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Research Article

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Evaluation of Functional Outcome of Patients with Extra Articular Distal Tibia Fractures Treated by Intramedullary Nailing at Government Medical College, Thrissur – A Prospective Study During March 2022 to December 2022

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ABSTRACT

Background: Distal tibia fractures that involve the tibial metaphysis often pose significant challenge to the Orthopedic surgeons. The relatively lesser vascularity, the subcutaneous location and the close proximity to the ankle joint which is of the hinge configuration, responsible for major weight transmission and its complex biomechanics results in high incidence of complications including malunion.

Methods: 61 Patients who had distal tibia fractures and fixed with IM nailing were prospectively followed up was performed on patients treated with intramedullary nailing for extraarticular distal tibia fractures during the period from March 2022 to December 2022 in the Department of Orthopedics Government Medical College Thrissur. On follow up, patients were clinically assessed by at the end of 3 ,6 and 9 months, Radiological parameters were recorded with anteroposterior and lateral view of the limb. Functional scores like the American Orthopaedic Foot and Ankle Society Score and Olerud and Molander Scores were calculated using appropriate patient questionnaires Functional scores were analysed statistically using STATA 14.0 version software.

Results: Out of the 61 patients recruited for the study, 50 patients were males and 11 were females.82%(n=50) sustained the injury due to high velocity injury.57.4%(n=35) patients sustained closed fractures. The average time to surgery was 4.18 days. And the average time taken to partial weight bearing was 12 weeks. The mean AOFAS score was 87.12; assessed at 3 months from date of surgery and 89.4 when assessed 6 months from the surgery. The mean Olerud and Molander score was 80.24 at 3 months and 83.7 at 6 months from the date of surgery.

Conclusions: Intramedullary nailing achieved consistent union and good functional outcome in patients with distal tibia fractures. AOFAS score and Olerud and Molander score are good scoring systems to assess the functional outcomes in patients with distal tibia fracture. However, there is significant incidence of implant related pain in patients who had IM nailing.

Keywords: Distal Tibia Fractures, Intramedullary Nailing, American Orthopedic Foot and Ankle Society Score, Olerud and Molander Score, Functional Outcome

Introduction

The rapid growth of urbanization and development of technology has led to a rapid increase in the network of roads and the number of vehicles plying on them. Proportionately there has been an

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increase in the number of accidents on the road. WHO estimates an average of 1.3 million deaths in a year due to road traffic accidents (RTA). A significant number of people, estimated between 20 and 50 million, suffer non-fatal injuries as a result of RTA, with many resulting in significant disability [1].

A large proportion of the fatalities of RTA in India involve the pedestrians and two wheelers users who are referred as the 'vulnerable road users. Overspeeding, alcohol use, avoidance of seat belts and helmets, lack of child restraint seat, and decreased visibility, distracted driving, unsafe roads are all identified risk factors for road traffic accidents which are widely prevalent in India [2]. The case fatality rate in India due to road traffic accidents is 14% in India, and is frighteningly high compared to countries like China which has a case fatality rate of 5% due to RTA.

Long bones especially tibia are vulnerable during RTA due to its subcutaneous location. Tibial shaft fractures are the commonest long bone fractures and are seen in 4 percent of the senior population.

Tibial fractures occur in a bimodal pattern involving both low and high-energy mechanisms. Low-energy injuries are a result of a torsional force, indirect trauma resulting in spiral fractures, and/or a fibular fracture at a different level with a minimal soft-tissue injury [3,4]. The treatment of distal tibial fractures with or without articular surface involvement is challenging and often causes complications such as infection, malunion, non-union and post-traumatic arthritis [5]. It is often difficult in choosing an appropriate implant in these fractures to achieve an adequate union and return of functional activity to early preinjury levels.

