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Functional Outcome of Intramedulary Interlocking Nailing in Distal Tibia Fractures

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Abstract

Distal tibial fractures accounts for less than 7% of all tibial fractures and less than 10%of all lower extremity fractures. Preoperative planning of distal third tibial fractures is of much importance since operative management is challenging in this injury. Fracture pattern, soft tissue injury, and bone quality critically influence the selection of fixation technique. Numerous techniques have been developed for management of distal third tibial fractures which includes conservative management, hybrid external fixation, minimally invasive percutaneous plate osteosynthesis and intra medullary nailing. The Intra medullary Interlocking nailing of distal tibial fractures allows load sharing, it does not damage the soft tissue attachments and thereby it preserves periosteal blood supply, in addition Intra medullary Interlocking nailing also preserve the fracture hematoma. Intra medullary Interlocking nailing allows early mobilization and return to function in most of the individuals, which is the need for the hour. After getting institutional human ethical committee and research committee approval, This Prospective Study was conducted among 60 patients in Sree Mookambika Institute of Medical Sciences, Kulasekharam, who were diagnosed to have extra articular distal tibia fractures. We included patients with age >18 years, extra-articular distal tibia fractures, Closed fracture and Type 1 and 2 Gustilo and Anderson type fracture, AO Type 43 A1, A2 and A3 fractures Acute fractures (<2 weeks old). We have done Closed Reduction and Internal Fixation with Intra medullary Interlocking Nailing (IMILN) for those patients. The patients were regularly followed up for a period of 6 months in regular intervals at 4 , 8 , 12 and 24 weeks. Functional outcome was measured using Modified Klemn and Borner scoring system. Based on the score the patients were graded as Excellent, Good, Fair and Poor. According to this score, in IMILN Excellent was observed in 14 patients, good outcome in 30, Fair in 10 and Poor outcome in 6 patients We observed IMILN has 44 patients of Excellent to Good results (73%). Distal tibial fractures can be effectively treated by Intra medullary Nailing with minimal soft tissue injury providing good to excellent results. Very minimal complications were encountered in our study. There were 2 cases of non-union was seen. In our present study we IMILN there was 87% of good to excellent result according to the scoring system used. Though Interlocking Intra Medullary Nailing allows early weight bearing in patients, malunion was more frequently seen, which affects the functional outcome.

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Key Words

Distal tibial, medically, fracture

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INTRODUCTION

Distal tibial fractures accounts for less than 7%[1,2] of all tibial fractures and <10%[3,4] of all lower extremity fractures. Distal tibial fractures are more commonly seen in males between the age group[5] of 30-50 yrs. Tibial fractures have a bimodal distribution, low energy spiral patterns being commonly seen in patients over 50 years of age due to rotational forces[6] and high-energy transverse or comminuted fractures seen in patients under 30 years of age due to fall from height and Motor vehicle accidents[7]. Low energy fractures three times more common in females than males however high energy tibial fractures in young patients are more commonly seen in males[8]. Due to the proximity to ankle joint, these fractures are difficult to treat than mid shaft fractures therefore distal tibial fractures remain a challenging subject in spite of many advances. The goal in expert care is good fracture reduction, limb length restoration and quick recovery of function[9]. The metaphyseal flare involved in the fracture of distal third of tibia usually causes disturbance in implant contact leading to instability and mal-alignment during fixation. Preoperative planning of distal third tibial fractures is of much importance since operative management is challenging in this injury. Fracture pattern, soft tissue injury, and bone quality critically influence the selection of fixation technique. Numerous techniques have been developed for management of distal third tibial fractures which includes conservative management, hybrid external fixation, minimally invasive percutaneous plate osteosynthesis and intramedullary nailing. The fibular fractures not necessarily be fixed while using the intramedullary multidirectional interlocking nailing for fixation of tibia. Conservative management[10,11,12] such as traction and application of plaster of Paris have a limited role in patients medically unfit. However, there are more complication in non-operative management like shortening, decreased ankle movements, mal-alignment, secondary osteoarthritis of the ankle joint and the risks of pneumonia, deep vein thrombosis and pressure sores are not surprising. Open reduction and internal fixation with plates can be done but it disturbs the periosteal blood supply which delays the healing process and we couldn't make the patient to weight bear immediately. The Intramedullary Interlocking nailing of distal tibial fractures allows load sharing, it does not damage the soft tissue attachments and thereby it preserves periosteal blood supply, in addition Intramedullary Interlocking nailing also preserve the fracture hematoma. Intramedullary Interlocking nailing allows early mobilization and return to function in most of the individuals, which is the need for the hour. However, Intramedullary nailing in cases of distal tibial fractures having short distal fracture fragment has complications like instability of fracture, mal-alignment especially in coronal plane, non-union as a consequence of muscle actions producing displacement at the fracture site also in few cases require secondary procedures like dynamisation for union. The mal-alignment in Intramedullary nailing of distal tibial fracture is a consequence of disparity amongst the diameter of the medullary canal of distal end of tibia and the diameter of nail. This variation results in loss of contact between nail and the cortex, allowing the nail to sway laterally along coronally placed locking screws and stress is increased on the locking holes to maintain alignment of the fracture after surgery resulting in failure. in MIPPO technique complication like implant failure, non-union, malunion has been reported and weight bearing is delayed in case of MIPPO whereas immediate weight bearing is possible in IMILN. Therefore, various techniques have evolved to improve fixation of distal both bone fractures of leg including fibular plating (distal third fractures), different nail design with different proximal bends (proximal third fractures), blocking screws (poller screws) and Locking plates. All methods have some merits and demerits of its own, therefore gold standard treatment option for distal 1/3rd tibia fracture is still controversial.

