

Comparative study of management of Gustillo Anderson Type I & II Fracture Tibia by Plaster of Paris Cast method and External Fixator Method

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Abstract

Background: Management of open fracture of leg are the subject of ongoing controversy and discussion despite newer innovation in implants and External Fixator devices. In spite of recent advances in implants choices, conservative management of fractures remain a viable option for surgeons in developing countries like India. The present study was to compare the effectiveness in terms of union of bone and wound healing between external fixator method management with conservative closed POP cast method management in Gustillo Anderson Type – I & Type – II open fracture of leg.

Material and Methods: Total forty patients were followed those having compound fracture tibia and fibula grade 1 & 2, randomly selected for external fixator and conservative POP cast management. In these two groups i.e. closed plaster [CP] group and external fixator [EF] group 20 patients in each group followed on 3, 6, 12, and 24 weeks.

Results: Assessment was done based on different parameters and found that Gustillo Anderson Type – I & Type – II open fracture of Tibia and Fibula are better managed in CP group in term of better rate of healing and union of bone rather than external fixator group.

Conclusion: Considering all results conservative management (Cast Method) of open fractures grade 1 and 2 of tibia and fibula gives good results or even better than external fixator method. It is easy to apply in day to day practice and also cost effective in developing countries.

Keywords - tibia fracture, external fixator, cast methods

Introduction

Tibial diaphyseal fractures are commonest open long bone fractures encountered by most orthopaedic surgeons (1). It is seen 23.5 % of these fractures are compound fractures (2). Guidelines to manage these compound fractures are Antibiotics as soon as possible to reduce the risk of infection, irrigation of open fracture wounds, early fracture stabilization after adequate debridement of wound, early closure of adequately debrided wounds(3). In past era three main techniques were used to prevent infection and treat open fractures (4,5,6).

1. The dressing were done by Dakin's Solution.
2. The wound was merely exposed and allowed to granulated.
3. Conservative management like plaster to treat fractures

In developing counties like India where motor bikes are more common vehicle to use for transportation, Tibia bone fractures mostly compound fracture grade I and grade II. The management methods in these compound fracture of the Tibia by using External Fixator or Plating or Nailing which are costly so affordability of patients in developing counties is also a big concern. In modern era external fixator is main stay of treatment in open fractures

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but simultaneously conservative management with plaster cast method is also practiced by orthopaedic surgeons due to economic condition of patients and rush of patients in developing countries in grade 1 and grade 2 compound fractures.

Keeping mind all the facts in the developing country setting the present study has been done to see the effectiveness of POP cast method and External fixator method for management of compound fracture leg Gustilo Anderson type 1 and type 2.

Material and Methods

The aim of this comparative study to compare the effectiveness in the terms of union of bone and wound healing between External Fixator method and Plaster of Paris Casts Method. This trial was conducted from December 2014 to December 2015, in Hospital of Uttar Pradesh University of medical sciences Saifai Etawah after proper informed consent of each patient.

Inclusion criteria were female or male ≥ 18 years, with compound type 1&2 Gustilo-Anderson diaphyseal tibial and fibula (both bone leg fracture) fracture. Absence of any other bone fracture and any other organ injury in other parts of the body. No compartment syndrome or other pathology of bone so that avoiding the factors that could affect the fracture healing. The fibula intact with tibia fractures or both leg bones fracture with compounding grade 1 / 2 were included in this study. Compound fracture grade 3 were excluded from the study.

After wound debridement in the management of wounds of Gustilo Grade I and Gustilo Grade II of open fractures of tibia different parameters were as follows in terms of –

1. Wound healing which was defined as -
 - Difference in the size of wound from the initial wound on 03 weeks, 06 weeks, 03 months, 06 months.
 - Presence of healthy granulation tissue on 03 weeks, 06 weeks, 03 months, 06 months.
 - Absence of purulent discharge on 03 weeks, 06 weeks, 03 months, 06 months.
2. Duration of Hospital Stay.
3. Direct costs borne by the patient
4. Bone healing by radiologically and finally at 6 month with radiology and clinically.

