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A comparative study of outcome of retrograde enders nailing and intra-medullary interlocking nailing as a treatment modality in middle third - distal third tibia fractures

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Abstract
Aims & Objectives: To evaluate outcomes of both techniques with regards to healing, union, complications, range of motion at knee and ankle joints in middle and distal third tibia fractures.
Materials: 40 patients of either sex with closed and open fractures (upto Gustillo- Anderson type 3A) were included in this study. All patients were briefed about purpose of study, informed consent for surgery and for use of data for study were purpose were obtained. Patients with G.A. type 3B and above open fractures, proximal shaft fractures, fractures primarily treated with external fixator and intra-articular fractures were excluded from this study. Primary outcomes were assessed by a Knee Score and Ankle score system by Hughes *et al.*
Results and Observations: Out of the 40 patients, there was an increased incidence of fracture in the 20-40 years age group (62.5%). 30(75%) patients showed union within 15 weeks of surgery, 10(25%) showed union within 15-20 weeks. Average union time for was 13.1 weeks with no significant difference between fracture union in open fractures(14.3 weeks) and closed fractures(13.7 weeks). The patients were evaluated with respect to range of motion, time to union, and complications. Functional results were assessed using the Johner-Wrush criteria.
Conclusion: Enders nailing shows satisfactory functional and radiological outcomes in the treatment of adult distal third of tibia fractures and can be an alternative in the treatment with regards to intramedullary nailing. Short operative time, minimal invasive techniques, dynamic controlled motion at fracture site leading to early callus formation which is favorable biomechanically and biologically and sufficient stability in all planes that allows early motion without additional fracture support with usage in segmental fractures, poor skin condition, osteoporotic bones lends credence to Enders nailing being a viable treatment option for distal third of tibia fractures.

Keywords: Enders nail, distal tibia, nailing, diaphyseal fractures

1. Introduction
Historically, the non operative treatment of low grade tibia shaft fractures have involved closed reduction with cast application and immobilization [1, 2]. As industrialization and urbanization progress rapidly each year so do the incidence of high energy trauma leading to complex, comminuted fractures of the distal third of tibia associated with compromised skin condition and poor neurovascular status. High energy, distal third tibial fractures pose a greater challenge in modality of treatment as the distal tibia is a subcutaneous bone and lacks adequate soft tissue coverage and any major muscle attachments leading to poor vasculature and thus increasing the chances of complications that could arise from such trauma like infection, non union and delayed union. Enders nails with their minimally invasive approach do not insult the already wounded soft tissues, help in preserving the periosteal blood supply that can be lost due to reaming and achieve better three point fixation due to ability to stack multiple nails in the medullary canal make them a viable fixation method of distal third tibia fractures.

2. Materials and Methods

The present comparative type of clinical study was conducted at Padamshree Dr. D.Y. Patil Medical College and Hospital, Navi Mumbai. A total of 40 patients with middle third and distal third tibia fractures were selected and 20 patients were operated with Intramedullary interlock nails and 20 patients with multiple Enders nailing were selected for the study. All the patients coming to Trauma centre were initiually given first aid in the form of splintage, in the form of above knee slab, supportive care, analgesics and if needed antibiotics, IV fluids and routine relevant investigations were carried out. Basic radiological investigations pertaining to the nature of fracture sustained were done in addition to standard trauma series of investigations.

2.1. Inclusion criteria

- Patients of age > 20 years of either sex.
- Closed or Gustilo Anderson upto type 3A open fractures
- Middle 3rd and distal 3rd tibia fractures

2.2. Exclusion criteria

- Patients with Gustilo Anderson type 3B and above open fractures
- Proximal shaft fractures.
- Fractures treated primarily with External Fixator.
- Intra-articular fractures.

Patients who fulfilled the inclusion criteria were studied and evaluated.

2.3. Clinical

2.3.1. Subjective: A detailed questionnaire was completed with each patient to evaluate subjective factors such as pain, functional limitations and occupational considerations.

2.3.2. Objectives: Objective examination included inspection of the knee for deformity, tenderness, abnormal mobility of the knee and ankle joint, measurement of range of movements.

