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To Study the Clinical and Radiological Outcomes of Primary Internal Fixation in Gustilo Anderson Grade III A and III B Compound Fractures of Tibia

Neeraj Jain[1], R.K. Jain[2], Ajay Sabhnani[3], Sparsh Jain[4], Manish Patidar[5]

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Abstract

Tibial fractures are the commonest long bone fractures encountered by orthopaedic surgeons, because one third of the tibial surface is subcutaneous throughout most of its length, Tibia is the commonest bone for open fractures than any other major long bone. The management of open tibial fractures is often difficult, and the optimum method of treatment remains a subject of controversy as these fractures are associated with high prevalence of complications. Intramedullary nails have been used successfully in the treatment of open tibial fractures after thorough debridement and and have been associated with low rates of complications and early mobilization.

This led us to design a trial, to study the results of primary internal fixation in the treatment of compound fractures of the tibia.

Methods: Thirty patients who had open fractures of tibia were treated with wound debridement and primary internal fixation at Sri Aurobindo Medical College & P.G. Institute, Indore (M.P.). Patients more than 18 years of age with open fractures of Tibia with Type III A and B according to Gustilo Anderson classification are included. Our objectives is to evaluate the functional and radiological outcomes using Johner and Wruh's criteria at 6 months and to assess the complications associated with study.

Results: Final assessment in our series was done at 6 months using Johner & Wruhs criteria. Excellent, good, fair and poor were the grading used for Functional Outcome. In our study higher proportion 63.3% was for excellent, followed by 30.0% for good, lower proportion 3.3% was for fair & poor respectively. The study was associated with very low rate of complications.

Conclusion: We recommend early extensive debridement, aggressive antibiotic therapy and primary stabilization followed by early wound coverage if required. Advantage of this study in addition to early joint motion, early weight bearing allows earlier return to work.

Keywords: Open fracture; Primary Internal Fixation; Trauma; Gustilo Anderson III; Wound; Intramedullary nailing.

Author Affiliation: [1]Assistant Professor, [2]Professor, [3,5]PG Resident Final Year, [4]PG Resident Second Year, Department of Orthopedics, Sri Aurobindo Medical College and PG Institute, Indore 453555, Madhya Pradesh, India.

Corresponding Author: Ajay Sabhnani, PG Resident Final Year, Department of Orthopedics, Sri Aurobindo Medical College and PG Institute, Indore 453555, Madhya Pradesh, India.

E-mail: ajaysabhnani777@gmail.com

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INTRODUCTION

As industrialization and urbanization are progressing year to year, with rapid increase in traffic, incidence of high energy trauma is increasing with the same speed. Tibial fractures are the commonest long bone fractures encountered by most orthopaedic surgeons. There are about 26 tibial shaft fractures per 1 lakh population per year in an average population. Males are more commonly affected than females with male incidence being about 41 per 1 lakh per year, and female incidence about 12 per 1 lakh per year. Distribution of tibial fractures is bimodal with young males being more prone.[1]

Because one third of the tibial surface is subcutaneous throughout most of its length, open fractures are more in tibia than in any other major long bone. Further-more the blood supply of tibia is relatively more delicate than that of other bones enclosed by heavy muscles.[2]

There are five principle causes of tibial diaphyseal fractures; falls, sports injuries, direct blows or assaults, motor vehicle accidents and gun-shot injuries.[1] The important factors in prognosis are (1) amount of initial displacement (2) degree of comminution (3) whether infection has developed and (4) severity of soft tissue injury excluding infection.[2]

Compartment syndrome, vascular or neural injurymay be associated with Tibial fractures. No adjustment for rotatory deformity after fracture due to presence of hinge joints at the knee and the ankle. The management of open tibial fractures often is difficult, and the optimum method of treatment remains a subject of controversy as these fractures are associated with high prevalence of complications.

Every fracture is an individual problem and the decision to treat it with internal fixation or conservative treatment must be made on the basis of an assessment of the advantages and the demerits of each method in the circumstances of that particular case. This calls for a high degree of clinical judgement which is harder to acquire or to impart than technical virtuosity in the operating theatre.[3]

Management of the fractured tibia requires the widest experience, greatest wisdom and the best of clinical judgement in order to choose the most appropriate treatment for a particular pattern of injury.[4] Among the various modalities of treatment such as conservative gentle manipulation and use of short leg or long leg cast, open reduction and internal fixation with screws and plates, intramedullary fixation (including ender pins, intramedullary pins, and intramedullary pins with or without reaming) and external fixation techniques, the surgeon should weigh the advantages and disadvantages of each. We need to be able to weigh and tailor the best possible treatment. The optimal treatment depends on the morphology of the fracture, the amount of energy transferred to the limb, the mechanical properties of the bone, the age and general condition of the patient, and most importantly the soft tissues (skin, limb muscles and associated neurological and vascular structure). These objectives must be fulfilled for the treatment of compound fractures of tibia, the infection prevention, the attainment of bony union and the restoration of function. These objectives are interdependent and usually are achieved in the chronologic order given, for example failure to prevent infection promotes delayed union or non-union and delays functional recovery of the limb.