Forty consecutive patient with Gustilo Grade I and Gustilo Grade II open Fracture of Tibia/ both bone leg fractures were included in the study after informed consent. The patient were randomly allocated to one of the two groups namely Closed Plaster in (CP) group (group 1) and External Fixator (EF) group (group 2). After through wound debridement and reduction of Fracture CP group was treated with the application of above knee closed plaster as it is applied for any injury to the leg. In the EF group fracture were stabilized by external fixators.

In external fixator group patient's skin was prepared and tourniquet applied. Washing and draping of the wound was done as for a normal surgical procedure but allowing for a wide exposure of the involved area. The debridement of tissue began at the skin. Devitalized skin was removed until bleeding was visible in the skin edge. In a similar fashion the subcutaneous tissue was removed, including all contaminated tissue. The wound was enlarged sufficiently to allow adequate debridement and exposure of the fracture. After all dead tissue had been removed; irrigation of the wound with normal saline, povidone-iodine and hydrogen peroxide solution and surgically created wound was closed first. Thereafter according to the comparative groups, the fracture was stabilized by the help of an above knee plaster of Paris cast of CP group while for the EF group external fixation was done.

External fixator was applied after sharply incising the skin with short longitudinal incisions along safe zones. Bone was reached along the subcutaneous border of the tibia. A drill sheath was used during low-speed power drilling tapping and pin insertion. Pins were inserted by hand through sheaths with a T-handle.

The follow-up was done every 03 weeks, 06 weeks, 03 months, 06 months and the condition of the wound was noted. The wound in the plaster cast was inspected through a window and a Check X-ray was done to ascertain the alignment of reduction and if needed (i.e. loosening, lost reduction) the cast was changed. If no manipulation was needed or if the cast was not loose then the window was closed after dressing the wound with normal saline. Povidone-iodine and sterile gauze. For the External Fixator group, the patient was to get dressing done as per the condition of the wound and dressing was done mostly by normal saline, povidone-iodine and hydrogen peroxide (if needed). All the dressing were done mostly on OPD basis. At every follow up Size of wound in square

Table 1: Type of first aid received by patients before referring to our hospital

Type of first aid received	No of cases	Percentage
Dressing only	2	5%
Splint only	8	20%
Dressing + splint	10	25%
Splint + antibiotic	2	5%
Dressing + antibiotic +splint	18	45%
Dressing + antibiotic + splint + suture	0	0
total	40	100%

Table no 2: frequency of open grade fractures on Gustillo et al classification between two groups

Fracture grade	Cast group		Ext fixator group	
	Frequency	Percent	Frequency	Percent
Grade 1	9	45%	4	20%
Grade 2	11	55%	16	80%
total	20	100%	20	100%

Table no 3: Frequency of fracture pattern treated by both groups

Fracture Pattern	Treatment group – Cast		Treatment group – Fixator	
	Frequency	Percent	Frequency	Percent
Transverse	8	40.0%	3	15.0%
Oblique	6	30.0%	7	35.0%
Spiral	0	0.0%	0	0.0%
Comminute	6	30.0%	9	45.0%
Segmental	0	0.0%	1	5.0%
Total	20	100.0%	20	100%

Table no 4: Frequency of mode of injury among the two group of patients:

Mode	Treatment group– Cast		Treatment group – Fixator		
	Frequency	Percent	Mode	Frequency	Percent
RTA	12	60.0%	RTA	11	55.0%
Fall	7	35.0%	Fall	8	40.0%
Cut	1	5.0%	Cut	1	5.0%
Total	20	100.0%	Total	20	100.0%

Table no 5: Frequency of occupation of injury among the two group of patients:

Occupation	Treatment group – Cast		Treatment group – Fixator		
	Frequency	Percent	Occupation	Frequency	Percent
Unemployed	3	15.0%	Unemployed	2	10.0%
Student	3	15.0%	Student	5	25.0%
Businessman	2	10.0%	Businessman	1	5.0%
Driver	5	25.0%	Driver	4	20.0%
Farmer	7	35.0%	Farmer	8	40.0%
Total	20	100.0%	Total	20	100.0%

centimeters was taken by taking an impression of the wound on a sterile gauze piece and transferring the imprint into a graph paper and measuring the number of square centimeters covered.