MATERIALS AND METHODS

After getting institutional human ethical committee and research committee approval, This Prospective Study was conducted among 60 patients in Sree Mookambika Institute of Medical Sciences, Kulasekharam, who were diagnosed to have extra articular distal tibia fractures. We included patients with age >18 years, extra-articular distal tibia fractures, Closed fracture and Type 1 and 2 Gustilo and Anderson type fracture, AO Type 43 A1, A2 and A3 fractures Acute fractures (<2 weeks old). We have excluded patients with age <18 years, Intra articular fractures (AO type B1-3, C1-3), Open fractures (Gustilo and Anderson Type 3 and 4), Pathological fractures, Fractures >2 weeks. In our study most of the patients were of the age group 32-46 years with 25 patients in this age. However, 23 patients were of the age group of 46-60 years in the study population. In our study of 60 patients with distal tibia fractures, there were 36 males and 24 females with slight Male predominance since the Road traffic accidents are more common among males. In our study the most common mode of injury was found to be Road Traffic Accident (RTA) in about 33 patients (55%). Fall from height caused distal tibia fracture in 5 patients, fall of object lead to fracture in 10 patients and Self fall was the mode of injury in 12 patients. All the patients involved in the study were explained in detail and informed consent forms were obtained. All required investigations were

done including X-Ray, CT-Scan, blood investigations. All patients were treated with Intramedullary interlocking nailing. The patients were regularly followed up for a period of 6 months in regular intervals at 4 , 8 , 12 and 24 weeks. Functional outcome was measured using Modified Klemn and Borner scoring system. Patients were evaluated for complications such as infection, mal-alignment and pain on weight bearing, muscle atrophy and ankle Range of motion. The data collected was subjected to double data entry in MS Excel. The data was analysed using SPSS Version 20.0 using Chi square test.

RESULTS AND DISCUSSIONS

A total of 60 patients were diagnosed to have extra articular distal tibial fracture. Out of 60 cases, 51 (85%) cases were closed fractures and 9 (15%) cases were Grade I open fractures according to Compound Gustilo Anderson classification. Based on pattern of fracture by AO classification A1 were 45 (75%) cases, A2 were 13 (21%) cases and A3 were 2 (4%) cases. Duration between injury and operation were noted that <10 days were among 37 (61%) cases, 11-15 days were among 15 (25%) cases and > 15 days among 8 (14%) cases. The functional outcome of 60 patients in our study was evaluated using Modified Klemn and Borner score.

In our study the range of movements of ankle joint was assessed at each follow up. There was no restriction of movements was seen in about14 patients of IMILN and minimal (<25%) restriction was observed in 30 IMILN patients. Moderate restriction (>25%) was seen in 10 IMILN patients. Severe restriction was seen in 6 IMILN patients. Among 60 IMILN patients, 44 patients (73%) had full range of movements to minimal restriction only.

In our study on 60 patients, atrophy of calf muscle was observed 44 patients (73%) underwent IMILN. There was no muscle atrophy was seen in 16 patients (27%) were IMILN. In our study of 60 patients, all fractures except one united with average union time of 23.18 weeks overall. There was one case of non-union. In our study on 60 patients the fracture alignment was normal in 30 patients (50%) underwent IMILN and angular deformity of varying degree was noted in the rest, 15 (25%) patients had minimal angular deformity (<5), 10 (16%) patients had <10 of malalignment and 5 (9%)patient had >10 malalignment. Among 60 patients, pain complaints were noted on prolonged activity among30 (50%) patients who underwent IMLIN and on weight bearing among16 (26%) patients and pain complaints were absent among 14 (23%) patients.

Based on the score the patients were graded as Excellent, Good, Fair and Poor. According to this score, in IMILN Excellent was observed in 14 patients, good outcome in 30, Fair in 10 and Poor outcome in 6 patients We observed IMILN has 44 patients of Excellent to Good results (73%).

