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Immobilization of open tibial diaphyseal fracture by POP splint and external fixation device

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Abstract

Background and objective: Tibial diaphyseal fracture is of two types, closed fracture, in which the skin is intact and open fracture in which the skin is injured. An open fracture is a type of fracture in which a break in the skin and underlying soft tissues communicates with the fracture and its haematoma .i.e. the fracture and its haematoma communicates with external environment. Our aim is to evaluate the treatment outcome of this structured protocol in terms of soft tissue injury healing and effective fracture stabilization by POP and external fixation, and to detect if there is any difference in time needed for union in both methods.

Methods: This is a comparative study done in Emergency hospital in Erbil – Kurdistan region, for management of open tibial diaphyseal fractures caused by gunshot injuries. The study included 50 patients of 18 to 65 years old. Patients were divided into two groups after debridment according to methods of treatment; group 1 was managed by POP, group 2 was managed by external fixation. The patients recruited and treated over 11 month period (August 2007 to June 2008).

Results: The study included 50 patients; 44 males (88%) and six females (12%). Their ages ranged between 18 years and 65 years with the mean age of 27.46 years. Patients divided into three groups according to Gustilo classification: GI included 8 patients (16%), GII included 34 patients (68%) and GIII included 8 patients (2A, 6B) (16%). There was significant difference between immobilization of open tibial diaphyseal fractures by pop and external fixation (P=0.001).

Conclusion: There will be delay union of the fractures when immobilized by external fixation. It is better to remove external fixature after 6 weeks and replace it by another method of immobilization of the fracture. Treatment of type III fracture is very difficult and needs long time, usually more than one year.

Keywords: split skin graft, external fixation , plaster of paris

Introduction

An open fracture is a type of fracture in which a break in the skin and underlying soft tissues communicates with the fracture and its haematoma[1], i.e. the fracture and its haematoma communicates with external environment. Open fractures are surgical emergencies caused by different types of trauma, such as fall from height, road traffic accidents, gunshot injuries (high-velocity and low velocity), during sports. All these causes are still common in our locality. Management of closed fracture is differs from that of open fracture, and there is also difference in management of open fracture due to gunshot injuries and those caused by other factors, our subject is bout open fractures due to bullet injuries. Management of such injuries requires care of contaminated soft tissue injury involving skin, muscles and neurovascular strucures. Management of the wound in compound fractures of the tibia and fibula presents certain special problems:

(1) Completely detached small Pieces of cortical bone are potential sequestra, their removal is necessary.

(2) Loss of tissue is frequent, and this

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makes wound closure difficult[2]. Some 50-75% of war injuries involve the limbs. Many principles governing bone healing in civilian blunt trauma do not apply to war injuries. The excisional aspect of the surgery of war wounds with fractures is particularly important. Avoiding complications has higher priority than rapid mobilization. Two phases of holding may be considered.

* Initial holding between first and second operation. This should be confined to POP techniques.
* Definitive holding-definitive holding may be a continuation of initial holding or a new technique. For instance, initial holding of a tibial fracture may be by a POP slab and the definitive holding for reasons of wound access and mobilization of joints may be by external fixation[3]. Equipment for internal fixation should not be made available for early management of war wounds (Except interlocking K Nail) it is readily abused, with disastrous results[4]. Early and aggressive physiotherapy is of paramount importance. Good surgery without physiotherapy often results in a human catastrophe.

Methods

This is a comparative study done in Emergency hospital in Erbil – Kurdistan region, for management open tibial diaphyseal fractures caused by gunshot injuries, stabilization of the fracture is done by plaster of Paris (POP) and external fixation device, the comparison is for: fracture stabilization and state of fracture after removing pop and external fixature, whether more support is needed or not. The patients recruited and treated over 11-month period (August 2007 to June 2008). The study involved 50 patients between 18 and 65 years. Patients were divided into two groups, Group 1 managed by POP, group 2 managed by External fixation. Average time since injury was 6.5 hours (The time between injury and operation).