Granulation tissue of the wound was graded as per the visual observation into 0= absent, pale = 1, pink = 2 and red = 3.

If the epithelization of the wound was completed before six weeks then that was noted, else condition of the wound was noted at each follow up and split skin grafting was done when the wound was fit for the same and that time was noted.

.When granulations tissue adequate and no discharge from wound skin grafting of wounds were done if required.

.Stop Rules:

The allocated treatment was to stopped if –

In a smaller sample one group proved to better clinically and statistically then the trial wound have been stopped and all recruited patients were to receive the better treatment.

In the closed plaster group if there was –

- 1.High grade fever above 103⁰ F associated with tachycardia.
- 2.Excessive swelling and tenderness of regional lymph nodes.
- 3.Edema of distal part of the extremity.
- 4.Features of impending compartment syndrome.
- 5.Odour which was intolerable to the patient.
- 6.Vascular insufficiency suspected.
- 7.Gas gangrene suspected.

Results:

This study was done in our hospital that is tertiary center where mostly trauma patients were referred cases. In referred patient who received primary treatment before arriving in the hospital were received antibiotics, dressing and splintage of the fracture at primary center. The next amount of patient were receiving dressing and plintage followed by only plintage. Thus splintage was the most common first-aid which was given to the patient followed by dressing and then

Table 6 Comparison of rate of wound healing between groups

Variables/Groups	Cast group mean	Fixator group mean	P-values
Difference in size of wound on 03 week in cm	3.48±3.27	1.37±0.93	0.03
Difference in size of wound on 03 month in cm	0.07±0.17	0.00±0.00	0.09
Difference in size of wound on 06 week in cm	1.19±1.69	0.42±0.34	0.06
Difference in size of wound on 06 month	0.00	0.00	0.00

Table 7: Comparison of wound granulation and discharge between groups

Variable/Group	Means	Cast group	Fixator group	P value
Granulation on 03 weeks	Present	17	7	0.01
	Absent	3	10	
Granulation on 06 weeks	Present	12	10	0.26
	Absent	3	7	
Granulation on 03 months	Present	17	17	0.23
	Absent	3	0	
Granulation on 06 months	Present	20	20	0
	Absent	0	0	
Discharge on 03 weeks	Non-purulent	20	13	0.03
	Purulent	0	4	
Discharge on 06 weeks	Non-purulent	20	16	0.45
	Purulent	0	1	
Discharge on 03 months	Non-purulent	20	17	0
	Purulent	0	0	
Discharge on 06 months	Non-purulent	20	20	0
	Purulent	0	0	

Table 8 Radiologically callus visible in both groups

Time	Callus at 3 weeks	Callus at 6 weeks	Callus at 12 weeks	Callus at 24 weeks
Cast group	0	9	18	20
Fixator group	0	8	16	20
total	0	17	34	40

antibiotics. (Table1)

Injury of compound grade tibia fracture Gustilo type 2 was more compare to type 1 in our emergency department (Fig. 1 and 6). In both group Gustilo type 1 fracture patients were less. There were more patient of Gustilo grade II Fracture treated by both the methods (Table 2). Comminuted and oblique fracture accounted for nearly 80% patient in both the groups. (Table3) Majority of

patients were victim of road traffic injury in both groups (Table4). Most injuries were sustained during either motor vehicular accident or during fall from heights accounting for nearly 90% of the fraction of both groups of study. In view of socioeconomic status of patient family majority patients were of young age in both groups. 60% in cast group and 70% in fixator group were the patient who were economically productive to the society. So earning members of the family were injured in 67.5% of total patients. (Table5)