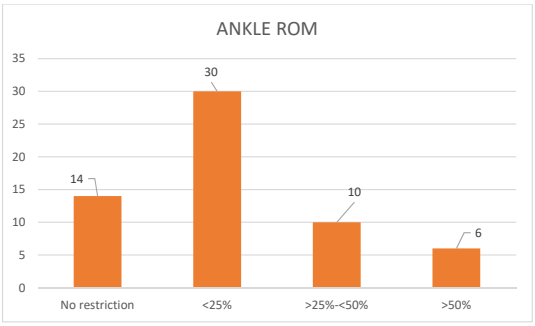

Fig. 1: Ankle Range of Motion after 24 weeks of follow up in our study

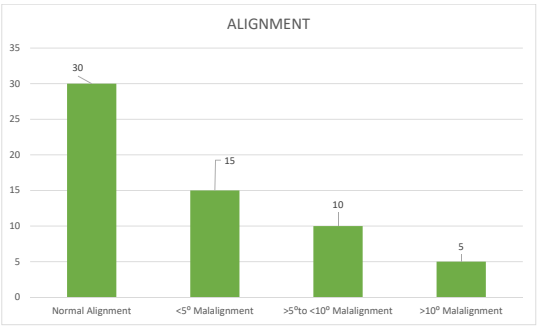

Fig. 2: Alignment of fracture after IMILN fixation during 24 weeks of follow up in our study

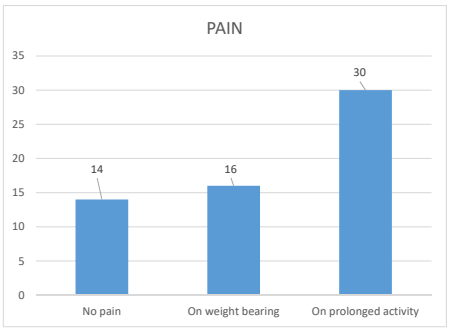

Fig. 3: Alignment of fracture after IMILN fixation during 24 weeks of follow up in our study

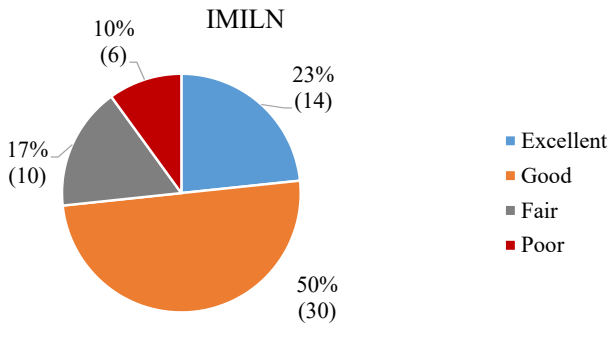

Fig. 4: Functional outcome of IMILN in distal tibia fractures after 24 weeks of follow up

Table 1: Comparison of mean union time in IMILN with other studies

Study	Mean Union Time in Imiln (weeks)
Present study	23.34
Fang *et al*[20]	22.6
Li Y *et al*[22]	21.3

Table 2: Comparison of full weight bearing time in IMILN with other studies

Study	Full Weight Bearing in Imiln (weeks)
Present study	11.16
Daolaguppu21	10.09

Table 3: Comparison of IMILN functional outcome with other studies

Study	Functional Outcome in Imiln
(Excellent to Good %)	
Present study	73%
Y Li, Jiang *et al*[22]	73.3

In our study the time for full weight bearing was ranging from 14-24 weeks. Full weight bearing was tolerated by about 54 patients in IMILN group by the end of 16 weeks. In this study there were complications like Malunion, delayed union, non-union and superficial wound infection were seen. In IMILN there was 16 cases of malunion (26.6%), 4 cases (6.6%) of superficial wound infection and 2 cases of non-union (3.3%) was observed.

Distal third tibia fractures had encountered higher complication rates when treated with plate fixation specifically after high energy trauma. Therefore, many surgeons chosen intramedullary interlocking nailing to reduce damage to fracture hematoma and surrounding soft tissue. Using intramedullary device, it is highly challenging to control proximal and distal third tibia fractures. Therefore, there is variable rate of malunion from 5% to 58%[14].

The main factor in treating these injuries is to estimate the degree of associated soft tissue injury. Since both open and closed fractures were included in our study, we used Gustilo-Anderson classification for open fractures and the Tscherne classification for closed fractures with soft tissue injury to assess and grade the severity of soft tissue injury. Definitive surgical fixation is desirable and posted for surgery only when there is soft tissue healing. This is indicated by the skin wrinkle sign, once limb oedema subsides.
In our study, to analyse IMILN technique various factors like rate of fracture union, rate of malalignment, muscle atrophy, range of ankle movements, pain during rehabilitation, incidence of complications and the overall functional outcome were analysed and graded using Modified Klemn and Borner scoring system were used[17]. Seven patients in our study required secondary procedures in IMILN underwent dynamization. All patients were given spinal anaesthesia.

