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The functional outcome of limited open reduction and percutaneous plate osteosynthesis for distal tibial fractures

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Abstract

Introduction: In current orthopaedic practice, minimally invasive plating osteosynthesis (MIPO) and interlocking nailing are the preferred techniques for fractures of the distal third tibia. Even though intramedullary nail spares the extraosseous blood supply, allows load sharing, and avoids extensive soft tissue dissection, proximal and distal fragments of shaft fractures can be difficult to control with this technique. Traditional open plating techniques have greater instances of wound complications and hence less invasive methods of plating such as Limited Open Reduction and Percutaneous Plate Osteosynthesis (LORPO) are currently gaining recognition.

Materials and Methods: This was a prospective observational study conducted on 21 patients who were admitted with extra articular fractures of distal tibia at a tertiary care hospital and managed with Limited Open Reduction and Percutaneous Plate Osteosynthesis (LORPO). Patients were followed up at intervals of 3 weeks, 6 weeks, 12 weeks and 6 months. Outcomes were assessed by signs of local infection including redness, induration, local rise of temperature and pain. Time taken for callus formation, time for bone union- painless full weight bearing and radiological union of 3 cortices in standard AP and lateral X-rays were assessed. Pain tolerance was evaluated using Visual analogue score (VAS), functional scores using SF-36 health survey and Lower extremity functional scale (LEFS). Data was entered into Microsoft excel data sheet and analysed using SPSS 22 version software.

Results: The mean age of the patients was 45.38 ± 16.16 years. Maximum subjects i.e. 23.8% belonged to <30 age group. The study included 17 males (80.9%) and 4 females (19.04%). RTA was found to be the most common cause of injury. 20 patients (95.2%) underwent Limited open reduction and percutaneous plate osteosynthesis (LORPO) whereas 1 patient had to undergo LORPO with lag screw fixation (4.8%). 1 patient in our study returned with complications of implant failure (4.8%). 3 patients returned with valgus deformity (14.3%). Mean ankle ROM at 1 month was found to be 7.75±2.55 and 21.25±5.82 for dorsiflexion and plantar flexion respectively, while at 6 months it was found to be 20.5±4.26 and 35.25±4.13. Only 4 out of 21 patients (19%) returned with decreased ROM of ankle. As assessed by SF 36, there was found to be a progressive improvement in quality of life from the periodic assessment at 3weeks, 6 weeks, 12 weeks and 6 months. LEFS Mean score at 3 weeks was 13.05±3.07, at 6 weeks it was 26±7.99, at 12 weeks it was 54.35±8.34 and at 6 months it was 62.8±7.7.

Conclusion: LORPO is an effective method for treatment of closed, extra articular, distal tibial fractures. It yields favourable results for acute complications, union rates, functional outcomes, patient satisfaction and return to full activity on the basis of various scoring systems.

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Key words: Distal Tibia Fracture, AO/OTA Classification, Limited Open Reduction and Percutaneous Plate Osteosynthesis (LORPO), SF-36, Lower Extremity Functional Scale (LEFS)

1. Introduction

The tibia is the main weight-bearing bone in the leg, carrying greater than 80% of load. Throughout the entire leg, the fibula is posterior and lateral to the tibia, and a thick interosseus membrane connects the two bones. Compared to the tibial diaphysis, the distal and proximal metaphyseal bones are relatively weaker [1].

Tibial fractures have a bimodal distribution with low-energy spiral patterns being more common in patients over 50 years of age and high-energy transverse and comminuted fractures being more common in patients under 30 years of age. Among Medicare patients aged ≥65 years tibial fractures are almost three times more common in women than in men. However, high-energy tibial fractures in younger patients are approximately twice as common in males than females. There is no significant racial disparity [2].

Devastating injuries, such as distal tibia fractures, are frequently caused by high-energy events like falls from great heights or car accidents. Rotational injuries to the ankle may also result from low-energy causes, as is the case with these injuries. It is difficult to treat a distal tibia fracture. The optimal treatment of distal tibia fractures without articular involvement still remains a matter of controversy because of inadequate amount of soft tissue coverage, subcutaneous location and poor vascularity.

In current orthopaedic practice, Limited open reduction and percutaneous plate osteosynthesis (LORPPO) and interlocking nailing are the preferred techniques for fractures of the distal third tibia. Devastating injuries, such as distal tibia fractures, are frequently caused by high-energy events like falls from great heights or car accidents. Rotational injuries to the ankle may also result from low-energy causes, as is the case with these injuries. It is difficult to treat a distal tibia fracture [3].

In an effort to decrease the wound complications associated with traditional open plating techniques, less invasive methods of plating have been developed. Ligamentotaxis is used to initially decrease the fracture, and then small incisions are used to conduct additional reduction and plating. Open medial plating has been discovered to more severely interrupt the distal tibia's blood supply than percutaneous plating, which could increase the risk of delayed union or non-union [4].

Materials and Methods

Study Design: A Prospective, observational study.

Study Period: 1 year 6 months (18 months).

Source of Study: The data was collected from patients visiting the Department of Orthopaedics at a tertiary care centre, Bangalore.

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Method of Collection of Data

Data was collected from patients who were admitted under the Department of Orthopaedics at a tertiary care centre, Bangalore, with extra articular fractures of distal tibia. The data was collected over a period of 18 months following ethical clearance and written informed consent obtained from each patient enrolled in the study.