Principles of treatment:

1. Resuscitation started by inserting IV lines, some times more than one line needed, antibiotics given, reduction and splinting the injured limb for immobilization, wounds are covered with sterile dressing, then patient sent for X- Ray of the injured limb, then he or she transferred to the theater for wound debridement.
2. Wound debridement: as much as possible dead muscles are removed with contaminated subcutaneous fatty tissues.
3- Only necrotic skin edges excised, small detached pieces of bone removed, while large detached pieces of bone are kept, after washing these fragments with isotonic saline. Repair of injured nerves and tendons delayed for the time wound become clean, Figure1 and Figure 2.

Figure 1: Multiple shell injuries, before debridement

Figure 2: Debridement of the wound done.

4- Antibiotics given, against both Gr+ve and Gr-ve micro-organisms, and continued for three days, and the wound kept open.

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5- Immobilization of the fractured limb. If POP used for immobilization, the fracture reduced by traction and posterior slab is applied, this is for type I and type II While for type III and some time for type II, External fixation used. When POP used, it changed from posterior slab to full above knee POP after removing of the stitches, in flexed 10° flexed knee, Figure 3.

6**- Wound cover**. Wounds coved after five days, by delayed primary closure (DPC) without tension, or by split skin graft (SSG).

7- Good physiotherapy started (e.g. quadriceps exercise) after operation frequent times daily.

8- Follow up done monthly.

9- Partial weight bearing (PWB) started after 6 weeks, using axillary crutch True grading is performed at the time of surgical debridement[5] several classification systems have been proposed for open fractures The Gustilo-Anderson system[6].

Grade I: the wound is less than 1-cm. there is little soft tissue damage with no crushing and the fracture not comminuted, Figure 4 and Figure 5.

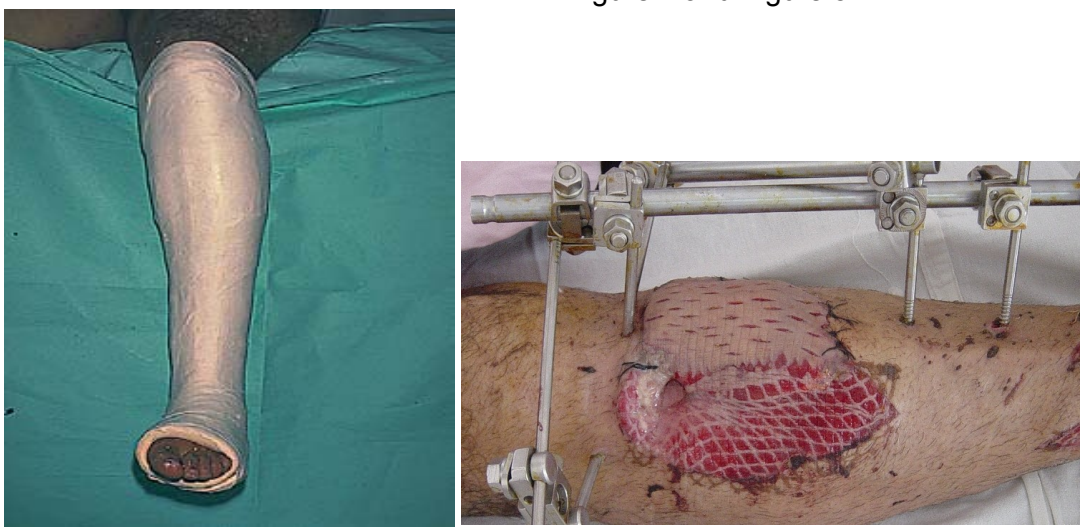

Figure 3 : Fracture stabilized by external fixation and the wound covered by SSG. Fracture immobilized by POP.

Figure 4 : GI wound.