2.3.3. Radiological Examination: The radiographic evaluation by antero-posterior, lateral oblique radiographs was done to classify fractures(AO Classification), to assess extent of comminution, degree of displacement, angulation, to measure likely length of implant and CT scan was done for any further evaluation

3. Results and Observation

A total of 40 patients operated for middle third and distal third tibia fractures were selected for the study.
The following observations were noted: -

3.1. Age distribution

Table 1: No of patients in different Age Groups.

Age (years)	N	%
21-30	15	37.5
31-40	10	25
41-50	6	15
51-60	5	12.5
61-70	4	10
Total	40	100

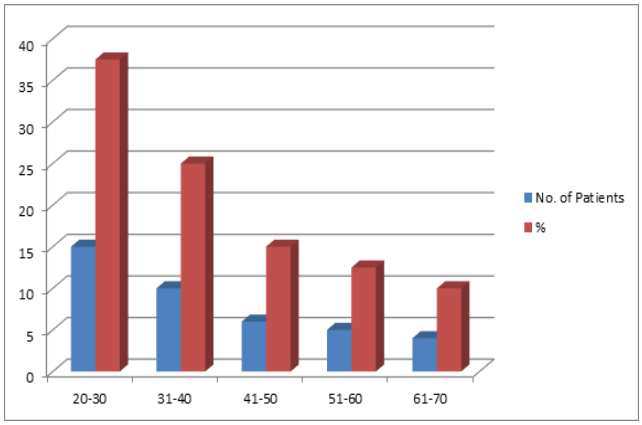

Fig 1: Graph depicting the number of Patients in Different Age Groups

It was observed that there was increased incidence of fracture in the age group of 20-40 years.

3.2. Sex distribution

Table 2: Sex distribution

Sex	N	%
Males	30	75
Females	10	25

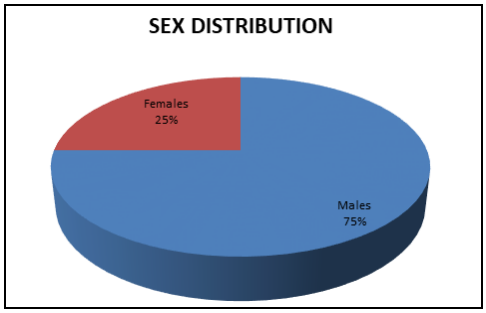

Fig 2: Pie chart depicting the Sex Distribution of patients.

3.3. Mode of Injury

Table 3

Mode of Injury	No. of Patients	Percentage
Vehicular Accidents	35	87.5
Fall from height	5	12.5
Total	40	100

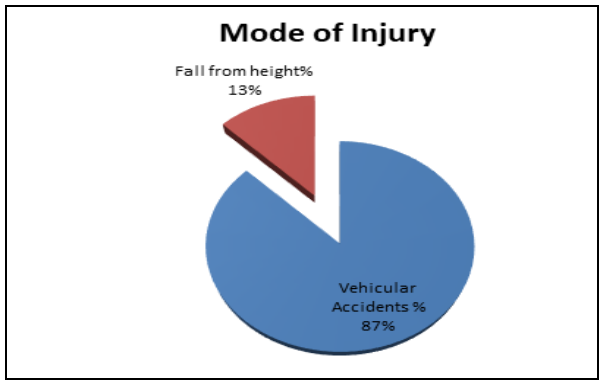

Fig 3: showing mode of injury with vehicular accidents being the main cause (87.5%) of distal third tibia fractures

