Fixation Of Compound Fractures Of Distal Tibia Using A Delta External Fixator As A Definite Modality Of Treatment With Or Without Fibular Plating/ Limited Internal Fixation With K- Wires.

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Citation

A Shikari, A Wani, K Padha, M Bhatti, H Dang. *Fixation Of Compound Fractures Of Distal Tibia Using A Delta External Fixator As A Definite Modality Of Treatment With Or Without Fibular Plating/ Limited Internal Fixation With K- Wires.*. The Internet Journal of Orthopedic Surgery. 2010 Volume 18 Number 2.

Abstract

Introduction : The goal was to evaluate the results of fixation of compound fractures of distal tibia using a delta external fixator and to analyse the results vis-à-vis functional outcome, soft tissue healing and fracture union. Compound fractures of distal tibia produce a challenge to manage, especially when associated with significant soft-tissue injury. Although a variety of options are available to treat these fractures, timing of definitive surgery is crucial with respect to the condition of the soft tissues. Despite the advances that have been made in managing these fractures, new developments in the field continue to lead to better outcomes. Ankle spanning external fixation has become the initial treatment of choice for complex tibial pilon fractures [1].Material: Between 2006 and 2010, 25 patients, three lost in follow up, net 22 (17 men and five women) with compound tibial fractures were treated with delta external fixator using a two staged protocol at the Department of Orthopaedics and Traumatology ,government medical college jammu. The average age of the patients was 35.5 years. The fractures, evaluated by the AO classification, included 14 AO43A2, 5 AO43C1, 1 AO43B3, 1 AO43C2,1 AO43C3.There were 5 type I, 9 type II, 6 type IIIa, 2 type IIIb open fractures according to the Gustilo-Anderson Classification [2]. In 13 patients the fracture was associated with multiple traumas and in 12 it was a single injury. The injury was due to a high-velocity motor vehicle accident in 18 and a fall in three patients. Method: All the patients were treated by debridement followed by Ankle spanning Delta external fixator, with or without fibular plating/ K- wire fixation of articular elements.All the patients were assessed clinically and radiographically for an average follow-up of 7.5 months using American Orthopaedic Foot and Ankle Society score (AOFAS). RESULTS: The evaluation, based on clinical and radiographic findings and subjective complaints of the patients, was made with the use of the American Orthopaedic Foot and Ankle Society score (AOFAS). 22 patients were followed up, three failed to turn up. AOFAS scoring: excellent in 81% (18/22).Average hospital stay: 28.6 days .Non union: one case, delayed union: two case.Mean time to union 5.5 months (3-16 months). Conclusion: Delta type of external fixator is a safe and useful modality in compound tibial fractures as definitive modality, however caution is advocated as cohort is short.

INTRODUCTION

Since Lambotte [3] described a method of external fixation of fractures in 1907 several devices have been presented for the fixation of fractures by external methods [4, 5, 6, 7, 8] .A number of these devices have been used only rarely, and some of them have required additional fixation with a plaster cast .Intraarticular fractures of tibial plafond, especially caused by high-energy trauma, pose a therapeutic dilemma. Such fractures are usually associated with extensive soft tissue damage with or without compounding. The management of such high-velocity injuries becomes a challenge to the trauma surgeons. Extensive experience with stable external fixation of open tibial fractures has confirmed the observation that this method promotes healing of skin and soft tissue damage, reduces the risk of infection, and facilitates the treatment of patients with multiple injuries. In cases of very severe open fractures the method seems to be the treatment of choice and can reduce the frequency of amputation. Recently, complete long-term follow-up results showed that healing times can be reduced if the period of rigid external fixation is reduced. The goals of management of these periarticular fractures are: restoration of joint congruity by anatomic reduction of the articular fragments,

stable fixation of fragments thus allowing early joint movements, and proper care of injured soft tissues. Various authors have reported their results following open reduction and extensive internal fixation with high rates of wound problems, infection and other major complications [9, 10, 11, and 12]. In earlier days, uniplanar external fixations were used with very high rates of pin-tract complications [13]. These fixators require placement of pins across the adjacent joints, thus causing joint stiffness. Recently, great emphasis has been laid on limited internal fixation supplemented with external fixation of the periarticular fractures [14].

We present the use of a delta external fixator as a definite modality of treatment of compound fractures of distal tibia with or without limited internal fixation.

MATERIALS AND METHODS

From 2006 to 2010, 25 patients (three lost in follow up) with open distal tibial fractures were treated at the Department of Orthopaedic Surgery Government medical college Jammu using delta external fixator spanning the ankle using a prospective study. There were 17 males and five females (table2), with the mean age being 35.5 years (range, 19-73 years) (table1) with 18 patients having sustained high-velocity trauma (table3). Mean follow up 7.5 months (6-18 months). The fractures, evaluated by the AO classification, included 14 AO43A2, 5 AO43C1, 1 AO43B3, 1 AO43C2,1 AO43C3(table2).There were 5 type I, 9 type II, 6 type IIIa, 2 type IIIb open fractures according to the Gustilo-Anderson Classification [2]. Fibula fracture was seen in 15 patients (67.9%). Thirteen (13) of the patients had other injuries in addition to the open tibial fracture (Table 4).

