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Role of various modalities in the management of compound grade 3A and 3B fractures of tibia

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Abstract
Tibia is most frequent site of an open fracture, with incidence ranging from 49.4% to 63.2%. India has the highest road accident rates in the world one of every forty two vehicle in country had met with an accident. Out of 30 patients 15 patients treated by external fixation and imil nailing and 7 patients by external fixation and ilizarov, 8 patients by ilizarov fixation. Skin grafting done in 12 cases and flap coverage in 4 cases. Over all good to excellent results seen in 20 cases, fair in 6 cases and poor in 4 cases. Early intervention and aggressive soft tissue management in open tibial fractures result in decreased number of procedures, minimal hospital stay and early return to their daily activity.

Keywords: tibia, external fixation, ilizarov fixation, skin grafting

Introduction
Tibia is most frequent site of an open fracture, with incidence ranging from 49.4% to 63.2% [1, 2]. India has the highest road accident rates in the world one of every forty two vehicle in country had met with an accident in 1986 [3]. A large proportion of vehicles involved were two wheelers. The lower Limbs are involved in 49.6 % of motor cycle accidents.
By its very location the tibia is prone to frequent injuries. Furthermore, the blood supply of the tibia is more precarious, high-energy tibial fractures are associated with compartment syndrome or neural or vascular injuries. Open fractures have a higher infection rate than closed fractures [4, 5] and the rate increases with the increasing severity of the soft tissue injury [6, 7]. The risk of delayed union and nonunion in closed, and open treatment is increased with comminution.
Their treatment, prognosis, and outcome are mainly determined by the mechanism of injury, degree of comminution, soft tissue injury and displacement
There are many options available for management of fracture tibia,

1. Closed reduction and cast treatment
2. Pin and plaster technique
3. External fixator
4. Intramedullary nailing
5. Rigid fixation with plate and screws

Our study is to highlight the important role of ilizarov ring fixator for compound grossly comminuted fracture tibia and use of external fixator and intramedullary nailing in IIIA fractures and use of ilizarov ring fixator in compound in IIIB fractures.
About 23% of all tibial fractures are open and most of these are Gustilo grade III [8]. Most of them are due to road traffic accidents followed by fall, sports activities, blow / assault, gunshot injuries and other rare injuries like blasts. Open injuries of tibia are associated with twice the amount of contamination than other open fractures.

Aim and objectives of the study
To evaluate the role of different types of management options in compound grade IIIa and IIIb fractures of tibia.
To analyse the results in management of compound grade IIIa and IIIb fractures of tibia.
To follow up the patients operated upon and note functional outcome and complications.

Methodology

The study is done in 30 patients. All of them are treated and followed in NRI medical hospital, orthopaedic department; patients will be evaluated as per the history, mode of injury. Necessary radiological investigations and hematology profile will be done on admission. Type of surgery and details will be noted. The immediate post- operative x-rays will be evaluated. All the cases will be again evaluated through clinical and radiological methods at 6 weeks, 12 weeks, 6 months and 1 year for range of movements, clinical and radiological union and infection status.

Inclusion criteria

1. Patients above 50 yrs.
2. Patients who gave consent for study.

Exclusion criteria

1. Compound humerus fractures
2. Patients with comorbid conditions and medically not fit for anesthesia.

Results

In our study a total of 30 cases were operated and followed up. Minimum follow up period was 10 months and maximum follow up period was 42months period.

Age distribution

Majority of patients i.e. 16 (54%) patients in our study were in the age group of 20 -35 years, 10(33%) were in the age group of 36 - 50 years, 04(13%) were in the age group of 51 - 65years

Table 1: Age Group (n= 30)

Age Group (Yrs)	No. of Patients	Percentage
20-35	16	54%
36-50	10	33%
51-65	04	13%