Immobilization with a cast has historically been the most common, but it does not always maintain tibial length and is relatively inaccessible to the wound.[5] Open reduction and internal fixation with plates and screws has yielded unacceptably high rates of infection.[6,7,8] This method may be selected with more severe or local injuries, associated displaced intra articular fractures of knee and ankle. External fixation, considered as the treatment of choice by many surgeons, has the limitation of the bulky frames and frequent pin track infections, non- unions, and malunions.[6,9]

The J. Charnley in his text, Closed Treatment of Common Fractures said that he believed the eventual solution to the tibial fractures would be a intramedullary nail.[10] Locked or unlocked intramedullary nailing became an attractive option as image intensifiers enabled closed intramedullary nailing. Nails are load sharing devices and are stiff against both axial and torsional forces. Closed nailing minimizes soft tissue disruption, fracture hematoma, and the natural process of bone healing compared to other forms of internal fixation.

Intramedullary nails have been employed successfully in the treatment of open tibial fractures after thorough debridement and have been associated with low rates of post-operative infection,

decrease in hospital stay, early mobilization and early weight bearing.

This led us to design a trial, to study the results of primary internal fixation in the treatment of compound fractures of the tibia (Gustilo Anderson Type III A & Type III B)

MATERIAL AND METHODS

This is a cross sectional study of 30 patients presenting with open tibia fractures in extremities of Gustilo Anderson grade III A and III B in the department of Orthopaedics, Sri Aurobindo Medical College and PG Institute, Indore. The duration of study was 18 months from 1.4.21 to 30.9.22. All the patients more than 18 years of age with open fractures of Tibia with Type III A and B according to Gustilo Anderson classification were included in the study. Patients presenting after 24 hours of injury, having wound with signs of infection and having open fractures of Tibia grade I, grade II and grade III C were excluded.

General condition of patient was assessed to rule out any other injuries and hypovolemia, x-rays and clinical assessment including the choice of implants, surgical approach with the estimated implant position were done before surgery. Preoperative antibiotics were administered as soon as possible. If the patients had any other comorbidities, concerned specialist opinion was obtained prior to surgery. A written informed consent for surgery was taken and fracture was reduced and nailing/plating was done as per fracture type.

Post operatively limb elevation over pillows and ice fomentation was advised and X-rays in both A-P and lateral views were taken. Post operative day 2 and 5 inspection of wound and dressing was done followed by rehabilitation protocol as per the fracture pattern. The wound inspection was done at 2 weeks, during which the surgical scar was inspected and sutures removal was done.

Secondary wound coverage procedure if required was done as soon as possible. Further follow up was done at 6 weekly intervals and each patient was individually assessed clinically and radiographically. Post operatively wound healing, complications, range of motion at affected Jointwas assessed. Patients was followed up for a minimum period of 6 months at intervals of 4 weeks, 3 months, and 6 months for functional assessment and evaluation was done according to Johner and Wruhs criteria.

OBSERVATIONS AND RESULTS

The table 1 shows the distribution of patients on basis of Age Groups.

The higher proportion 40.0% was for age group <=25 yrs, followed by 36.7% for 26-45 years and the lower proportion 23.3% was for age group >=46 yrs respectively.

Table 1: Distribution on Basis of Age Groups

Age Group	Frequency	Percent
<=25 Years	12	40.0
26-45 Years	11	36.7
>=46 Years	7	23.3
Total	30	100.0

The table 2 shows the distribution of patients on basis of Sex Groups.

The higher proportion 90.0% was for male and the lower proportion 10.0% was for female respectively.

Table 2: Distribution on Basis of Sex Groups

Sex	Frequency	Percent
Female	3	10.0
Male	27	90.0
Total	30	100.0

The table 3 shows the distribution of patients on basis of Sides Involved.

The proportion 50.0% was for left side and right side both respectively.

Table 3: Distribution on Basis of Sides Involved

Side	Frequency	Percent
Left	15	50.0
Right	15	50.0
Total	30	100.0

The table 4 shows the distribution of patients on basis of comorbidity.

The higher proportion 83.3% was for Nil and the lower proportion 10% was for T2DM and 6.6% was for HTN respectively.

Table 4: Distribution on Basis of Comorbidity

Comorbidity	Frequency	Percent
Nil	25	83.3
HTN	2	6.6
T2DM	3	10.0
Total	30	100.0

The table 5 shows the distribution of patients on basis of Gustilo Anderson Grade.