3.4. Type of Fracture - Open and Close

Table 4

Type	No. of Patients	Percentage (%)
Open	14	35
Closed	26	65
Total	40	100

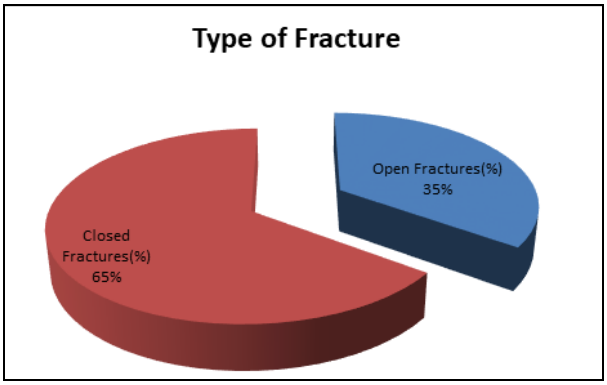

Fig 4: showing 65% of fractures in this study being closed variety

3.5. Type of Fracture According to Gustilo-Anderson Classification

Table 5

Type	No. of Patients	Percentage (%)
I	10	71.5
II	2	14.25
III	2	14.25
IV	14	100

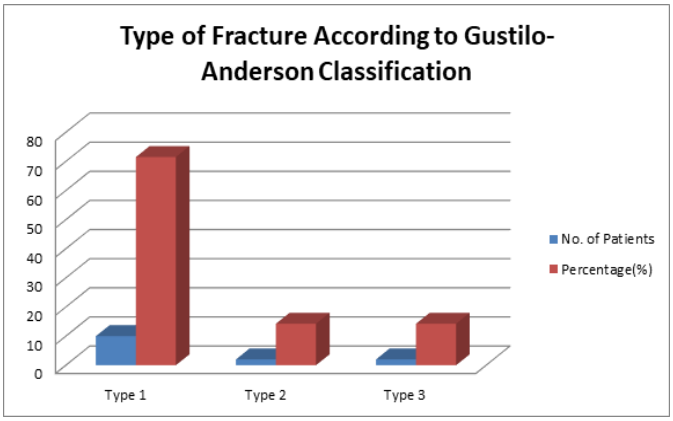

Fig 5: showing type of fracture according to Gustilo-Anderson Classification

3.6. Type of fracture according to AO classification

Table 6

Type	No. of Fractures	Percentage (%)
A1	08	20
A2	10	25
A3	02	20
B1	03	7.5
B2	05	12.5
B3	00	00
C1	03	7.5
C2	00	7.5
C3	00	00
Total	40	100

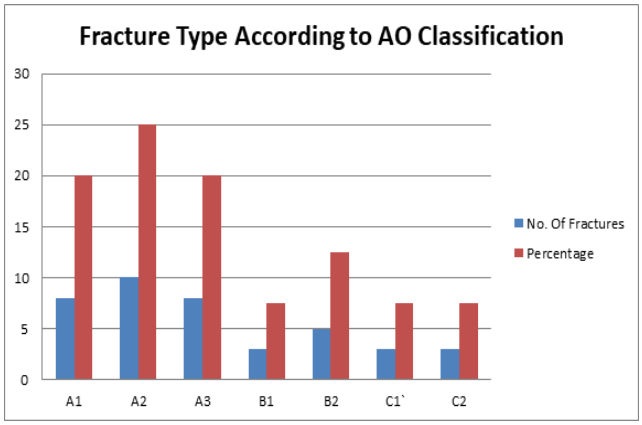

Fig 6: Showing fracture type according to AO Classification Type - A fractures accounted for 65%, Type - B for 20% and Type - C for 15% of the fractures.

3.7. Type of Fixation

Table 7

Method	No. of Patients	Percentage (%)
Enders Nailing	20	50
Interlock Nailing	20	50
Total	40	100

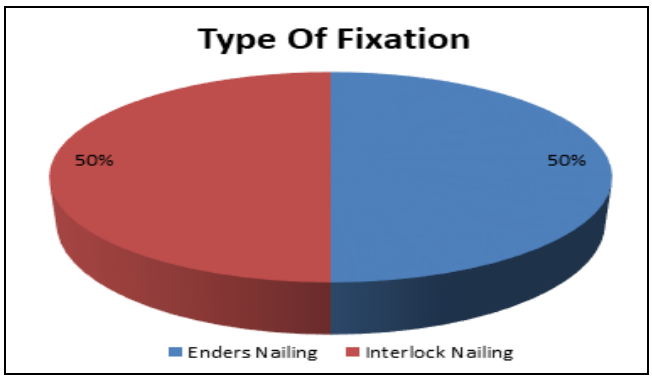

Fig 7: Showing type of fixation

3.8. Fracture Union

Table 8

Time	Interlock Nailing	Percentage (%)	Enders Nailing	Percentage (%)	Total	Percentage (%)
<15 weeks	14	70	16	80	30	75
15-20 weeks	6	30	4	20	10	25
>20 weeks	0	0	0	0	0	0