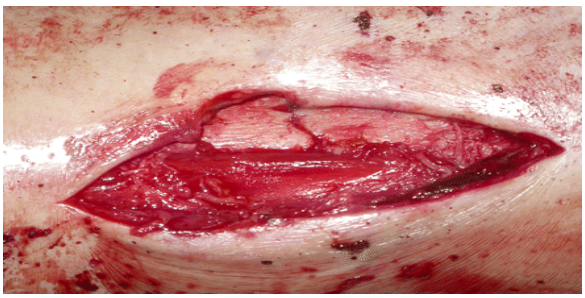

Figure 5: Following surgical extension of the wound, the open fracture site was débrided and the fracture was fixed.

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Grade II: **-**: the wound is between 1- 10 cm long, there is not much soft tissue damage, and there is moderate comminution of fracture, Figure 6.
Grade III: the wound is greater than 10 cm, there is extensive damage to skin, soft tissue and neurovascular structures; it is further subdivided Into:
A: (soft tissue wound with sufficient remaining tissues to Provide bony coverage).
B: (the bone can not be covered, and there is also periosteal stripping.
C: (arterial laceration requiring surgical repair), Figure 7.

Figure 6 : GII wound.

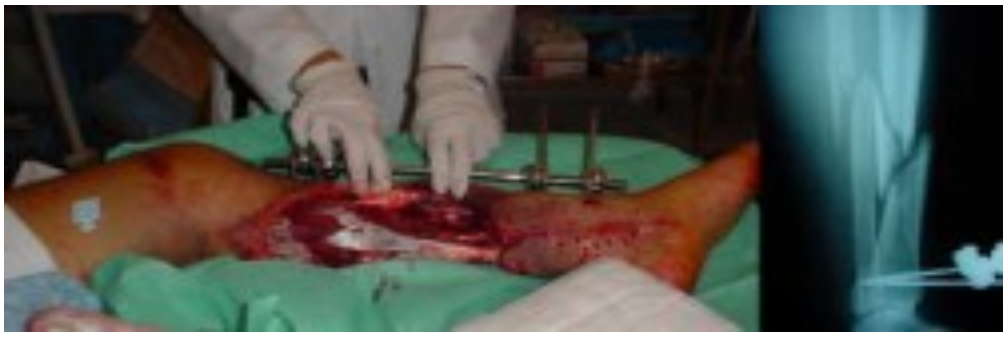

Figure 7 : GIII wound.

Results

The study included 50 patients; 44 males (88%) and 6 females (12%). Their ages range between 18 years and 65 years with mean age of 27.46 years, Table 1.

Table 1 : The sex distribution is seen in diagrams.

Gender	Frequency	Percent
Male	44	88.0
Female	6	12.0
Total	50	100%

Table 2 : Distributions of fractures according to Gustilo-Anderson classification.

Gustilo grade	Frequency	POP	Ext. Fixation	Percent
GI	8	6	2	16.0
GII	34	18	16	68.0
GIII	8(2A,6B)	0	8	16.0
Total	50	24	26	100%

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Table 3: Fracture of bones of the leg.

Gustilo grade	Total	Fracture tibia alone	Fracture tibia & Fibula
G I	8	5	3
G II	34	21	13
G III	8	0	8
Total	50	26	24

Surgical indications
12% (Gustilo type-I fractures) were no need for debridement
88% were in need for debridement.

Table 4: Debridement (DBR).

Gustilo Grade	Total	No DBR	DBR once	DBR twice	DBR three times
G I	8 (16%)	6 (12%)	2 (4%)	0	0
G II	34 (68%)	0	29 (58%)	4 (8%)	1 (2%)
G III	8 (16%)	0	3 (6%)	4 (8%)	1 (2%)
Total	50 (100%)	6 (12%)	34 (68%)	8 (16%)	2 (4%)

Table 5 : The various methods adopted for primary soft tissue management.

Wound covering	Total	Gustilo I	Gustilo II	Gustilo III	Percent %
DPC	24	2	22	0	48.0
SSG	14	0	8	6	28.0
DPC+SSG	6	0	4	2	12.0

Stabilization methods were employed as primary device are external fixation for 25 patients and POP for 25 patients.