Figure 1

Table1. Age distribution

	Age in years	No. Of patients
	<30 yrs	08
	31-40	12
	41-50	03
	>50	02

Figure 2

Table2. Fracture categorisation

Ao classification	
14	43A2
05	43C1
01	43B3
01	43C2
01	43C3
Gustillo Anderson	
05	TYPE 1
09	TYPEII
06	TYPEIIIA
02	TYPEIIIB

METHOD: A two-staged protocol was followed

STAGE1: All the 22 distal tibial plafond fractures were compound. At the emergency department, before the first roentgenographic examination, a cephalosporin infusion was administered as prophylaxis against infection. After roentgenography patients were taken to the operating theatre, where debridement of the wound was performed in accordance with current principles.

After thorough wound debridement, Calcaneal pin traction was given. The different fracture fragments were reduced and articular congruity at the distal articular surface was achieved. In those Intraarticular fractures (n =15) where the overlying skin was healthy, the fibular fracture was internally fixed with a one-third tubular plate. The wounds were always left partially or completely open, but the fractures were invariably covered with soft tissues and, when necessary, myoplasty was performed- No plastic surgery was undertaken primarily in this series.

Stage2: External Fixator in Delta Mode: Multiaxial, biplanner, Across Ankle Same Calcaneal pin used in fixator assembly Metatarsal pin used to prevent equinus

FOLLOW UP

The wound was sutured primarily in 18 compound cases. In 5 cases, delayed primary closure was done. The intravenous infusion of antibiotics was continued for about 24 hours after operation, after which corresponding antibiotics were administered orally for five to seven days. Non-weight bearing crutch walking was continued up to 1-8 weeks. PTB was applied and Partial weight bearing was started 06-10 weeks postoperatively (average: 9 weeks). PTB was removed and Full weight bearing was advocated 14-30 weeks postoperatively. Minor wounds healed secondarily, but large skin defects were covered with a split-thickness

skin graft or a skin flap within one to two weeks. After mobilization had begun secretion sometimes occurred around the transfixing pins. To prevent this and also to avoid pin tract infections, sufficiently large skin incisions were given when the pins were inserted. Usually the secretion ceased when the patients reduced their activity. Great attention was paid to the care of the skin around the pins. Daily cleaning with saline solution or alcohol was meticulously performed during the early postoperative period, and the patient and or a relative was given instructions so that adequate skin care could be continued at home after discharge from the hospital.

In order to prevent ankle stiffness metatarsal pin was adjusted by first keeping the ankle in neutral position (0 °) in the immediate post-op period followed by

10° (Dorsiflexion) at 4 weeks

-10° (Plantar flexion) at 8 weeks

0 ° (neutral) at 12 weeks

All the patients were followed-up and evaluated both clinically and radiographically. Results were evaluated using American Orthopaedic Foot and Ankle Society score (AOFAS) which included assessment of pain, range of motion and swelling.

RESULTS

The present study was conducted in the Department of orthopaedics, Government Medical College, Jammu over a period of one year from June 2005 to May 2006 to evaluate the efficacy of percutaneous bone marrow injection in cases of delayed union and non-union. 50 cases of post-traumatic delayed and non-union (out of 50 cases, 38 were of delayed union and 12 were of non-union), irrespective of their age and sex, were selected from Orthopaedic OPD and bone marrow grafting done. After six months of follow up of each case, results of study were compiled and following observations were recorded. The mean age of patients was 36.2 years. The maximum number of patients i.e. 33 (66%) were found in age group of 21-40 years. 1 case (2%) was above 60 years while 2 (4%) patients were below 21 years. The minimum age was 20years and maximum was 65 years. Of all patients, 39(78%) were males and 11(22%) were females.

22 cases: 17 males and 05 females

Mean age: 35.5 years (range, 19-73 years)

Mean follow up 7.5 months(6- 18 months)

18 cases of high energy trauma (RTA).

14 AO43A2, 5 AO 43C1, 1 AO 43B3, 1 AO 43C2,1 AO43C3

5Gustillo I, 9 Gustillo II, 6 Gustillo IIIa, 2IIIb

Average hospital stay: 28.6 days

Mean time to union 5.5 months (3-8 months).

Non union : 1 case

(Treated by bone grafting)

Delayed union : 2 cases

(This subsequently achieved union in another 3months with immobilization)

Union rate 95.45 %(one non union required bone grafting)

AOFAS scoring:

Figure 3

Excellent	>92	18 cases
Good	87–92	3 cases
Fair	65–86	1cases
Poor	<65	nil

COMPLICATIONS

delayed union 2 case

Non union 1 case

Infections: (Healed by drainage & debridement)

8 superficial

1 deep infection in AO43C3

3 pin tract

Figure 4

Table3: Mode of trauma

RTA	18
Fall	03
Accident at work	01

Figure 5

Table4: Associated injuries

Head injury	04
Femoral shaft fracture	01
vertebral fractures	02
pelvic fractures	02
Fracture of radius and ulna	01
Fracture of humeral shaft	01
fracture of contra lateral Calceaneum, talus or scaphoid	02
Total	13

