susceptible location of this long bone, its precarious blood supply, relatively poor and asymmetrical muscle coverage, make it more vulnerable to fractures[4]. The combination of substantial bony injury and considerable soft tissue damage, caused by high energy trauma makes the management of these fractures challenging for the surgeons and tiring for the patient.s[5,6] Road traffic accidents, fire arm injuries and falls are the common causes of high energy trauma in this hilly region. An aggressive protocol comprising of early start of intravenous antibiotics, thorough irrigation, a radical wound debridement, fracture stabilization and early soft tissue coverage, if adopted, can reduce the rate of complications[7]. The use of external fixator as a definitive mean of fixation makes the additive procedures as bone grafting, soft tissue coverage and wound care feasible[8]. External fixation is a useful and versatile tool in the treatment of these fractures. There are many designs of external fixators, but broadly they can be combined into three groups' i.e, half-pin fixators, wire and ring fixators, and hybrid fixators that combine half-pins and tensioned wires. In tibial diaphyseal fractures the easiest frames to apply are the uniplanar frames, which are usually applied on the

anteromedial border with four or six Schanz screws. Most modern unilateral fixators have a facility to distract or compress the fracture. In addition, some fixators allow dynamization of the fracture to be carried out after a few weeks. Many external fixators permit surgeons to use multiplanar frame designs 12, 26. The external fixator also provides a stable fixation to ensure union, without, further compromising the blood supply of the bone, and without increasing the chances of infection by avoiding osteosynthesis material placement in the injury field [9,10]. This study was thus planned to evaluate the outcome of external fixator used as a definitive mean of fixation in open fracture of tibia.

METHODOLOGY

This cross sectional study was based on 40 patients with open fractures of the tibia. This study was conducted in District Headquarter Hospital Timergara Dir Lower NWFP Pakistan, from December 2005 to September 2008.All the patients were evaluated in the accident and emergency department for associated life threatening conditions according to the ATLS protocol[11]. The wounds were covered with sterile dressing, the limbs were temporarily stabilized with above the knee back slabs. Intravenous access was secured with two 16 G cannulae. Appropriate analgesia was given and intravenous antibiotics i.e first generation cephalosporin with aminoglycosides was started[12]. Tetanus prophylaxis was provided. Once the patients were resuscitated anteroposterior and lateral radiographs were taken for the affected bone with the joint above and below. Then the patients were prepared for emergency surgery under general or spinal anaesthesia. The entire leg and foot were thoroughly washed with liquid soap (payodin scrub) for 5 to 10 minutes, the legs were shaved if needed and then washed with normal saline to clear the soap and hair from the leg. The limbs were elevated for about 5 minutes and tourniquet was then applied. The limbs were scrubbed and draped. The wounds were extended if needed to ensure appropriate wound toilet, and to gain anatomical reduction of the fragments. All the devitalized tissues, foreign bodies and debris were removed, tissue was taken for culture and sensitivity, the fracture field was washed with large amount of normal saline and the limbs were redraped. Knowing the importance of anatomical reduction, efforts were made to achieve it as accurate as possible. The fracture fragments were fixed with AO external fixators. Those parts of the wounds that we extended for the irrigation of tissue planes and anatomical reduction of the fracture, were approximated and stitched, and the original wounds of trauma were left open. Second debridement was done in next 24 to 48 hours, and then multiple dressings and debriment were done accordingly. Soft tissues coverage procedures as split thickness skin grafting, local fasciocutaneous flaps and muscle flap were done during the first two weeks of fracture fixation, but in four patients these procedures were delayed due wound infections. Once the skin and soft tissues were found stable and there were no signs of infection, the patients were educated about the pin site and wound care, rehabilitation exercises, and were discharged. In 12(30%) patients dynamisation was done to enhance fracture healing[11]. Prophylactic bone grafting was done in four patients during 12 to 16 weeks time, when sequential radiographs did not show progression of union till 12 weeks[11]. Once there was radiological evidence of *callus* formation, the fixators were removed and functional Sarmiento,s braces were applied till the time of union.

