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Results of open fractures of tibia treated by external fixator as primary and definitive procedure

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Abstract
Unilateral AO external fixator was used as primary and definitive procedure for treatment of open fractures of both bones of leg. There were 37 patients, and according to Gustilo and Anderson classification there were 20 patients in Type II and 9 in type III A and 8 in type III B. Type I and Type II C were excluded from the study. Males were 30 and females were 7. Maximum cases were in the age group 31-40 years (12 patients). The most common level of injury was at middle 1/3 of tibia. There were associated injuries in seven patients. In all the cases initial debridement and unilateral external fixation was applied. In 31 cases primary closure was done after ensuring the viability of the soft tissues and skin. Secondary closure was done in six cases. Flap cover was given in three cases and skin grafting in three cases. Release incision was done in two cases. The patients were followed for union of fracture; function of the limb and for complications. Fractures in 36 patients united by 10 to 24 weeks with an average of 16 weeks. The complications encountered were, non-union in one, loss of reduction in three, Pin track infection in 8, osteomyelitis in one patient.

Keywords: Compound fracture, external fixator, debridement, open tibia fractures

1. Introduction
Open fractures of leg are quite common especially due to two wheeler accidents and pedestrian accidents. The normal protocol for open fractures of leg is initial thorough debridement, soft tissue coverage and intramedullary nailing or external fixator application. External fixator may be later converted to internal fixation with reamed or unreamed intramedullary nail or left as definitive treatment [1].

The goals of open fracture management are prevention of infection, soft tissue coverage, achievement of bony union and restoration of function. Important principles involve antibiotic utilization, timing of initial surgical intervention, thorough debridement, type of wound closure and fixation of fracture after proper alignment [2].

The management depends on type of injury, contamination of wound, viability of skin and soft tissues and compartment syndrome. Though intramedullary interlocking nailing is used in open fractures of tibia, the problems like delayed union or non-union, breakage of implant were more in unreamed nail. In reamed nail the infection rate has been reported high. A high incidence of infection has been reported in delayed intramedullary nailing [3]. There is controversy in literature regarding the best way of management of type II and type III open tibia fractures [4]. Ex fix as a definitive procedure reduces the cost of one more surgery for nailing.

The aim of this retrospective study is to evaluate outcome after external fixator as primary and definitive fixation in open tibia fractures.

2. Materials and Methods
The study was done at MVJ Medical college and research hospital from January 2009 to December 2015. Open fractures of both bones of leg type II, type III A and B (Gustilo Anderson) were included in the study. Fractures of condyles of tibia, plafond fracture of tibia and open fractures with bone loss were not included in the study. Gustillo-Anderson Type I and Type IIIC fractures are not included in the study.

All the patients were admitted at MVJ Medical College and research hospital, Hoskote. The patients were examined for injuries and stabilized initially and taken up for surgery as early as possible. Intra venous antibiotics were started covering both gram positive and gram negative organisms. Initially a thorough wound wash was given and debridement was done. An AO type external fixator was applied after proper alignment of fracture under the guidance of C arm. Three pins proximally and three pins distally to the fracture were applied to stabilize the fracture. If the tissue and skin viability is good a primary closure was done without any tension. If necessary release incision was given for primary closure of wound. Wound swab was taken for culture and sensitivity before closure.

Secondary debridement and closure was done in six cases. External fixator realignment was done in three cases for loss of reduction. Soft tissue coverage by flap or skin grafting was done within two weeks in patients in whom primary closure was not done. Depending on the culture sensitivity of the organism appropriate antibiotics were continued for ten days.

The patients were allowed partial weight bearing after 48 hours and exercises of knee and ankle were started. The pins were cleaned and dressed with beta dine on alternate days. X-rays were taken after surgery, at three weeks, six weeks, 12 weeks, later every fourth week to assess the union of the fracture. Full weight bearing allowed when good callus was seen. Pin tract infections were treated by dressing, appropriate antibiotics. If there is any loosening of the pin, it was replaced by a new shanz pin. No dynamization or tensioning of the external fixator was done. The external fixator was removed when there is union of the fracture. A pop slab was given for two weeks for the healing of pin tracks and later PTB cast was given for four to six weeks for consolidation of fracture. The patients were assessed for healing of soft tissues, fracture union, function of knee and ankle. Complications encountered were noted at regular intervals.

