ORIGINAL RESEARCH PAPER

Orthopaedics

FUNCTIONAL OUTCOME OF ENDER'S NAILING AS AN OPERATIVE TECHNIQUE FOR FRACTURE LOWER THIRD TIBIA.

KEY WORDS: Ender's Nail , Lower Third Tibia, Three Point Fixation

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ABSTRACT

Background: - Tibia has the highest incidence of diaphyseal fractures, of all the long bones. Considerable concern exists that malalignment of a healed tibial shaft fracture may result in post-traumatic arthritis of the ankle or knee.

Material and Methods: - It was an interventional study conducted on 84 patients at tertiary care center in department of orthopedics. Patients underwent surgery of close reduction with internal fixation for fracture lower third tibia with Enders nailing and were followed up for 6 months.

Result:- The mean age of the patients was 32.4±9.17 years. The clinical result of most patients 45 (53.6%) was excellent. 20 (23.8%) patients reported good to excellent result, 10 (11.9%) patients reported fair to good result, 7 (8.3%) patients reported fair result and 2 (2.4%) patients reported poor result.

Conclusion:-Ender's nailing is a good alternative in lower third tibia fractures. It gives increased chances of fracture union with minimal risk of infection. But a brief period of post-operative immobilization is required.

Introduction: Tibia has the highest incidence of diaphyseal fractures of all the long bones[1, 2]. Because the shaft of the tibia is subcutaneous throughout its length and may have a diminished blood supply, severe complications and major disability are common outcomes. Fractures of the tibia and fibula can range from completely undisplaced fractures with minimal soft tissue damage, to traumatic amputations. The treatment modalities described for tibia and fibula fractures range from simple cast immobilization to complex surgical procedures[3].

Considerable concern exists that malalignment of a healed tibial shaft fracture may result in post traumatic arthritis of the ankle or knee[4].As the location of the deformity approaches the ankle or the knee, malalignment results in maldistribution of articular surface pressures that may predispose a patient to premature osteoarthritis[5]. The location of the mal-union is important, with distal deformities more likely to be symptomatic.

In the treatment of fractures of the distal third of tibia and fibula, the fibular fracture is often ignored and is not fixed because any specific treatment is rarely required for the fibula. The role of the fibula in maintaining stability after fixation of distal tibial fractures has not been clearly defined [6] .To the best of our knowledge no study on the effect of fibular fixation in patients with fractures of the both bones of lower third leg treated with intramedullary nailing of tibia is available in literature. However cadaver study on the effect of fibular plate fixation on rotational stability of simulated distal tibial fractures treated with intramedullary nailing has been done.

Ender and Simon-Weidner introduced flexible intramedullary nailing of the proximal femur in 1970, since then it has become an accepted mode of treatment. Favorable mechanical conditions are obtained following flexible intramedullary nailing because axial forces are distributed along the entire length of the nail and bending moments are minimized. Compression of the fracture fragments occur without excessive stress on the nails, enabling the patient to bear weight on the extremity.[7]

The proponents of the operative treatment believe that by this method complications like rotational mal-alignment, non union, malunion are low in addition to reduced cost as compared to non operative treatment. The advantages of flexible intramedullary nails as a fixation device are well known and include closed insertion of the nail, with preservation of the fracture hematoma and minimal risk of fracture site infection. Reaming is required, so as to increase stacking of maximum nails into medullary cavity. The nails, when present, appropriately provide stable three-point fixation. They are load-sharing devices that can permit early mobilization and weight bearing.[8]

Dynamic intramedullary fracture fixation using Ender's nail achieves osteosynthesis with minimal surgical intervention. It is a relatively a simple procedure. As the fixation by Ender's nail is not rigid, some amount of micro motion occurs between the two fragments which in turn stimulate fracture healing. Operative time, Image intensifier exposure and blood loss in using ender's nail is much less than using interlocking nails. Ender's nailing therefore appears to be simple, safe and effective method of treating tibial diaphyseal fracture in adults as well as children.