Wound size difference between two groups were clinically in external fixator group wounds heals much faster than plaster group. In external fixator group within 3 months wounds healed completely while in plaster group wound healed more than 3 months but difference in healing of the wound by the two modalities was found to be statically non-significant. Implying that the rate of wound healing by the two treatment option is similar (Table 6)

From the point of view of the quality of wound healing it was seen that the absence of the purulent discharge was significantly higher in the cast group thus suggesting a better wound healing is cast group at three weeks of observation. After three weeks when the patient was again studied the two groups showed non-significant difference and at six weeks all the wound had not purulent discharge except one of fixator group. After three months all the wound had not purulent discharge. For the granulation tissue there was very high significance in the appearance of red granulation tissue in cast at three weeks thus there was faster healing of wound in the cast group at three weeks. At the follow up six weeks and three months and six months the significance was not appreciable on univariate analysis (Table7)

All the patients at each follow up in both groups were examined for bone healing through x-rays (Fig. 2 and 7). At first follow up no callus was visible on x-rays in both groups. At second follow up 9 patients in plaster group and 8 patients in external fixator group x rays showed callus formation. At 6 months follow up (figure 5 and 10). No abnormal mobility and pain at fracture site. All the fractures in both groups those are included in study were

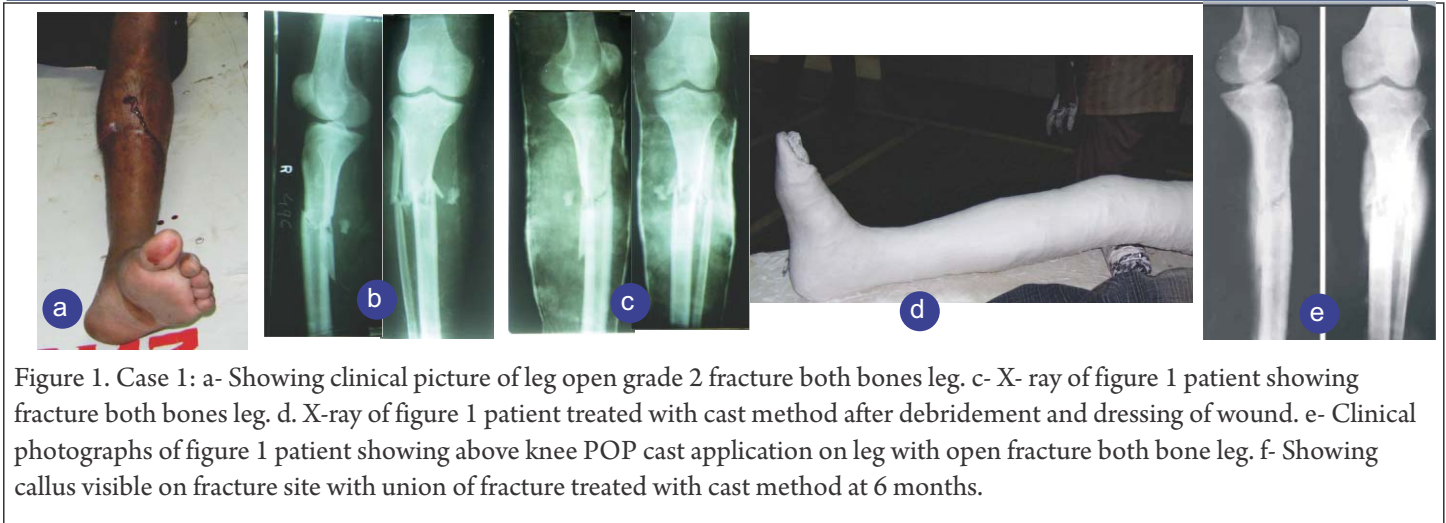


Figure 1. Case 1: a- Showing clinical picture of leg open grade 2 fracture both bones leg. c- X- ray of figure 1 patient showing fracture both bones leg. d. X-ray of figure 1 patient treated with cast method after debridement and dressing of wound. e- Clinical photographs of figure 1 patient showing above knee POP cast application on leg with open fracture both bone leg. f- Showing callus visible on fracture site with union of fracture treated with cast method at 6 months.