Chi square: 0.533, P Value: 0.465

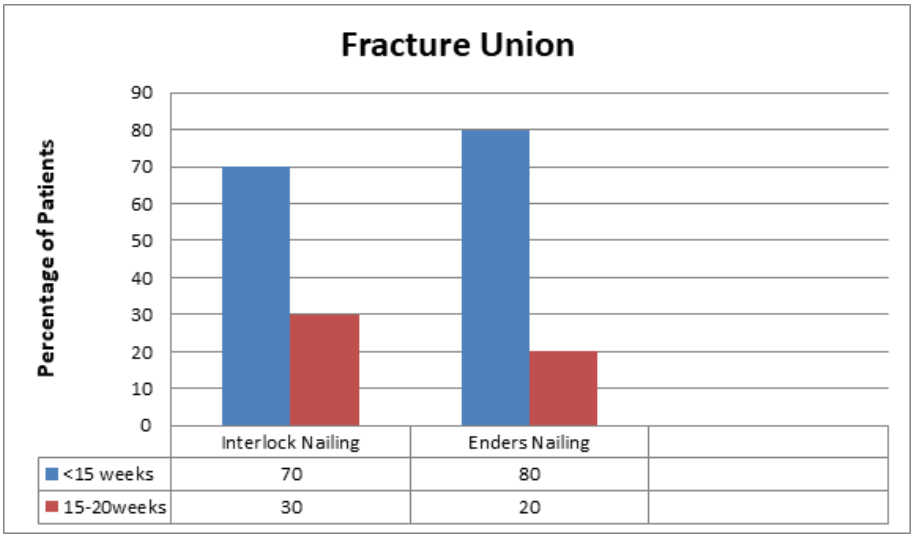

Fig 8: Showing time to fracture union

Average time of union in enders nailing was 13.1 weeks while 15.5 weeks in interlock group.
80% of patients in Enders nailing group and 70% in interlock nailing group showed union within 15 weeks post surgery.
30% in interlock nailing group and 20% in Enders nailing group showed union between 15-20 weeks.

3.9. Complications

Table 9

Complications	Interlock Nailing	Enders Nailing	No. of Patients
Restriction of Movement at Knee	4	0	4
Restriction of Movement at Ankle	3	9	12
Lower Leg Pain	01	01	02
Superficial Infection	01	01	02
Deep Infection	0	01	01
Nail Backout	0	02	02
Total	9	14	23

Chi square: 1.65, P value: 0.648

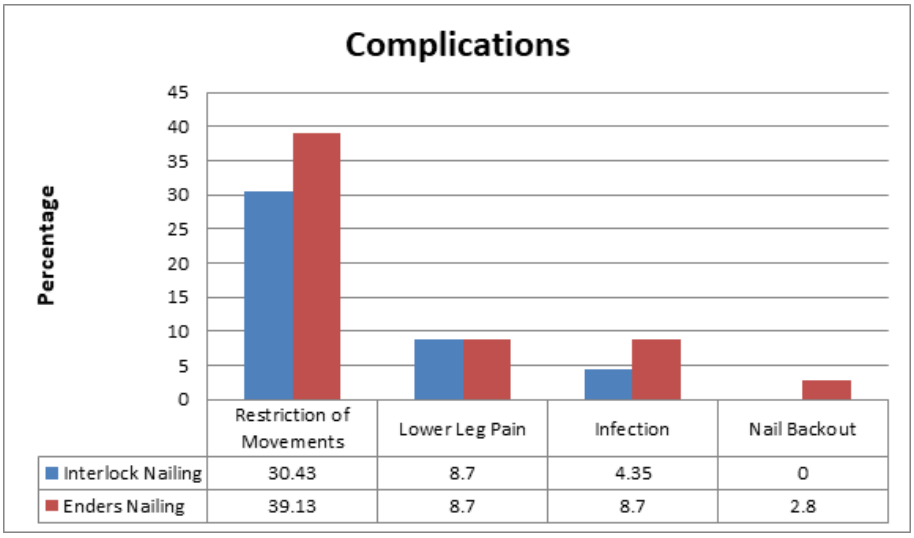

Fig 9: Showing complications associated with both procedures

3.10. Knee Range of Movements

Table 10

Knee Movement	Interlock Nailing	Percentage (%)	Enders Nailing	Percentage (%)	Total	Percentage
No restriction	16	80	20	100	36	90
<15 Degrees	4	20	0	0	4	10
15-30 Degrees	0	0	0	0	0	0
Total	20	100	20	100	40	100