Hence the present study was done at our tertiary care center to evaluate functional outcome of ender's nailing as an operative technique for fracture lower third tibia and to study various complications in patients managed by ender's nailing.

Material and methods

A prospective study was conducted on 84 patients to evaluate functional outcome of Ender's Nailing as an operative technique for fracture of lower third tibia. The study was conducted for a period of 18 months at a tertiary care center. The patients satisfying the inclusion criteria underwent the procedure and were followed up for a period of 18 months. Assessment of outcome was done with the help of Lysholm knee score. Grading was done as per the Tegner Lysholm knee Scoring Scale[9]

Score	Grade
>90	Excellent
84-90	Good
65-83	Fair
<65	Poor

Inclusion criteria –

- Male or female between 19 years to 80 years of age with lower third fracture tibia.

- Close lower third tibia fractures.
- Patients including Type A, B, and C. of AO classification of tibia diaphyseal fractures and 43-A1, 43-A2 and 43-A3 of AO classification for distal tibia fractures.

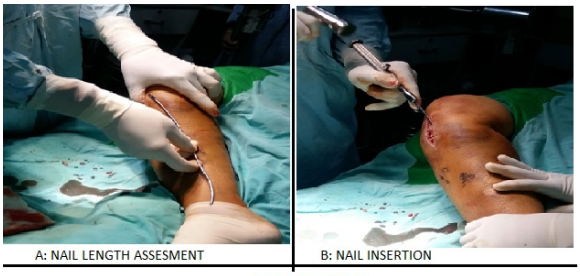
Exclusion criteria -

- Patient who were unfit for anesthesia.
- Established cases of non union from previous fracture of tibia.
- Tibia fractures other than lower third.
- Open fractures and associated neurovascular deficit
- Patients who do not give consent for the procedure
- Patients with distal tibia fracture with Intra-articular extension

SURGICAL GROUP:

Operative procedure:

Patient was operated in supine position under general or spinal anesthesia, under sterile conditions. Draping was done to the affected side of the leg. Longitudinal incision was taken 1cm medial to the tibial tuberosity. The cortex was perforated with an awl. Reaming was done with the help of flexible reamers. The procedure was usually performed by two surgeons. One kept the fracture reduced by manipulation and traction while the other drove the nails across the fracture site, one at a time in an antegrade manner. Each Enders nail was prebend. It was close procedure, every time the nail was rotated and advanced. Jamming of medullary cavity with fanning at distal end of tibia was done. Each nail reached the subchondral area. Minimum 4 nails were inserted. All the procedure was be done under C-arm guidance. The wounds were closed and a below-knee plaster splint is applied.



INTRA-OPERATIVE

Post-op protocol:

After the surgery, limb elevation was given to the operated limb. Frequent wound checkups were done and the sutures were removed at postoperative day 10 to day 12 depending upon wound condition. At 5 day partial weight bearing was started and full weight bearing after 1month. Unstable fracture needed external splintage and weight bearing was delayed in these cases.

Static and dynamic quadriceps exercises were encouraged. Then patients were encouraged for high sitting exercises once pain subsided. From the third day onwards non weight bearing crutch walking was allowed. Patients were called for clinical and radiological follow-up at 1month, 3month and final follow up of 6 month. Once early callus formation was present on x-ray, patients were advised progressive weight bearing as tolerated. On each follow up for the assessment of the patients, Lysholm knee scoring system and foot and ankle disability index (FADI) score was done.

Outcome Assessment:

1. Knee mobilization
2. Ankle mobilization
3. Day of weight bearing

Statistical analysis

The data obtained from the study was analysed with the help of student 't' test and Chi-Square test. 'p' value less than 0.05 was taken as significant.

RESULTS:-

Distribution of patients according to Age

Majority of the patients (34.5%) were in the age group of 31-40 years followed by 26.2% and 21.4% in the age groups of 41-50 years and 21-30 years respectively. 17.9% patients were in the age group of 19-20 years. The mean age of the patients was 32.4±9.17 years.