In our study population the age group of patients sustained distal third tibia fracture ranges from 24-60 years. The majority of patients of patients were between the age group of 31-45 years. In addition, Cory Collinge[15] also had the age group of 17-62 years with mean age of 43 years in their study population.

In our study, there were male preponderance with 18 male and 12 female patients among the IMILN group and in Heather A Vallier[16] study there were 69 males and 31 females. In this present study left side was most commonly fractured. There were 28 (47%) patients with right distal tibia fracture and 32 (53%) patients with left distal tibia fractures.
In our study population of 60 patients with distal tibia fracture, the most common mode of injury was found to be High energy Road Traffic Accident (RTA) with 33 patients which accounts for 55% of total study population. Followed by Low energy injuries like Fall from height, fall of object, and Self fall. This was similar to the study by Andrew Grose[18] where there was 58% of high energy injury and 42% of low energy injury in addition Shrestha[19] had equal amount of high and low energy injury.

In our study population there were 51 patients with closed distal tibial fractures which was 85% of total and 9 patients with Grade I of Gustilo Anderson type which is 15%. This was comparable to the other studies conducted by Hazarika[13] who had 60% closed and 40% open fractures. According to AO fracture classification there were 44 patients (73.3%) sustained AO type A1 fracture and 14 (23.3%) with AO type A2 and 2 patients (3.3%) with A3 type of fracture tibia. Shrestha[19] where there was 60% A1 type and 20% of A2 type and 10% of A3 and B1 each.

In our study of 60 patients, all fractures except one united with average union time of 23.18 weeks. There was 2 cases of non-union among IMILN that may be attributed to fibular plate fixation and in addition poor bone quality with osteoporosis in that patient. This findings in our study is similar to the Fang[20] study, which has mean union time of 22.6 weeks in the IMILN. It has been established that safeguarding the soft tissue environment and the blood supply of surroundings the fractures by using indirect reduction techniques would promote fracture healing.

In this present study among 60 patients of distal third tibia fracture, patients were allowed for weight bearing as tolerated. Average time required for full weight bearing was 11.16 weeks. This outcome is similar to the study conducted by Daolagupu[21] which had average time for full weight bearing 10.09 weeks in IMLN. In our study only 3 patients had delay in weight bearing that is also due to fracture comminution, unstable fracture pattern and associated comorbidities of the patients.

In our study on 60 patients the fracture alignment was normal in 30 patients (50%) underwent IMILN and angular deformity of varying degree was noted in the rest, 15 (25%) patients had minimal angular deformity (<5), 10 (16%) patients had <10 of malalignment and

5 (9%) patients had >10 malalignment. In Y Li, Jiang[22] study there was 4 cases (10%) of malalignment noted in IMILN.

The functional outcome of 60 patients in our study was evaluated using Modified Klemn and Borner score Based on the score the patients were graded as Excellent, Good, Fair and Poor. According to this score, in IMILN Excellent was observed in 14 patients, good outcome in 30, Fair in 10 and Poor outcome in 6 patients. These patients had poor outcome due to inability to maintain fracture reduction of distal fragment in nailing. We observed IMILN has 44 patients of Excellent to Good results (73%). Y Li, Jiang[23] in their study and 87% excellent to good result following IMILN.

In our study, malunion was seen among 16 patients which is 27%. This is similar to the study conducted by Li[22] in which there was 3 cases (13.4%) of malunion in IMILN method of treatment and 1 case (4.3%) in minimally invasive percutaneous plating. This complication is greatly reduced by concurrent fibular fixation, however, fibula fixation in IMILN causes non-union in few cases.

In our study there were two cases of non-union (3.3%) observed in IMILN group this may be attributed to fibular fixation in that patient. This was probably due to the age and bone quality of the patients. Guo[23] in their study reported no cases of non-union in both nailing and percutaneous plating groups.

In our study there was superficial infection seen in 4 patients of IMILN. These infections were settled with routine dressing and regular antibiotics course. All the patients who developed infections were diabetic. However, no deep surgical site infection was seen in our study. Also, the chance of infection was highly reduced due to shorter duration of operative procedure and very minimal exposure of the soft tissue in both the techniques of fixation under study. Guo[23] in their study reported only 6.8% in intramedullary nailing group had superficial infections.

CONCLUSION

Distal tibial fractures can be effectively treated by Intramedullary Nailing with minimal soft tissue injury providing good to excellent results. Very minimal complications were encountered in our study. There were2 cases of non-union was seen. In our present study we IMILN there was 73.3% of good to excellent result according to the scoring system used. Though Interlocking Intra Medullary Nailing allows early weight bearing in patients, malunion was more frequently seen, which affects the functional outcome.

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