3. Observation and Results

There were 37 patients in the study. 30 were males and seven females. The mode of injury was RTA in 22, fall in 13 and assault in two patients. Maximum number of patients were in the age group– 31-40 years (12 no).

4. Age distribution

Age in years	Number of patients
15-20	03
21-30	08
31-40	12
51-60	07
51-60	05
60	02

The level of fracture was at middle 1/3 in 26 and lower 1/3 in 9 cases and upper 1/3 in 2 cases. The grade of open fracture was type II in 20, type III A in nine and type III B in eight patients. There were associated injuries in seven patients. The associated injuries were fracture of humerus in one, fracture of clavicle in one and metatarsal fracture in one and multiple soft tissue injuries in four.

Timing of surgery-Surgery was done within 24 hours in 21 and after 24 hours in 16 patients. The delay in surgery was due to late arrival of patients to the hospital and financial constraints.

Initial wound wash and debridement was done in all cases. Primary closure of wound was done in 31 in which release incision and closure was done in two. Secondary debridement was done in six patients. In these patients flap cover was done in three and skin grafting in three. Realignment of the fixator was done in 3 patients.

Open wound was present on the antero-medial aspect in 23 cases, medial aspect in 9 cases and on the lateral aspect in 5 cases.

The complications were loss of reduction in 3 cases, pin tract infection in 8 cases, pin loosening in one case, Chronic osteomyelitis in one case at fracture site and non-union in one case which was lost for further follow-up.

In most cases the external fixator was removed between 8-12 weeks. Removal was delayed if there delay in callus formation. Fracture united in 36 patients (97.3%).

The fractures healed by 10-12 weeks in six (16.2%), 12- 16 weeks in twenty (54.4%), 16-20 weeks in seven (18.915), 20-24 weeks in three (8.1%) patients.

Pre-op X-ray **Immediate Post-op x-ray**

x-ray after fracture union

Limb after fracture union and wound healing

5. Discussion

Open tibial fractures pose a significant challenge due to problems such as infection, soft tissue injury, malunion and non-union [5]. These cases are best managed at the earliest with a thorough irrigation and wound debridement, to obtain and maintain alignment and stability, an external fixator, reamed or unreamed nailing with soft tissue cover have been proposed [1, 2]. Each of these methods has their merits and de-merits. External fixator is an accepted method of treatment in severe open fractures, infected non unions, correction of malalignment, length discrepancies, severe comminuted fractures, some fractures in children, arthrodesis and osteotomies. By stabilization of bone and soft tissues at a distance from the injury site, risk of infection is much lower than with internal fixation devises [5]. Further risk of soft tissue injury and loss of blood supply is less in external fixator [6].

The risk of pin tract infection and loss of reduction in external fixation can be tackled by appropriate measures [7, 8]. Though there is risk of delayed union and non-union, it may be because of injury itself and soft tissue injury, loss of blood supply at fracture site, anatomical location and not only because of external fixator [8, 9].

A meta-analysis of randomized prospective study comparing external fixator with unreamed nailing showed no statistically significant difference between the two methods [3]. Bhandari carried out an indirect comparison between reamed nailing, unreamed nailing and external fixator. He concluded that reamed nailing reduces the rate of re-operation but not that of deep seated infection and non-union [3]. Valazev and Fleming reported 12.5% of delayed union [10]. Giannoudis *et al* in 536 open fractures treated by external fixator of which 82% were Grade III open injuries, the incidence of delayed union was 24% [11]. Michail Beltrios *et al* reported 87.27% union, 18 non-union, 21 delayed union and 4 mal-unions, pin-tract infection 26.36% and osteomyelitis in 3 cases [1.36%] in their study of 212 patients treated with external fixator as a definitive treatment [4].

In our study of 37 patients 36 fractures united. There were 8 patients with pin-tract infection [24%], one case of non-union [2.75%] and one case of chronic osteomyelitis [2.7%].

6. Summary

External fixator can be applied quickly in an emergency and they provide stability and alignment. There is no metal implant across the fracture site and causes less vascular damage that may be already compromised. Advantages of external fixator are it can be used as a definitive procedure with cost effectiveness.

In our study of 37 patients with open tibia fractures of grade II/III treated with external fixator had 97.3% union rate. Only one case of non-union 2.7% and one case of chronic osteomyelitis [2.7%] was encountered in our study.

In view of this it is in our opinion that open tibia fractures can be successfully treated with a thorough debridement, soft tissue cover, a stable construct external fixator application and meticulous follow up of patient.

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