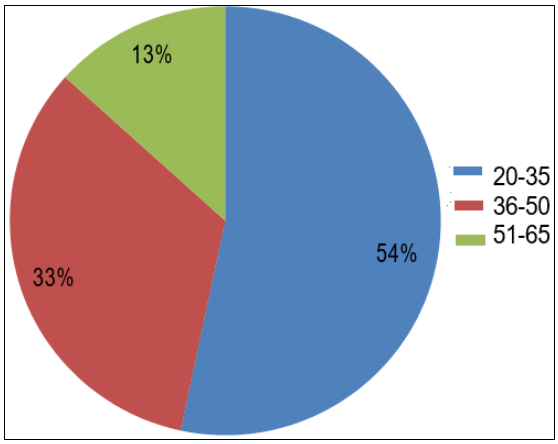


Diagram 1: PIE Diagram showing the Age Group

Sex distribution

Male predominance was found in our study. 28 (93.3%) patients were males and 2 (6.66%) patient was female. This probably because males are more frequently involved in road traffic accidents.

Table 2: Sex Distribution (n=30)

Sex	No. of PTS	Percent- age
Male	28	93%
Fe- male	2	7%

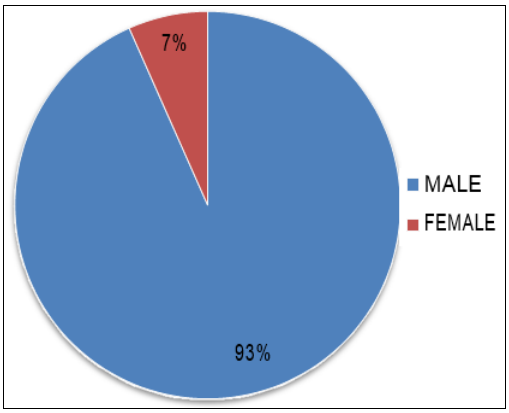


Diagram 2: Sex Distribution

Laterality

Left knee were affected in 12 (40%) patients and Right knee were affected in 18 (60 %) patients. There was not much difference in lateralization of the injury.

Table 3: Laterality (n=30)

Side	No. of PTS	Percent- age
Left	12	40%
Right	18	60%

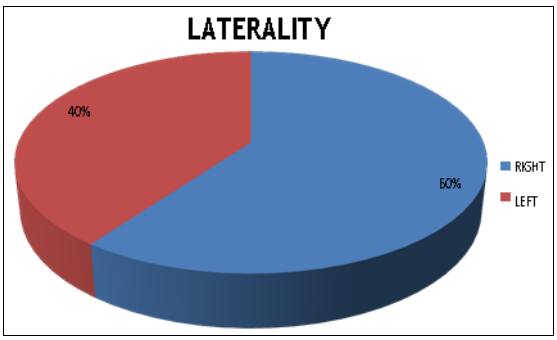


Fig 3: Diagram showing the Laterality

Associated injuries

Fifteen patients in our study had isolated tibial injuries and rest had associated injuries to metatarsals, femur, patella, distal radius.

Table 4: Associated Injuries (N= 30)

Structures In- Olved	No. of Pa- tients
Isolated Tibia	20
Tibia+Femur	3
Tibia+Patella	3
Tibia +Distal Radius	2
Tibia+Metatarsals	2

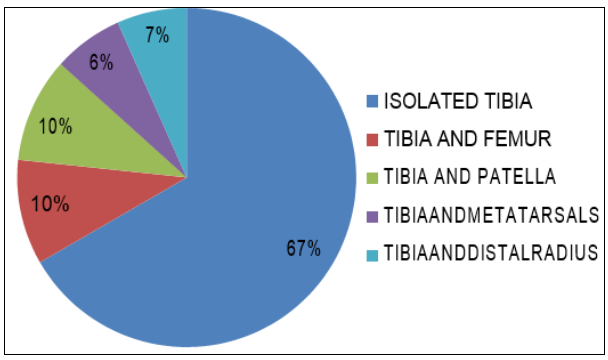


Fig 4: Diagram showing the associated injuries.

Table 5: Treatment modalities

Type of Surgery	No. of Patientsin 3a	No of Patients In Type3b
Ex Fix and Imil Nailing	13	2
Ex Fix and Ilizarov	2	5
Ilizarov Fixation	0	8

Range of motion operated knee

In our study of 30 patients, at 3 months follow up 15 operated with IMIL nailing patients had 110 to 120 degrees of range of motion of the operated knee, at 6 months follow up patients had equal range of motion compared to normal contra-lateral side, at 1 year follow up patients had equal range of motion compared to contralateral side.