The techniques of closed IM nailing resulted in a greater degree of preservation of soft tissue and thereby the blood supply ensuring adequate and exuberant callus formation owing to the preservation of blood supply [6]. The invention of closed locked IM nailing, based on the development of the Kuntschner 'Detensor' nail and described by Kempf and Klemm et al, was a significant breakthrough [6]. This technique combines closed nailing with the percutaneous insertion of screws that interlock the bone and nail. Not only this permits static locking that controls rotation and telescoping of the fracture fragments but also subsequently converts to dynamic locking when weight-bearing is initiated [6,7].

Aims and Objectives

To analyse the functional outcome of patients treated for extra articular distal tibia fractures using Intramedullary Nailing in patients between 18 to 60 years of age attending the orthopaedics department in government medical college, Thrissur from 01/03/2022 to 31/12/2023 and to study how early union and early mobilisation of the patients can be achieved.

Methods

This prospective observational study was done at department of orthopaedics, government medical college, Thrissur, Kerela during 01/03/2022 to 31/12/2023, study population include patients with distal tibia fractures undergoing interlocking nail fixation in the department of orthopaedics, government medical college, Thrissur, fulfilling the inclusion criteria during the study period.

Sample size was calculated based on the formula $(z\alpha)^2pq/d^2$ with 95% confidence interval and 5 percentage alpha error, 'P' was taken as proportion of patients with good outcomes which was given as 80% and the subsequent sample size calculated was 61.

Inclusion Criteria

Patients with age group between 18 to 60 years who sustained open or closed extraarticular distal tibia fractures from 4cms – 11cms above the tibial plafond/10 cm-15 cm from the mid shaft and were treated by intramedullary interlock nailing.

Exclusion Criteria

Paediatric and elderly population with fractures beyond the age range, patients with pathological fractures, patients with metabolic bone diseases, patients with Intrarticular fractures, patients associated with pelvic fractures and patients with polytrauma including chest wall and abdominal injuries.

An informed written consent was taken from all the patients recruited for the study. A careful history and examination of injured limb, anteroposterior and lateral radiographs were obtained. Patients were treated according to the standard institutional protocol. The operative procedures, its benefits and risks and complications were followed up on 6th week, 3rd month, 6th month and 9th month post op.

Functional outcome is evaluated using AOFAS and Olerud Molander score at 6th week ,3rd month ,6th month and 9th month. Serial radiographs were taken for each visit. Data were entered in Microsoft Excel datasheet and analysed using STATA software. Any patient who absconded from the wards or whose data could not be collected in completion were excluded.

Statistical scrutiny was performed using both univariate and multivariate analysis. An $\alpha < 0.05$ was taken as significant. Binary and multinomial logistic regression analysis were used to analyse the chances of survival or death with respect to the variable in study. Software used was STATA 14.0 version [Statistical Software: Release 14. College Station, TX: Stata Corp LP]

Frequencies, percentages, range, mean, standard deviation and 'p' values were calculated using this package. Categorical variables like gender, outcomes, cardiotoxicity etc, are represented in frequencies and percentages. Pie-charts and bar diagrams are used as appropriate. P-values less than 0.05 level was considered statistically significant.

Ethical Conflicts and Concerns of Interests

Clearance from IEC/IRB was obtained Informed written consent was taken from the subjects and the guardians/relatives if tall the patients in the study. As a result of taking part in this study the patient has not been put under any increased risk. No conflict of interest in the current study.

Preoperative Management

Patients usually present in casualty and were admitted to the ward. Detailed history was taken with particular emphasize on mode of injury and associated medical illness. Detailed clinical assessment was dine in each case.

In all patients, primarily above knee splinting was applied to the fractured lower limb with the aim of relieving pain and preventing further deformity and to reduce unnecessary movement of the injured limb. Oral or parental NSAIDs were given to relieve the pain. Anterior-posterior radiographs of the affected leg were taken for all the patients.

Routien investigation like complete blood count, blood grouping, renal function test, liver function test, urine routine, random blood sugar, serum electrolytes, screening for HBSAg, HIV and HCV, chest x-ray and ECG were done. Appropriate consultation and treatment were done according to co morbidities such as diabetes, hypertension, coronary heart disease, chronic obstructive pulmonary disease, chronic liver disease, asthma, renal failure etc. these patients are well evaluated before surgery.