Chi square : 4.44, P Value = 0.035

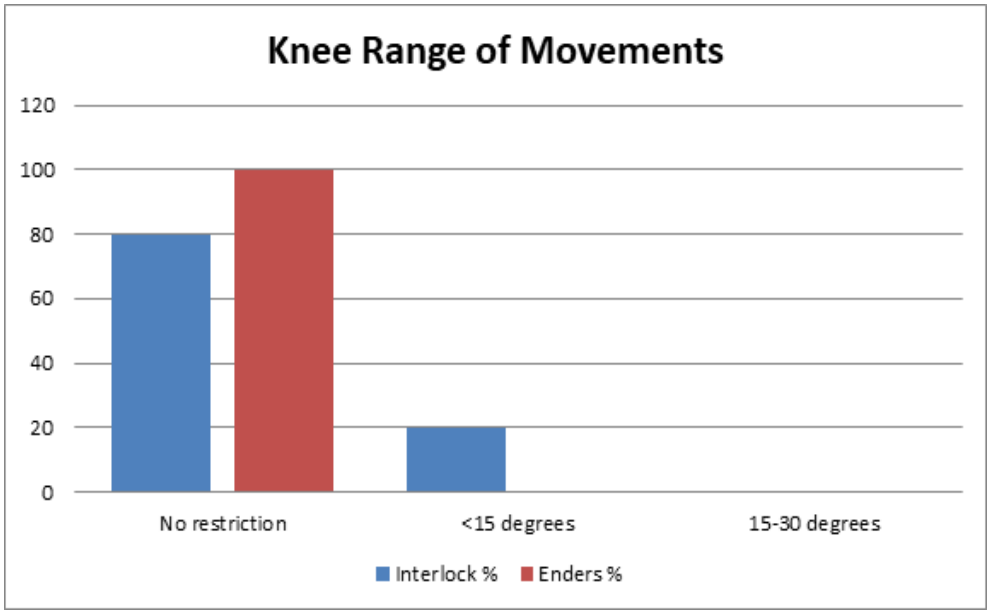

Fig 10: Showing restriction of movements at knee joint

90% of the patients in this study did not develop any restriction of movements at the knee joint while only 10 % developed less than 15 degree of knee restriction, that also in the interlock nailing group.

3.11. Ankle Range of Movements

Table 11

Ankle Movement	Interlock Nailing	Percentage (%)	Enders Nailing	Percentage (%)	Total	Percentage
No restriction	16	80	11	55	27	67.5
<15 degrees	4	20	5	25	9	22.5
15-30 degrees	0	0	4	20	4	10
Total	20	100	20	100	40	100