Table 6: IMIL nailing range of motion (Rom) at 3 months of follow up (N=15)

Decreased Rom	No. of Patients
No Decreased ROM	13
Up to 10 degree	2

Table 7: IMIL nailing range of motion (Rom) of Oper- Ated knee at 6 months of follow Up (n=15)

Decreased Rom	No. Of Patients
No Decreased ROM	14
Up to 10 degree	1

Table 8: Ilizarov fixation range of motion (Rom) of operated knee at 3 months follow up (n=15)

Decreased Rom	No. of Patients
No Decrease ROM	2
>20 degree	13

Table 9: Ilizarov fixation range of motion (Rom) of operated knee at 6 months follow up (n=15)

Decreased Rom	No. of Patients
No Decrease ROM	6
>20 degree	9

Various complications

Table 10: Complications by IMIL Nailing

Complications	No. Of Cases
Non Union	02
Osteomyelitis	01
Malunion	01
Shortening	01

Table 11: Complications by Ilizarov fixation

Complications	No. of Cases
Non Union	02
Osteomyelitis	02
Malunion	01
Pin Infection	03

Type of soft tissue procedures

Table 12: Soft tissue procedures in compound grade 3A

Type of Procedure	No. of Patients
Secondary closure	5
Skin grafting	7
Rotational flap	3

Table 13: Soft tissue procedures in compound grade 3b

Type of Procedure	No. of Patients
Secondary closure	1
Skin grafting	6
Rotational flap	5
Free flap	3

Table 14: Functional evaluation system by karlstrom-olerud

Measures	3 points	2 points	1 point
Knee pain	No	Little	Severe
Ankle pain	No	Little	Severe
Difficulty in walking	No	Moderate	Severe
Difficulty in stairs	No	Supported	Unable
Difficulty inprevious sportive activity	No	Some sports	Unable
Limitation at work	No	Moderate	Unable
Status of skin	Normal	Various colours	Ulcer/sinus
Deformity	No	Little	Remarkable
Muscle atrophy	<1	1-2	>2
Shortening	<1	1-2	>2
Loss of motion at knee	<10o	10-20o	>20o
Loss of motion at ankle	<10o	10-20o	>20o

*36 points, excellent; 35-33 points, good; 32-30 points, satisfactory; 29-27 points, moderate; 26-24 points, poor

Table 15: Average karlstrom-olerud score

Grade	Duration	Ex Fix and Imil	Ex Fix and Ilizarov	Ilizarov
III A	3 Months	29	25	0
IIIA	6 Months	31	28	0
IIIA	12 Months	33	32	0
IIIB	3 Months	0	23	22
IIIB	6months	0	26	25
IIIB	12months	0	31	31

Discussion

External skeletal fixation has become the established treatment for severe open tibial fractures despite the problems of malunion and pin-track sepsis associated with its use. In early years intramedullary nailing using unreamed unlocked nails had produced good results in type III open tibial fractures but the method did not adequately stabilize comminuted or seg- ment fractures. Then reamed interlocking nailing (J.F. Keatings *et al.*) have become the answer for this without increasing the rate of infection. Recently treatment for open tibial fractures have evolved into a stage where primary nailing and immediate/early soft tissue cover became the prime method of treatment.

In our hospital wound debridement and External fixation and elective delayed primary cover followed by internal fixation is the method of treat-ment for grade IIIA fractures.

The timing of secondary intramedullary nailing in our study shows that Grade III A fractures have undergone nailing with average of 21 days with the range of 14 – 28 days.

Ilizarov method involves a non invasive operation without problem of blood loss and transfusion, while providing stability and allowing weight bearing.

Difficulties may be encountered with the closed reduction of fracture necessitating longer operating time. Such difficulties are quickly overcome; however if the surgeon keeps to the assembly technique, pre assembled rings, proper pre operative planning the operating time is reduced with experience. The ad- vantages of fixation with Ilizarov apparatus compared with a traditional external fixation, cast, internal fixation are.