The details and complications of the surgery were explained to the patient and by stander for obtaining written informed consent. Before starting the surgery, a single dose of Intravenous antibodies and tetanus immunization were given. Parts were prepared from the umbilicus to the ankle.

Surgical Procedure

All surgical procedure was performed on an elective basis with asepticprecautions under spinal or general anaesthesia.

Position of the Patient

The patient is placed supine on a radiolucent table. The knee will need to be flexed to 90-110 degrees for entry site access and a support is placed under the knee, so that the tibia remains aligned and the foot can rest on the table.

Determination of the Entry Point

In the frontal plane, the entry point is located in line with the medullary canal (mm medial of the tibial crest). In the sagittal plane, the entry point should be located just distal to the angle between tibial plateau and anterior tibial metaphysis.

Skin Incision

Make a longitudinal skin incision over the planned entry point. Extend it 3-5 cm proximally from the level of the tibial plateau. An incision that is too medial interferes with proper entry into the medullary canal.

Tendon Incision

A transpatellar incision is made.

Creation of the Nail Entry Site

A preliminary guide pin helps locate the proper entry site. Various cannulated instruments can be inserted over such a pin. Alternatively, a solid awl can be used for the same purpose. Make sure that the location is correct before the full opening is created.

Guide Wire Insertion

Once the proximal metaphysis is breached, pass a ball-tipped guide wire down the medullary canal into the distal metaphysis. This requires fracture reduction. If reduction is difficult or the fracture is comminuted, special efforts may be required. Use fluoroscopy to check that the guide wire passes through the fracture site into the distal fragment and is positioned above the centre of the ankle joint.

Determination of Nail Length

Using a radiographic ruler.

Reaming and Determination of Nail Diameter

Insert the cannulated, flexible-shaft reamer over the ball-tipped guide wire. Begin with an end-cutting reamer and proceed sequentially to larger reamer diameters, usually in increments of 0.5 mm. Protect the soft tissues at the entry site. A chattering sensation indicates that the reamer is in contact with the internal cortical surface. A millimetre or two of additional reaming usually permits passage of an appropriate diameter. A proximal reamer is reamed through the proximal medullary canal.

A plastic medullary exchange tube is available for exchanging guide wires. Pass the medullary tube over the reaming guide wire and all the way passed the fracture site.

Insertion of the Cannulated Nail

With adequate reduction and sufficient over-reaming, it should be possible to insert the cannulated nail.

Make sure that the proximal end of the nail is below the surface of the bone at the entry site, to decrease the risk of knee pain. The tip of the nail should be placed in the centre of the distal tibia, approximately at the level of the physeal scar.

Locking of the Nail

Distal locking followed by backslap technique if fracture is distracted. Recheck the proximal end of the nail. After which proximal locking is done.

Wound Closure

Repair the patellar tendon and its paratenon with interrupted sutures. Skin and subcutaneous tissue are closed with a few loose sutures, which should be left in until the wound is securely healed. Apply a soft dressing that will permit knee motion.

Postoperative Management

Immediately after surgery, while the patient is still in the hospital, emphasis is given to

- Pain control
- Mobilization
- Infection and deep veinous thrombosis (DVT) prophylaxis
- Early recognition of complications

Parenteral antibiotics was given two times a day for the first three days and later shifted to oral antibiotics. A postoperative check X-ray was taken.

Encourage active motion of all joints (hip, knee, ankle, and toes). Gentle, progressive stretching to achieve knee extension and ankle / foot dorsiflexion begins as soon as tolerated.

Suture removal was done on the tenth postoperative day and the patient was discharged from the hospital.

Follow up

Patients were followed up at an interval of 6 weeks, 3 months and 6 months and 9 months. Functional outcome was finalised by AOFAS and Olerud and Molander scoring system. Serial radiograph were taken for each visit.

Results

Out of the 61 patients recruited for the study, 50 were males and 11 were females.