Figure 2. Case 2: a- Clinical photographs of open fracture grade 2 both bones leg. b- X ray of figure 6 case showing fracture both bones leg. c- X ray after application external fixator in open grade 2 fracture both bones leg. d- External fixator frame application in open grade 2 fracture both bones leg. e- X ray after external fixator removal with union at fracture site 6 months

united well on radiologically and clinically up to 6 months of intervention but union was much earlier visible on radiologically in more patients in plaster group (table 8)

Hospital stay in plaster group was significantly vary less compare to external fixator group. The mean of hospital stay in plaster group 2.1 days and in external fixator group was 7.05 days. More hospital stay directly proportional to cost of treatment. Including implant cost, operation cost and hospital stay cost make big difference in total cost of both treatment.

Discussion

Leg is most common extremity and tibia is most common bone to fracture (1). Exact treatment of stabilization of open fracture both bone leg is matter of debate in orthopedics (7). If we compare all open fractures 63% of open injuries occurs only in leg (8).

Due lack of blood supply in distal leg and soft tissue cover, distal leg fractures are more susceptible to infections and nonunion (9,10). To reduce these complications thorough repeated debridement, intravenous antibiotics, stabilization of fracture, and early soft tissue intervention is required (10,11). Gustilo and Anderson [12] reported a 2-16% incidence of infections, a majority of which were type III compound injuries. So the overall less chances of infection in grade 1 and grade 2 fractures.

Now days To stabilize these type of open fractures External fixators (Fig. 8 and 9) are most commonly used but disadvantages of external fixators are pin tract infections (16%), rigidity of construct leads to nonunion, OT cost, hospital stay cost and cost of implants [28]. In open grade 1 and 2 leg fractures pop cast method (Fig. 3 and 4) is easier, simple, OPD procedure so no cost of OT, hospital stay and no

implant cost.. In our study we were able to achieve primary closure of the wound in most of cases (in all cases of grade 1 and half of cases of grade 2 fractures). Near about 30% of total cases skin grafting was done. Yokoyama et al., [13] showed primary closures in 70.2% cases and secondary closures with Split skin grafts/ flaps in 29.8% cases.

Sir Winnett Orr (14) for the treatment of these fractures both the wound and the fractures were managed by closed plasters giving good results in 259/268 patients. Prof Trueta also used the method during the Spanish civil war with 976/1073 successful results (15,16).

A similar rate of healing was proved in the observation that the rate the difference the size of the wound was found to be non-significantly different in the two groups seen by the p – values of the means between the two group . This is seen in our observation that there was healthy granulation tissue in 20 to 20 patients in cast group while in the fixator group, there was healthy granulation 17 patients. The duration of hospital stay was also seen to be significantly different because the patients in whom cast was applied were discharged next days after checking for neurovascular assessment with explained instructions to follow up immediately in case of any explained stop rules of the treatment because no further intervention was required for the next three weeks. While in the fixator group, the patient was retained for wound inspection after two days. Regular dressings were done and they were discharged when the

wound became healthy. These two different managements resulted in a statistically different durations of hospital stay in cast group at 2 days and in the fixator group at 7 days. This is seen in the significant p-value observation of 0.0005. Thus in the study it was seen that wound in the Gustilo grade-I and Gustilo grade-II open fracture of Tibia are better managed in closed plaster treatment in terms of better rate of healing of wound and union of bone to the patient. The lower duration of hospital stay effectively can result in a better turnover of patients.

Limitations of this study is exclusion of Gustilo grade 3 tibia fractures from this study because in grade 3 external fixation is method of choice no place for plaster there.

Conclusion

This randomized analysis of open fractures leg Gustilo type 1&2 revealed that plaster method (conservative) is a feasible, cost effective , easy to apply, and effective method compare to external fixator method in developing country like India. In developing countries where more and more open fractures but less medical facility at right place, however it is old methods to treat but still its value now days. Most data that received from this study however are not significant statically but plater method seems better in this situation.

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