1. Stability
2. Preservation of blood supply
3. Maintenance of function
4. Negligible blood loss
5. Early weight bearing

Disadvantages include difficulties with frame assembly and closed reduction for the surgeon and difficulties with dressing and inconvenience for the patient.

Because of the tenuous soft tissue coverage of the tibia, plate fixation has typically been associated with an unacceptably high prevalence of wound complications, especially when it has been performed for the more severe fractures [9].

Tibial nailing though in popular use also has its own share of complications.

Malunion occurs after up to 37% of tibial nailing procedures and it is particularly common following fractures of the proximal third of the tibia. Severe comminution further adds to the complication. proximal tibial comminuted fractures were treated with Ilizarov fixator with only one case of malunion.

Intramedullary nail insertion is also shown to interfere with circulation in the diaphyseal cortex. Current debate concerns the use of reamed and unreamed intramedullary nailing because both techniques, to varying degrees negatively affect the circulation of cortical bone. In patients with an open fracture, this has significant implications. When the intramedullary blood supply is destroyed, it leads to necrosis of diaphyseal bone. The vascular system will reconstitute in 2 to 3 weeks, during which time the presence of dead bone and an open fracture wound may increase the risk for infection.

External fixator only provided a temporary measure with the additional morbidity associated with pin tract infections. Moreover early weight bearing could not be encouraged.

Ilizarov fixator was chosen to fix those fractures that produced high rate of complications with most conventional methods of fixation. For over half of a century the Ilizarov device has been used for treatment of acute fractures and non-unions of bone.

The structure is stable and enables the patient to bear weight on the affected limb straight away even in very comminuted fractures not easily achievable by other methods of fixation. The Ilizarov device is minimally invasive with little interference in the biology of fracture while at the same time providing optimal skeletal stability. It also provides opportunity for wound care and management of open fractures.

The timing of soft tissue coverage is a subject of controversy. The standard teaching has been that open fractures remain open until the patients is returned to the operating room for a secondary debridement to ensure that adequate debridement of necrotic tissue from the wound has done prior to wound closure.

Our protocol encouraged patient treated by ilizarov to partially weight bear within 48 hours progressing to full weight bearing within the limits of pain (usually within the first week). General condition of the patient and the presence of other associated injuries also influenced the decision to weight bear.

An Ilizarov fixator enables the surgeon to correct malalignments and in case of bone loss, to perform adequate limb lengthening.

Tucker *et al*. reported 100% union of 26 tibial fractures in 23 patients treated with the Ilizarov fixator. The average union time was 25.6 weeks.

Schtzker reported 32 open tibial fractures treated with Ilizarov fixator. Healing time was 21.9 weeks in patients with a single injury and 25.7 weeks with multiple trauma similar to the results reported by Schwartsman *et al*.

This series is unique with respect to the complexity of the fractures considered. The specific category of fractures subjected to Ilizarov fixation was with the view to clearly define the role of the fixator in management of tibial fractures. Even though the circumstances were adverse with respect to the fracture pattern, the union time was not unduly prolonged. However cases that required corticotomy and distraction of tibia, necessitated prolongation of the time on the fixator. This is an additional option with the Ilizarov fixator that makes it soversatile.

Table 16: Union Time (wks) III A

Author	Treatment	Union Time (wks) III A
Blick *et al*. (1989)	External fixation	38.6
Court-Brown *et al*. (1990)	External fixation	26.5
Court-Brown (1991)	Intramedullary Nailing	27.2
Our study	External fixation and secondary Intramedullary Nailing	30

Infection rate following sequential nailing

Comparing the other studies the infection rate following sequential nailing was comparable or better. Non union developed in 2 patients out of which 1 being aseptic nonunion. Aseptic nonunion were diagnosed to have delayed union for which bone grafting was advised, Bone grafting was done in these patient later after a trial of dynamisation.