Figure 6

Table 5: Healing Times (full, unprotected weight-bearing)

No. Of fractures	Months
06	3 -4
10	4 -6
03	6-8
02	Delayed union(treated by immobilisation)
01	Non-union (treated by bone grafting)
Total(22)	

Clinical Photographs

Figure 7

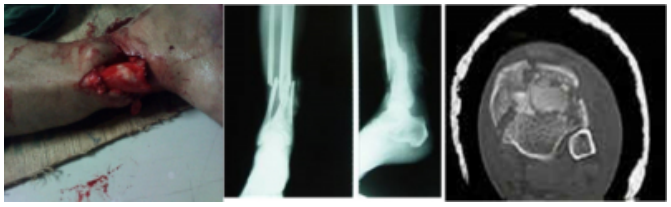
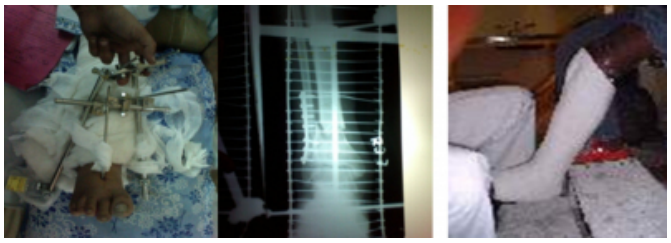


Figure 8



8 months follow up:

Figure 9

Figure 10

DISCUSSION

The treatment of open fractures, and perhaps especially of those in the tibia, is often associated with difficulties. The problems are attributable mainly to the skin injury, injuries to other soft tissues, and the severity of the bone damage.[15] An open wound over a fracture almost invariably means that the fracture is contaminated, implying a risk of infection. Other soft tissues are, as a rule, more severely injured in patients with open than in those with closed fractures. This makes the fracture more unstable and compromises the circulation in the fracture area, which is an important cause of delayed healing or non-union of a fracture. Moreover, bone damage is usually more severe in open than in closed fractures. Open fractures tend to be more comminuted and are more frequently accompanied by cortical bone defects. In general, cortical avascularity is more extensive in fractures of the open type. In this situation revascularization of the cortical fragments, which in tibial fractures are often relatively thick, can require considerable time.

Ruedi and Allgower in 1973 [16] ,Schatzker in 1988 [17],

McFerran et al in 1992, Teeny and Wiss in1993 and Wyrsch et al in 1996 advocated open reduction and internal fixation for high-grade tibial plafond fractures respectively, which necessitated extensive soft tissue stripping for adequate exposure. However, such procedures were associated with a high incidence of complications such as non-union, wound dehiscence and infection [18, 19, 20].

OPEN REDUCTION AND INTERNAL FIXATION

Figure 11

Author	Year	Complication Rate
McFerran et al.	1992	40% (21/52)
Teeny and Wiss	1993	37%(11/30)
Wyrsch et al.	1996	16 %(3/19) **amputation!**

With a view to avoiding therapeutic difficulties and a high incidence of healing disturbances and complications in severe open tibial fractures, an increasing number of orthopaedic surgeons seem to be accepting external fixation as a relatively safe and risk-free method if it is performed in the proper manner [21].

In our study, 22 cases of compound distal tibial fractures were treated using delta external fixator. We had two delayed union and one nonunion which subsequently united with immobilsation and bone grafting respectively. There was one primary deep infection and some innocuous superficial infections of wounds and pin tracts. These infections were easily treated by cleansing, incision or excision around pins, elevation of the limb, and a relatively short period of appropriate antibiotic therapy. In no case did the infection prolong the time of treatment or healing. As previously indicated, mild infections of pin tracts can be avoided by adequate drainage. This can be achieved by making sufficiently large incisions, which can then be supplemented as required with further incisions and excisions if skin tension or skin tenting occurs.[22,23,24]. Ankle equinus and stiffness was prevented using metatarsal pin and changing its angle during post-op follow up.

The healing times for the present series are in good accordance with the mean healing time of 7.5 months found by Anderson et a1.[25] in their series of tibial fractures treated by plaster casts and transfixing pins. It should be noted, however, that in the latter series only 46% of the fractures were open and that cases of delayed healing were not included. The mean healing time of 5.9 months in the last four years of the present series, therefore, seems very favourable, even when compared with plate-fixed open fracture [26, 27]. Our results are comparable to those in the scarce studies on the delta external fixator reported in the literature.

COMPARABLE TO THE RESULTS IN LITERATURE

Figure 12

Leonard et al. , 2008	Our group	Dickson et al 2001
AOFAS excellent 83% (20/24) Mean score: 84.6	AOFAS excellent ***81%*** (18/22) Mean score ***83***	AOFAS Mean score: 85/100
Nonunion 1/24	1/22	—

CONCLUSION

Delta type of external fixator is a safe and useful modality in compound tibial fractures as definitive modality, however caution is advocated as cohort is short.

CONSENT:The patients gave the informed consent prior being included into the study. The study was authorized by the local ethical committee and was performed in accordance with the Ethical standards of the 1964 Declaration of Helsinki as revised in 2000. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

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