Out of the study population 82%(n=50) sustained the injury due to high energy injury.18 %(n=11) sustained fracture due to low energy injury. High energy injuries were predominantly caused due to road traffic accidents. Low-energy fractures are as a result of falling from standing height or less, while high-energy fracture includes other types of traumas (falling from height higher than standing height and motor vehicle accident) [6,8].

Out of the study population of 61 patients,35 patients (57.37%) sustained closed fractures.42.67%(n=26) patients sustained open injury.

All the patients recruited for the study had undergone IM nailing for distal tibia fracture. The mean duration between the injury and the surgery was 4.18 days in the study populations. The duration of time to surgery in patients ranged from 13 hours to 6 days 14 hours.

The average time taken to partial weight bearing was 11.5 weeks (range of 3 weeks to 19 weeks). The average time taken to full weight bearing was 20.4 weeks (range of 4 weeks to 34 weeks). The average time taken to return to work was 30.4 weeks (range of 14 weeks to 37 weeks). Two patients did not return to their work. Out of the 24 patients, 9 patients have changed their job or have not returned to their job since they were not able to continue in their previous jobs due to their injury. 44 patients were able to return to their previous jobs without any difficulties.

Table 1: Mean AOFAS Score at 3 Months and 6 Months

	3 months	6 months
Male	87.59	89.71
Female	86.4	88.9

Table 2: Mean Olerud and Molander Score at 3 and 6 Months

	3 months	6 months
Male	80.7	83.9
Female	79.6	82.1

Complications

The cases were followed up at 9 months to assess the complications and assess the bony union.

Out of the 61 study patients, 6 patients had fracture site tenderness, pain on full weight bearing and radiological union of only two cortices out of 4. Those 4 patients were considered as non-union. 4 patients underwent additional procedures. Mostly for their soft tissue cover in the form of split thickness skin grafting. Among the 61 study subjects, 9 (14.75%) patients had implant related pain. 1 patient (1.67%) underwent implant exchange.2 patients (3.2%) had malunion of the fracture.

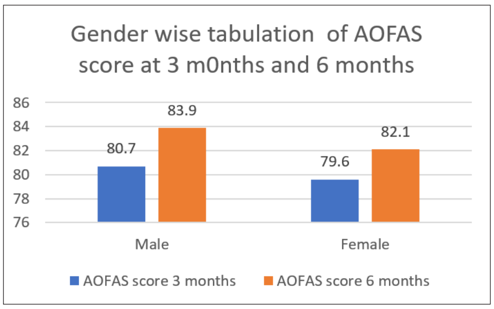

Figure 1: Gender Wise Representation of AOFAS Score at 3 Months and 6 Months.

Table 3: Patients with Complications Following Distal Tibia IM Nailing

Complications	No. of patients	Percentage
Malunion	2	3.2%
Non-Union	4	6.55%
Implant Related pain	9	14.75%
Implant Exchange	1	1.67

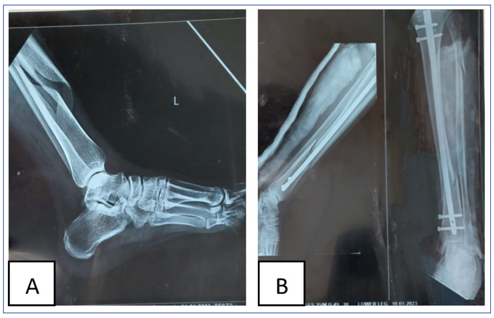

Figure 2 (A and B): Preoperative and Postoperative Radiograph Showing Fracture of Distal Tibia and Proximal Fibula Treated with Intramedullary Interlocking Nail.

Figure 3: Shows Skin Incision, AWL Entry, Guide Wire Introduction and Introduction of Intramedullary Interlocking Nail.

Figure 4: Wound and Functional Status Post Intramedullary Interlocking Nailing at 6 Months.

Discussion

61 patients were recruited for the study for assessment of functional outcome of intramedullary nailing for extrarticular distal tibia fractures. There is a definite male predominance (82% males vs 18 % females) in our study population. This is largely because of the more involvement of males and exposure to high energy injuries. The finding of our study in terms of gender distribution correlates with gender based epidemiologic data done in different parts of the world wherein there is a two-fold increase in prevalence among males [8].