Table 6 : Average time of removing of POP & External fixation, patients with external they were on need for more support.

Types	POP	Ext. Fix
I	17.6 Wks	19.65 Wks
II	18.2 Wks	20.3 Wks +POP support
IIIA		28 Wks +POP support
IIIB		38 Wks + POP support

The difference in rate of healing between both methods due to:
1-In POP there is stress on fracture site, which enhance callus formation, while in External fixation the stress mainly carried by pins of external fixation.
2- In POP usually there is some movement (little movement) at site of fracture, which is also enhance callus formation, while in external fixation such movement is not present.

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Table 7: Complications.

Complications	Grades	Ext.fix.	POP	Total
Soft tissue infection	GI	0	0	
	GII	4	3	7(14%)
	GIII	2(deep infection)	0	2(4%)
Shortening	Grades	Ext. Fix.	POP	Total
	GI	0	0	0
	GII	4	3	7(14%)
	GIII	4	0	4(8%)
Total		8	3	11(22%)
Angulations		2 (GII1-2%)	3GII (6%)	5(8%)

*Shortening due to: Bone loss, by the effect of bullet, removing small pieces of bone during debridement & impaction of fracture during weight bearing.
*Angulation may be due to inadequate fixation because highly comminuted fracture and inadequate realignment in POP.

Table 8: T –Test group statistics.

Hold Fracture	hold	No.	Mean	Std. Deviation	t	p
Time of removal	Ext.fix.	25	26.2216	8.16002	3.18	0.001
of fixator/Wks	pop	25	18.97	5.458		

There was significant difference between immobilization of open tibial diaphyseal fractures by pop and external fixation
P=0.001 p<0.05 Chi square=4.16 P=0.041

Discussion

Fractures are immobilized by pop & external fixation as follows: those of Gustilo type I are immobilized by pop, Gustilo type II immobilized by pop and external fixation, and those of type III are immobilized by external fixation only. This immobilization is similar to that mentioned by acharya Shankar etal,2007[1]. Infection rate was 14% (superficial skin infection) in Type II, & 4% (deep infection)in Type III A & B.This result in compare with the studies of[3], infection is more in grade II, while give same result for type III. Gustilo type I, wounds were needs no debridment. All wounds (Type II & III) are kept open, for 3-5 days. The wound closed by DPC, SSG or by both DPC & SSG. This result is dissimilar with the study of (Philip F.A) [9].Angulations, as a complication in cases may be due to iadequate fixation because highly comminuted fracture and inadequate realignment in POP. Debridment was done within 6.28 hours. It is the time that mentioned by Petal Minoo[1]. After external fixation removed, at an average time (22.65 weeks) still there was some movement and pain, pop used for further support for one Month or more. This is similar to that mentioned by Chapman[5], that external fixation delays union of fracture. There is shortening in both methods of immobilization, which is due partially to the bone loss by direct effect of the bullet, and partially to removing of bone pieces during debridement. Malalignment in 4% of

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cases immobilized by external fixation, while in the study done by Zalavras charalampos et al[11], it was 31%, but they had more patients, and it was 20% in Sarmiento et al. 1995. Average union for type II fractures was 18-30 weeks, while in court-Brown et al 1997[12] was 12-28 weeks.

Conclusion

The study showed that union rate is more rapid in pop than in external fixation. Shortening and malunion is more common in immobilization by plaster of paris than external fixation. Maximum time of union by external fixation is 26.22 weeks while by plaster of paris is 18 .97 weeks. Treatment of type III fracture is very difficult and needs long time, usually more than one year. When external fixation remain for long time, loosening of the pins occur specially if pins inserted in cancellous bone, and this leads to infection, so as much as possible insert pin in rigid bones (cortical). Delay in debridement in grade II & III increase number of operations for wound debridement, and this produce difficulty in wound closure. External fixator is better to be removed after 6 weeks and replaced by another method of immobilization.

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