Distribution of patients according to Gender

There was male preponderance (71.4%) in the study while female patients constituted 28.6% of the study group.

Distribution of patients according to Mode of Injury

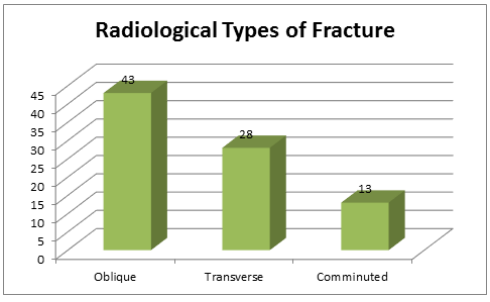
Road Traffic Accident was observed to be the main cause of fracture (75%) whereas 25% of fractures were due to fall from height.

Distribution of patients according to Radiological Types of Fracture

Majority of the fractures (51.2%) were oblique fracture followed by transverse (33.3%) and comminuted fractures (15.5%).

Table No. 1: Distribution of patients according to Radiological Types of Fracture

Radiological Types of Fracture	N	%
Oblique	43	51.2%
Transverse	28	33.3%
Comminuted	13	15.5%
Total	84	100%

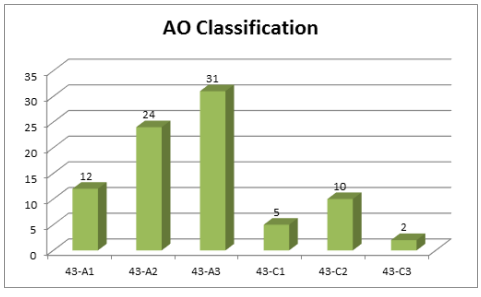


Graph 1: Distribution of patients according to Radiological Types of Fracture

Distribution of patients according to AO Classification

As per AO classification system 14.3% of the patients were type 43-A1, 28.6% type 43-A2, 36.9% type 43-A3, 5.9% type 43-C1, 11.8% type 43-C2 and 2.5% type 43-C3.

AO Classification	N	%
43-A1	12	14.3%
43-A2	24	28.6%
43-A3	31	36.9%
43-C1	5	5.9%
43-C2	10	11.8%
43-C3	2	2.5%
Total	84	100%



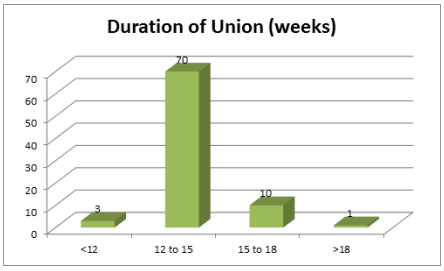
Graph 2: Distribution of patients according to AO Classification

Distribution of patients according to Duration of Union

Most of the fractures (83.3%) were united by 12-15 weeks while 10 (11.9%) fractures were united in 15-18 weeks. 3 (3.6%) fractures and 1(1.2%) fracture were united in <12 weeks and >18 weeks respectively.

Table No. 3: Distribution of patients according to Duration of Union

Duration of Union (weeks)	N	%
<12	3	3.6%
12-15	70	83.3%
15-18	10	11.9%
>18	1	1.2%
Total	84	100%



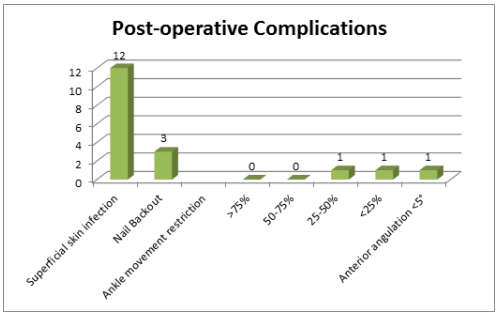
Graph 3: Distribution of patients according to Duration of Union

Distribution of patients according to Post-operative Complications

12 (14.3%) patients developed superficial skin infections while 3 (3.6%) patients had nail backout. There were 2 patients with ankle stiffness and 1 (1.2%) patient developed anterior angulation <5°.