The higher proportion 83.3% was for Grade III A and the lower proportion 16.7% was for Grade III B respectively.

Table 5: Distribution on Basis of Gustilo Anderson Grade

Gustilo Anderson Grade	Frequency	Percent
III A	25	83.3
III B	5	16.7
Total	30	100.0

The table 6 shows the distribution of patients on basis of Site.

The higher proportion 73.3% was for Shaft site and the lower proportion 6.7% was for Proximal site respectively.

Table 6: Distribution on Basis of Site

Site	Frequency	Percent
Distal	6	20.0
Proximal	2	6.7
Shaft	22	73.3
Total	30	100.0

The table 7 shows the distribution of patients on basis of Outcome at 6 Months.

The higher proportion 63.3% was for excellent, followed by 30.0% for good. The lower proportion 3.3% was for fair & poor respectively.

Table 7: Distribution on Basis of Outcome at 6 months

Outcome at 6 Months	Frequency	Percent
Excellent	19	63.3
Good	9	30.0
Fair	1	3.3
Poor	1	3.3
Total	30	100.0

Thetable 8 shows the distribution of patients on basis of Number of Surgeries.

The higher proportion 83.3% was for 1 surgery, followed by 6.7% for 2 & 3 surgeries. The lower proportion 3.3% was for 4 surgeries respectively.

Table 8: Distribution on Basis of Number of surgeries

Number of Surgeries	Frequency	Percent
1	25	83.3
2	2	6.7
3	2	6.7
4	1	3.3
Total	30	100.0

The table 9 shows the distribution of patients on basis of Complication.

The higher proportion 10.0% was for Infection. Patient having infection also have other complications that is 3.3% was for Ankle joint stiffness, Non-Union & Wound Dehiscence. The lower proportion of cases 3.3% was for pressure sore and wound dehiscence.

Table 9: Distribution on Basis of Complication

Complication	Frequency	Percent (N=30)
1. Infection	3	10.0
1.1 Ankle Joint Stiffness	1	3.3
1.2 Non Union	1	3.3
1.3 Wound Dehisences	1	3.3
2. Pressure Sore	1	3.3
3. Wound Dehisences	1	3.3

CASE 1

Pre-Operative X-Ray

Post-Operative X-Ray

3 Month Follow Up X-Ray

1 Month Follow up X-Ray

6 Month Follow Up X-Ray

WOUND MANAGEMENT

Pre Operative

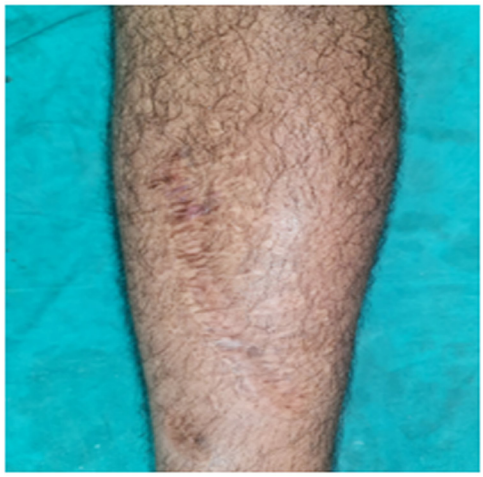
Immediate Post Operative

After VAC Dressing

After Tie Wrap Application

After Tie Wrap Removal

At 6 Months



CLINICAL IMAGES AT 6 MONTHS






DISCUSSION

The Optimal treatment of open tibial fractures remains fraught with several open questions. These fractures, usually caused by high energy trauma, are plagued by poor soft tissue coverage and limited tibial vascularity, leading to deformity, infection, and sometimes amputation. Although recent improvements in wound dressing techniques and fixation devices have reduced the incidence of these complications, the optimal treatment for open tibial fractures is still evolving.[11]

There are 2 major factors related to the lesion that alter the final outcome of tibial fractures. The first is the fracture severity, characterized according to EA Nicoll[3] by the degree of displacement, comminution and soft tissue injury. Accordingly, the more severe the fracture, the higher the rate of complications and the longer the periods of healing will be whatever the method of fixation used.

The second factor is the tibial blood supply damage. In compound fractures, not only is the endosteal circulation disrupted but also there is periosteal circulation disruption after severe soft tissue damage and periosteal stripping from the bone. This emphasizes the necessity to preserve as much as possible the vascularity of the endosteal vessels, using stabilization technique that avoid additional disruption of this blood supply.