RESULTS

The mean age of the sample was 28.80$\pm$9.87. There were 40 patients including 29(72.5%) males and 11(27.5%) females. The youngest one was 8 years old while the senior most was 70 years old, with a mean age of 31 years and 7 months. The maximum numbers of the patients were in the age range of 16 to 30 years. The mechanism of injury was road traffic accidents 17/40 (42.5%), fire arm injuries10/40 (25%), falls 9/40 (22.5%), crush injuries due to fall of heavy objects like rock etc 3/40 (7.5%) and blast injuries 1/40 (2.5%). All of the patients arrived at the emergency department within 12 hours of the injury. Using Gustilo Anderson's grading of open fractures, 16(40%) fractures were grade II, 19(47.5%) were grade III A and 5(12.5%) were grade III B. All the fractures were fixed with AO external fixators, in 4 patients it was applied in V or delta triangular fashion for the proximal metaphyseal-diaphyseal fractures, in one patient it was applied across the ankle for distal tibial fracture in bilateral uniplanar fashion. In rest of the patients the fixators were applied in unilateral, uniplaner fashion, in one patient we used six Schanz screws while in rest of them only four screws were used.

Soft tissues coverage was needed in most of the patients. Grade II injuries needed split thickness skin grafting in 6 patients and delayed

primary closure in 4 patients. In grade IIIA injuries soft tissues coverage was provided with split thickness skin grafting in 10 patients, local rotational flaps in 4 patients. In grade IIIB injuries coverage was given in the form of local fasciocutaneous flaps in 3 patients, medial gastrocnmius muscle flap in one and split thickness skin graft in one patient.

Dynamisation of the fixator was done in 12(30%) patients to enhances fractures healing.

The time to union was 16 weeks in 23 patients, 17 to 20 weeks in 11 patients and 21 to 24 weeks in 6 patients, and the average time to union was eighteen weeks. Four patients needed bone grafting to achieve union. While in one patient bone grafting with plate and screw fixation was needed for refracture of the tibia.

The most common complication was pin site infection that was found in 10 (25%) patients. In 6 patients the infection subsided with oral antibiotics, in 3 patients with removal of the external fixator and one patient needed curettage of the pin tract to eradicate osteomyelitis. Deep infection at fracture site occurred in 4(10%) patients that needed sequestrectomy, or multiple debridement and dressing, followed by bone grafting and soft tissue coverage. There was no malunion in any of the patients, while 4(10%) patients had delayed union, that healed with prophylactic bone grafting, thus all the fractures eventually united.

Ankle stiffness was noted in 6(15%) patients affecting the range of motion, which improved with physiotherapy and exercises.

Table 1: Age of patients with open fracture of tibia

Age range	No. of patients	Percentage
<15 years	3	7.5%
16-30 years	23	57.5%
31-45 years	4	10%
46-60 years	8	20%
>60 years	2	5%

Table 2: Mechanism of injury

Mechanism of injury	No. of Patients	Percentage
Road traffic accident	17	42.5%
Fire arm injuries	10	25%
Falls	9	22.5%
Fall of heavy objects	3	7.5%
Bomb blast injuries	1	2.5%

Table 3: Severity of injury (Gustilo's Grading)

Severity of injury	No. of Patients	Percentage
Grade II	16	40%
Grade III A	19	47.5%
Grade III B	5	12.5%

Table 4: Post operative complications

Complication	No. of Patients	Percentage
Pin tract infection	10	25%
Deep wound infection	4	10%
Delayed union	4	10%
Ankle stiffness	6	15%

DISCUSSION

Tibia is the most commonly affected bone in open fractures and is associated with considerable economic, social, and psychological implication. In the management of these fractures, external fixator can be used as a definitive mean of fixation to address the combined injury of bone and the soft tissues[4, 12].

We have applied the fames in unilateral uniplanar fashion in 35 patients, in triangular design in four patients for proximal metaphysio-diaphyseal fracture and in bilateral uniplanar quadrangular way across the ankle in one patient for distal tibial metaphysiodiaphyseal fracture.

In our study, twenty three (58%) of patients were in 15-30 years age group, as people in this age group are active, generally subjected to dangerous labour and recreational activities. Similar age distribution was observed by Bhandari M et al[13]. The mean age in our patients was 31 years and 7 months and this mean age was 31, 38, and 32 years noted by other authors[1, 10, 15]. The male to female ratio in our series was 2.6:1, as the males are more involved in road traffic travel, violent sports, occupational accidents and wars, which explains this male predominance. This ratio is comparable to studies conducted by Twagirayezu E et al and Sertório GMA et al[1, 15].