Table No.4: Distribution of patients according to Post-operative Complications

Post-operative Complications	N	%
Superficial skin infection	12	14.3%
Nail Backout	3	3.6%
Ankle movement restriction		
>75%	0	-
50-75%	0	-
25-50%	1	1.2%
<25%	1	1.2%
Anterior angulation <5°	1	1.2%



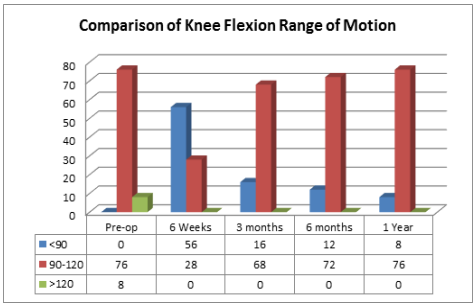
Graph 4: Distribution of patients according to Post-operative Complications

Comparison of Knee Flexion Range of Motion

90.5% patients achieved knee flexion in the 900-120ş range of motion within 1 year of operation.

Table No.5: Comparison of Knee Flexion Range of Motion

Knee Flexion ROM	Pre-op		6 Weeks		3 months		6 months		1 Year		p Value
	N	%	N	%	N	%	N	%	N	%	
<90	0	-	56	66.7%	16	19%	12	14.3%	8	9.5%	**p <0.05**
90-120	76	90.5%	28	33.3%	68	81%	72	85.7%	76	90.5 %	
>120	8	9.5%	0	-	0	-	0	-	0	-	
Total	84	100%	84	100%	84	100 %	84	100%	84	100 %	



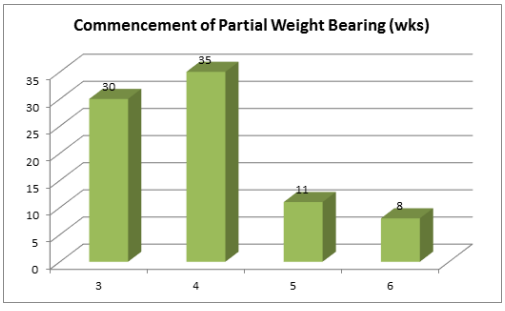
Graph 5: Comparison of Knee Flexion Range of Motion

Commencement of Partial Weight Bearing in patients

30 (35.7%) and 35 (41.7%) patients commenced partial weight bearing in 3 and 4 weeks respectively. 11 (13.1%) and 8 (9.5%) patients commenced partial weight bearing in 5 and 6 weeks respectively.

Table No. 6: Commencement of Partial Weight Bearing in patients

Duration (weeks)	N	%
3	30	35.7%
4	35	41.7%
5	11	13.1%
6	8	9.5%
Total	84	100%



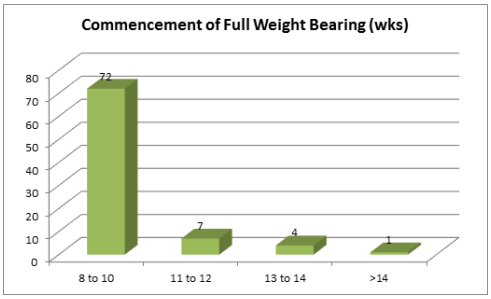
Graph 6: Commencement of Partial Weight Bearing in patients

Commencement of Full Weight Bearing in patients

72 (85.7%) and 7 (8.3%) patients commenced full weight bearing in 8-10 and 11-12 weeks respectively. 4 (4.8%) and 1 (1.2%) patient commenced full weight bearing in 13-14 and >14 weeks respectively.