The average age of all cases in our series was 34.4 years. The fracture is more common in the age group of <25 years. The average age in a study of 50 open fractures of tibia conducted by the AP Whittle, TA Russell, JC Taylor, DG Lavelle[11] showed that the average age was 34 years. In a study of 43 open fractures of tibia conducted by the RW Singer, JF Kellam[12] the average age was 36 years. In another study of 72 open fractures of tibia conducted by the T Bonatus, SA Oslan, Lees and MW Chapman[13] the average age was 30.3 years.

In our series, there were 27 male and 3 female patients showing male preponderance. The sex distribution in a study by the T Bonatus, SA Oslan, Lees and MW Chapman[13] showed that there were 52 men and 19 women. In a study by the RW Singer, JF Kellam[14] there were 30 males and 11 females.

In several reported series as well as in our series, the open fractures of tibia treated with interlocking intramedullary nailing have given excellent results in terms of union. In our series twenty-nine (96.6%) fractures united within 6 months of injury, is comparable with the other series as well. The delay in union was noticed in 1 patient with extensive soft tissue injury and signs of deep infection. The non-union in a study by the T Bonatus, SA Oslan, Lees and MW Chapman[13] showed that 17% non-union which were treated with various interventions including bone grafting, nail dynamization, and exchange tibial nailing. The physiological and stable fixation with interlocking intramedullary nailing should lower the rates of infection and malunions and expand the use of intramedullary locked nails to the tibial fractures with any degree of comminution and soft tissue injury. Malunion rate (Larsen *et al*.[15]) was 11% under external fixator group and 2.7% under reamed nail group under fix and shift technique. Giannoudis *et al*.[16] reported malunion rates of 20% under external fixator group and 6% under reamed nail group. Our study on the other hand had no malunion.

In the current series, there was three deep infection (10%) in open fracture. Two infections resolved when treated with exchange reamed tibial nailing and intravenous antibiotics while one infection is not resolved despite of exchange nailing and intravenous antibiotic therapy. The incidence of deep infection (10%) compares comparable with other series reporting rate of 2.4% to 11.6%. 49,50,51,52,53 MJ Patzakis, J Wilkins, and TM Moore[17] recommends removal of nail after fracture healed to avoid the risk for reactivation of infection.

In our study one patients (3.33%) has ankle joint stiffness, 2 patients (6.66%) develops wound dehiscence (treated with tie wrap application) and 1 patient develops pressure sore. In our series, no patient developed fat embolism, compartment syndrome, implant failure, peroneal nerve palsy and reflex sympathetic dystrophy.

Using Johner and Wruhs criteria outcomes of the patients were calculated at 1 month, 3 month and 6 months respectively. Final assessment in our series was done at 6 months using Johner & Wruhs criteria taking into account the presence of varus/valgus, anterversion/ recurvatum, rotation, shortening over affected leg, range of motion at the knee, ankle and subtalar joints, radiographic alignment, any other deformity, shortening and presence of radiological union, any post operative neurovascular disturbances and complications like non-union, osteomyelitis were evaluated. Functional outcome was graded into excellent, good, fair and poor. In our study higher proportion

63.3% was for excellent, followed by 30.0% for good. The lower proportion 3.3% was for fair & poor respectively. Klemm *et al*.[18] (1986) reported in a study 62.50% excellent, 31.8% good, 4.5% fair and 1.2% poor result. Arne Ekeland *et al*.[19] (1988) reported 64.4% excellent, 28.8% good and 4.4% cases as fair. The study shows that primary internal fixation with debridement of wound gives good results in open tibial fractures which are comparable to other studies. Acceptable alignment and range of motion can be achieved. Some cases because of associated injuries and comorbid condition ended with complications like ankle stiffness and infection. But still, we were able to achieve union in majority of cases.

Although SSG and flaps have been commonly employed for the closure of skin defects[20,21] Hallock[22] reported 30% complications with fascio-cutaneous flaps and Almedia[23] reported 25% complications and 4.5% failure with sural flaps, whereas the current article reports 0 case of failure or any complication in the 2 cases of SSG and 2 cases of free flap.

CONCLUSION

The results of the study have showed good to excellent functional outcome in majority of patients (93%) who have undergone primary internal fixation. Hence we strongly advocate the use internal fixation in the management of Type 3A and 3B open Tibial Fractures. Thorough wound debridement and early antibiotic coverage are key factors in the successful management was such fractures. If primary wound closure with minimal tension cannot be achieved during the initial surgery, then necessary plastic surgical intervention must be undertaken at earliest if not concomitantly with fracture fixation, to achieve good results. In conclusion, Primary Internal fixation of Compound Tibial fracture, reduces hospital stay, achieves better functional results without hampering soft tissue healing and reconstruction, acceptable complications rate as compared to other modalities of treatment. Low prevalence complications were not found due to the short sample size. For knowing the prevalence of the more uncommon complications a larger sample size will be necessary. Further research with long term follows up are required.

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