Out of the study population 82%(n=50) sustained the injury due to high energy injury.Tibia is a commonly fractured bone in high energy injuries like road traffic accidents, our study results corroborate with the previously available data published by Weber et al wherein, high energy injuries are the common cause of tibial fractures, especially the open fractures of the tibia [8,9]. 18 %(n=11) sustained fracture due to low energy injury.

In our study population, majority sustained closed tibial fractures (57.37%); and 42.67%(n=26) patients sustained open injury. In the study population, the commonest open fracture encountered were Gustilo Type I in 29.5%(n=18). Although there are no major epidemiological data published detailing the relative incidence of tibia fractures in our population, our data very much follows the trend in terms of the type and nature of the fractures [9,10].

The mean duration between the injury and surgery was 4.18 days in our study population. This did not have any significant impact on the outcome of the patient. However, it is the type of the fracture that determines the urgency of treatment in tibia fractures. The study published by Khatod et al shows that the Gustilo grading system of open fractures as a significant prognostic indicator for infectious complication and emergent treatment of open tibia fractures are indicated to optimise the outcome in such injuries [11]. However, the study done by Charalambous et al in 383 patients was unable to demonstrate any significant difference in infection rates or need of secondary procedures to promote bone union, between early and delayed surgical treatment of open tibial fractures [12]. The risk of infection necessitates the emergent needs of open tibia fixation.

Conventional IM nail was used in all cases in our study population. Concurrent fibula fixation was done in 39%(n=24) cases. The role of fibula fixation in these fractures is a matter of constant debate. There have been conflicting conclusions about the benefits and need for fibula fixation in distal tibia fractures. A study done by Chengxin et al has demonstrated that additional fibular fixation was statistically associated with a decreased rate of rotation deformity (OR = 0.13; 95% CI 0.02–0.82). However, there was no difference in the rate of malreduction between the trial group and the control group (OR = 0.86; 95%)13

However, there are multiple studies which also say that even though fixation of fibula fracture may aid in better anatomical reduction and biomechanical forces at the fracture site, it may also cause a higher incidence of non-union in such cases [13,14].

Intramedullary nailing is a preferred technique in managing tibial fractures because the implant allows some load sharing, spares the extra osseous blood supply and avoids extensive soft tissue dissection [15]. The AOFAS Olerud and Molander scores are excellent tools instigating the functional outcome in our study. There was significant correlation between both the scores. Both the scores had significant correlation with the functional status of the patients and showed comparable values at 3- and 6-months post-surgery.

The incidence of implant related pain in our study was 14.75 %(n=9) and 1.67 %(n=1) of patient had undergone implant exchange. The literature gives a 16%(55) incidence of implant exit after tibia nailing in distal tibia fractures. Anterior knee pain was the most common complaint for intramedullary nailing. The rate of non-union in IM nailing is 6.55 % (n=4) in our study group. fracture was well aligned within acceptable limits during immediate postop. There was no evidence of any infection.

AOFAS score and Olerud and Molander scores shows good correlation with each other and are effective tools for functional assessment in patients with fracture of distal tibia. The values obtained from these scores after surgical fixation is comparable at the strategically chosen study points.

Conclusion

In this prospective observational study done in 61 patients with extraarticular distal tibia fracture, the following conclusions are made.

- There is a relative predominance in males among the population who sustain extraarticular distal tibia fracture.
- Most cases of extraarticular distal tibia fractures are as a result of high energy injuries
- Intramedullary nail is a viable option of fixation in distal tibia fractures and may be superior to plating in distal tibia fractures.

- The commonest complications encountered after intramedullary nailing for distal tibia includes implant related pain and non-union.
- There is no correlation between the mean delay in surgery and AOFAS score at 3 months of surgery
- AOFAS score and Olerud and Molander scores shows good correlation with each other and are effective tools for functional assessment in patients following fracture of distal tibia

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