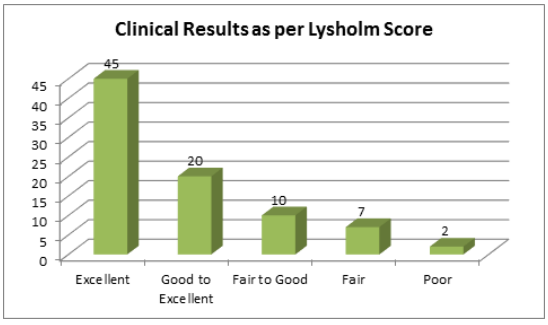
Table No. 7: Commencement of Full Weight Bearing in patients

Duration (weeks)	N	%
8-10	72	85.7%
11-12	7	8.3%
13-14	4	4.8%
>14	1	1.2%
Total	84	100%

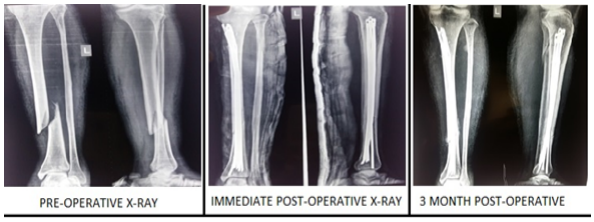


Graph 7: Commencement of Full Weight Bearing in patients

Clinical Results	N	%
Excellent	45	53.6%
Good to Excellent	20	23.8%
Fair to Good	10	11.9%
Fair	7	8.3%
Poor	2	2.4%
Total	84	100%



Graph 8: Clinical Results as per Lysholm Score



DISCUSSION:

We used Ender's nail of different sizes ranging from 2.5 to 3.5. As they are easier to introduce & chances of splintering bone near fracture is less with them. To achieve proper reduction and to reduce nail back out maximum nails should be inserted to achieve stacking of medullary cavity. Nail placement should be done up to subchondral part of distal tibia along with fanning of metaphyseal area as nails were bended at distal portion that provides good rotational stability to fracture and allowing early weight bearing to patients.

Our study was done to evaluate functional outcome of ender's nailing as an operative technique for fracture of lower third tibia. 84 patients were enrolled in the study. In our study majority of the patients (34.5%) were in the age group of 31-40 years and the mean age of the patients was 32.4±9.17 years with a male preponderance (71.4%). Road traffic accident was observed to be the main cause of fracture (75%). As per AO classification system maximum patients (36.9%) belonged to type 43-A3. On completing the study it was found that most of the fractures (83.3%) were united by 12-15 weeks while 10 (11.9%) fractures were united in 15-18 weeks. 3 (3.6%) fractures and 1(1.2%) fracture were united in <12 weeks and >18 weeks respectively. Most patients , 72 (85.7%) and 7 (8.3%) commenced full weight bearing in 8-10 and 11-12 weeks respectively. In the our study the clinical result of most patients 45 (53.6%) was excellent, 20 (23.8%) patients reported good to excellent result, 10 (11.9%) patients reported fair to good result, 7 (8.3%) patients reported fair result and 2 (2.4%) patients reported poor result.

In a study done by Hussain r et al 9 to assess the efficacy of flexible intramedullary Ender nails for the treatment of tibial diaphyseal found the average time to union in 34 out of 39 fractures was 17 weeks.

Ladani H et al10 in a study done on lower fourth extra-articular closed tibial fractures treated with Ender's nailing found time taken for fracture union was between 10 to 14 weeks in 6 patients, between 14 to 20 weeks in 11 patients and more than 20 weeks in 3 patients. Average union time was 16 weeks.

Conclusion:

Of all the long bones, the tibia has the highest incidence of diaphyseal fractures. Fractures of the tibial shaft are the most common of the long bone fractures. Because the shaft of the tibia is subcutaneous throughout its length and may have a diminished blood supply, severe complications and major disability are common outcomes.

Ender's nailing is a good alternative in lower third tibia fractures. It gives -increased chances of fracture union with minimal risk of infection. 2nd surgery of bone grafting or dynamization of intramedullary nails is not required. The implants are inexpensive and procedure is simple. But a brief period of post-operative immobilization is required.

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