Table 17: Nonunion (%)

Study	Treatment	Nonunion (%)
Clifford *et al*. 1997	External fixation and delayed Cover	23.8%
J.F. Keatings *et al*. 1997	Primary interlocking nailing and delayed cover	12%
Sanders *et al*. 1994	Primary interlocking nailing & delayed cover	17%.
Our study	External fixation with secondary Interlocking nailing	13.5%

In our study nonunion rate was similar to the external fixation group but morbidity associated with external fixator was there. On comparing with other studies, high rate of nonunion was due to delay in secondary intervention. Though there is high rate of nonunion, functional outcome assessment by Karlstrom & Olerud score was excellent to satisfactory in 14 patients and poor in only one patient. Anterior knee pain 10 was noticed in two patients.

Case 1

Inpatient No	:	1690888
Age & Sex	:	58 Years, Male
Date of admission	:	09/11/2016
Date of operation	:	11/11/2016
Date of discharge	:	29/11/2016
Address	:	Guntur.
Date & Mode of injury	:	Road Traffic Accident
Type of fracture	:	Grade IIIB Complications of
Fracture	:	Nil.
From Time of injury	:	7 Days.
Implant used	:	Ilizarov fixator
Bone grafting	:	No.
Soft Tissue procedure done	:	Secondary Suturing

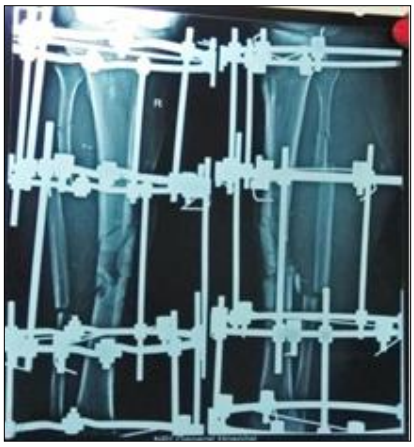
Follow up

Union of fracture : 12 weeks Movements at knee : Flexion-110 Extension-0 deg

Complications : Nil Period of follow up : 28 Weeks Functional outcome : Excellent

Pre-Operative X-ray

Wound Photo



Post-Operative X-ray

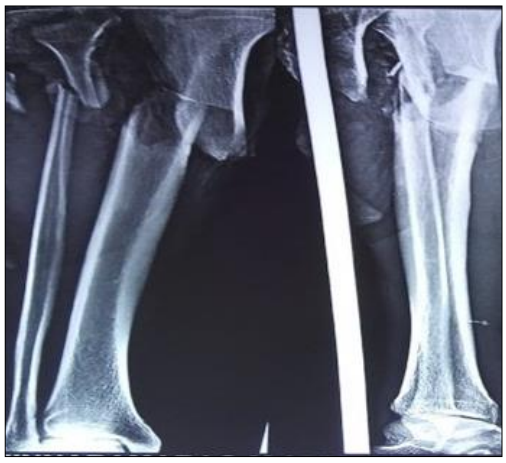

Post op extension of knee at 6months post op flexion of knee at 6 months

Case 2

Inpatient No	:	1936762
Age & Sex	:	35 Years, Male
Date of admission	:	16/02/2017
Date of operation	:	18/02/2017
Date of discharge	:	04/03/2017
Address	:	Mangalagiri
Date & Mode of injury	:	Road Traffic Accident.
Type of fracture	:	Compound Grade IIIB Complications of
Fracture	:	Nil.
Implant used	:	External Fixator and IMIL nailing
Bone grafting	:	No
Soft Tissue procedure done	:	Skin grafting

Follow up

Union of fracture	:	18 Weeks Movements at knee:
Flexion-120deg		
Extension-0 deg		
Complications	:	Nil
Period of follow up	:	30 weeks Functional outcome : Excellent




Pre-Operative X-ray Wound Photo


Post op follow up x-ray

follow up extension of knee 5 month

Follow up flexion of knee

Conclusion

Comparing our study with other studies fixation with intramedullary interlocking nail after primary external fixation in compound grade IIIa and Ilizarov fixation in compound grade IIIb are superior to other treatment modalities.

Early intervention and aggressive soft tissue management in open tibial fractures result in decreased number of procedures, minimal hospital stay and early return to their daily activity.

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