Chi Square = 5.04, P Value = 0.081

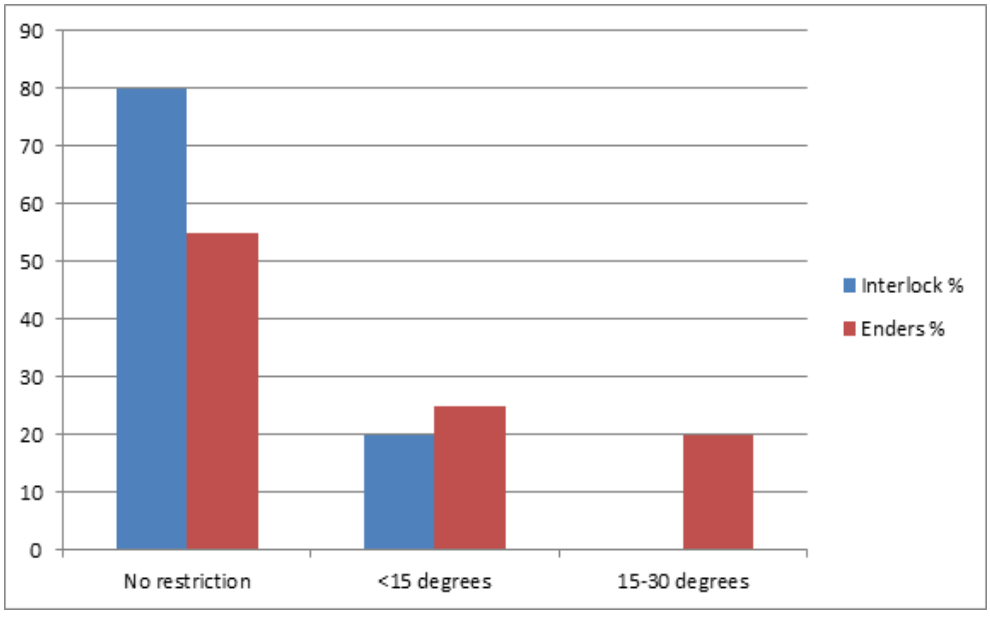

Fig 11: Showing restriction of ankle movements

3.12. Results

Table 12

Results	Interlock Nailing	Percentage (%)	Enders Nailing	Percentage (%)	Total	Percentage (%)
Excellent	18	90	16	80	34	85
Good	1	5	1	5	2	5
Fair	1	5	3	15	4	10
Poor	0	0	0	0	0	0
Total	20	100	20	100	40	100

Chi square : 1.12, P Value : 0.572

Fig 12: Showing 90% of excellent results in interlock nailing group and 85% of enders nailing group having good and excellent results.

3.13. X-Rays

Fig 13: Pre Op Xray(AP view)

Fig 14: Pre Op Xray(Lateral View)

Fig 15: Post Op Xray(AP view)

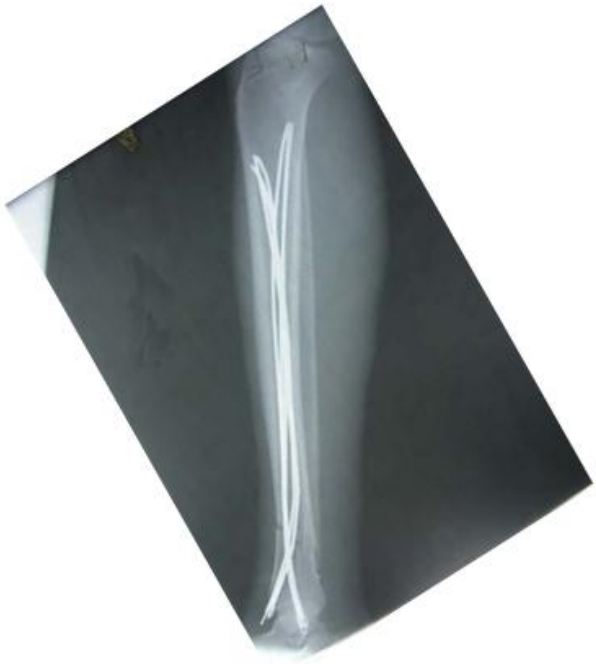

Fig 16: Post Op Xray (lateral view)

4. Conclusion

Distal third tibia shaft fractures are important for the reason that they are common and the exposed anatomical location of the tibia leaves it vulnerable to high energy trauma resulting in fractures that are often communited associated with significant loss of skin and soft tissues. Furthermore, the inadequacy of musculature around the tibia leaves it with precariously low blood supply thereby increasing the chances of complications and consequences such as infection, compartment syndrome, vascular and/or neural injury. Treatment of tibial fractures, despite recent advancements in techniques, equipments and materials, remains controversial. Antegrade intermedullary nailing and minimally invasive percutaneous plate osteosynthesis represent the mainstay of fracture treatment but cannot be used for all bony and soft tissue injuries. Ender's nailing provides an alternative treatment modality being a closed insertion technique, preserving the fracture hematoma with minimal risks of infection, without compromising endosteal blood supply and dynamic controlled motion, which stimulates periosteal callus formation. The nails also allow stacking of the canal leading to axial stability and rotational control leading to early mobilization and weight bearing leading to union and good outcomes for middle third distal third tibia fractures.

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