The most common mechanism of injury in our series was road traffic accidents 42.5%, followed by fire arm injuries (25%) and falls (22%). The percentage of Road traffic accidents in some African and South American studies was more than 70%, but in a local study it was 40%. This high percentage of road traffic accidents is due to heavy traffic and bad driving[18]. The fire arms are the second common cause of these injuries, due to the prevalence of weapons in the region[1, 10, 15].

Twenty seven (67.5%) patients were received in the emergency department with in six hours of injury and the rest of them within twelve hours, which is much earlier presentation than the rest of the studies, and thus the treatment was started within the initial important hours of the injury, which reduced the rate of infection markedly in our study, compared to the others[10, 17]. This early initiation of treatment was possible because of the easily accessible location of the hospital in such a far periphery of the province and the in time, availability of the required facilities at that centre.

We provided soft tissue coverage with in the first two weeks, that enhanced fractures healing, reduced the chances of infection, made the nursing care easier, elevated the patient's morale, and encouraged them to early mobilisation and rehabilitation[14,20,21]. In four patients with wound infections the coverage was delayed, till the infection subsided. Early soft tissue coverage reduces infection because it converts open fracture into a close one; as well it promotes bone healing, by promoting revascularization of the injured bone and by preventing ischemic necrosis of the exposed bone[22].

The average time to union of these fractures was eighteen weeks in our patients which is comparable to other studies. It was 16 weeks in a study of Oriyes-Perez RS et al[16], eighteen weeks in the study by Sertório GMA et al[15], twenty weeks in Christina Nila S et al[19] and 12 weeks in a local study[10]. The time to union was prolonged in those fractures caused by fire arm injuries and in other grade IIIb fractures. Only four patients required prophylactic bone grafting for bone healing. Dynamization of the fixator was carried out in 12(30%) patients that enhanced healing in these patients.

Pin tract infection developed in 10 (25%) of our patients, while it was noted in 11.4%, 17%, 10.4% and 47% of the patients, by other authors[10, 16, 19, 23]. Pin tract infection in our patients was lower than the local study[10], and can be attributed to the proper predrilling of the holes, protection of soft tissues during insertion of the pins, appropriate pin site care, regular follow up and good compliance of the patients.

Infection at the fracture site was noted in four patients (10%), and was controlled with sequestrectomy and debridement. This reduced rate of infection was possible due to certain factors and measures as follows. First; early provision of treatment, with in the first 6 hours(golden hours) or 12 hours, second; thorough cleansing of the leg, meticulous debridement, irrigation with large amounts of saline done in all patients, third ; regular repeated debridement and early soft tissue coverage, fourth; the conviction that, this external fixator is to be used as the definitive mean of fracture fixation, persuaded us to be more meticulous in carrying out all the measures that prevent infection and promote fracture union. Wound infection was noted by other surgeons in 10%, 23%, 50% of the patients[10, 15, 24].

No malunion developed in our study, which was possible because of anatomical or near anatomical reduction of the fracture fragments at the time of fixation. Mal union was noted in 6.5% and 9.2% patients by Khan MA et al and Kapukaya A et al respectively[10, 25].

Delayed union was noted in four (10%) patients with fire arm injuries. Prophylactic bone grafting was done in these patients and all the fractures eventually united without any non-union. Delayed union was observed in 17.76% of the patients[25]. Our reduced rate of delayed union can be attributed to near anatomical reduction of the fractures, early soft tissue coverage and dynamization of the fixators.

Non-union developed in 3.3%, 5.8%, and 12% of patients in studies conducted by Khan MA et al, Kapukaya A et al and **Sertório GMA** respectively[10, 15, 25]. None of our patient developed non union that can be attributed to, anatomical or near anatomical reduction, early soft tissue coverage, dynamisation of fixators, early start of weight bearing , better patients compliance and in time prophylactic bone grafting.

CONCLUSION

Open tibial fractures are surgical emergency and treatment should be started as early as possible. External fixator can be effectively used as definitive mean of fixation in open fractures of tibia with extensive soft tissue damage. External fixator is a safe alternative in the management of open fractures of tibia in settings where internal fixation with interlocking nailing is not feasible due to lack of facilities of image intensifier or when internal fixation is deemed to be associated with complications of infection, or internal fixation can't be carried out due to fracture geometry in these open fractures.

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