Selection Criteria

Inclusion Criteria

- Aged 18-65 years.
- Distal tibial diaphyseal and metaphyseal fractures.
- Left or right lower limbs.
- Surgery performed within 7 days of trauma.

Exclusion Criteria

- Open fractures.
- Patients with acute or chronic kidney diseases.
- Neurovascular complications.
- Polytrauma.
- Adjacent fractures of the ipsilateral limb.
- Bilateral lower limb fractures.
- Patients with associated head injuries.
- Smokers.
- Systemic compromise with pre anaesthetic fitness.
- Poor skin condition.
- Old fracture (>7 days).
- Limited open reduction technique converted to open reduction and internal fixation.

2. Results

This was a prospective observational study conducted on 21 patients who were admitted under the Department of Orthopaedics at a tertiary care centre, Bangalore, with extra articular fractures of distal tibia over a period of 18 months. All 21 patients with distal tibia fractures were managed with Limited Open Reduction and Percutaneous Plate Osteosynthesis (LORPPO).

Demographic Details

In our study, the mean age of the patients was 45.38 ± 16.16 years (Table 1). Maximum subjects I i.e. 5 (23.8%) belonged to <30 age group, 4 (19%) belonged to 31-40, 41-50 and 61-70 years age group. 3 belonged to 51-60 years age group and only 1 patient (4.8%) was greater than 70 years of age. This is shown in Table 2 and figure 1.

Table 1: Age of the study subjects

	N	Mean ± SD	Median (IQR)	Range
Age (yrs)	21	45.38 ± 16.16	46(32,59.5)	18-76

Table 2: Distribution of subjects based on age

Age (years)	Number (n)	Percent
<30	5	23.8
31-40	4	19
41-50	4	19
51-60	3	14.3
61-70	4	19

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>70	1	4.8
Total	21	100

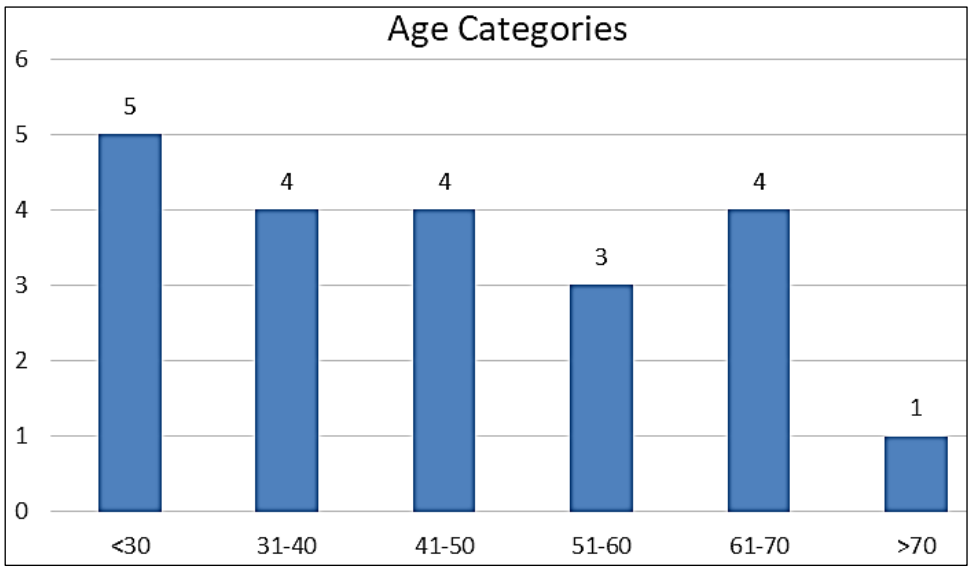

Fig 1: Distribution of subjects based on age

The study included 17 males (80.9%) and 4 females (19.04%) (Table 3 and Figure 2), indicating a male preponderance.

Table 3: Distribution of subjects based on gender

Gender	Number (n)	Percent (%)
Female	4	19
Male	17	81
Total	21	100

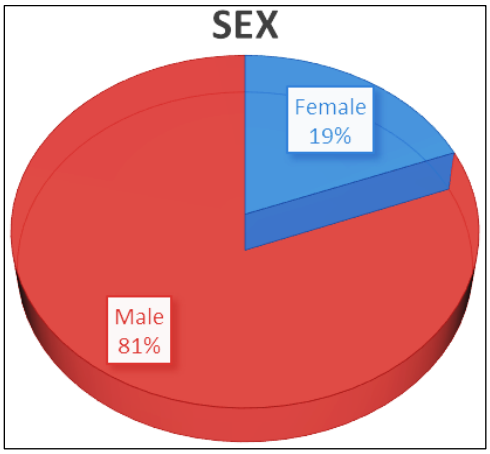

Fig 2: Distribution of subjects based on gender

3. Discussion

Surgical management of distal tibia fractures includes external and internal fixation, ORIF with plate osteosynthesis, intramedullary nails and more less invasive plating techniques such as Minimally Invasive Percutaneous Plate Osteosynthesis (MIPO) and Limited Open reduction percutaneous plate osteosynthesis (LORPPO).

We conducted a prospective observational study on 21 patients who were admitted under the Department of Orthopaedics at a tertiary care centre, Bangalore, with extra articular fractures

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of distal tibia over a period of 18 months. All 21 patients with distal tibia fractures were managed with Limited Open Reduction and Percutaneous Plate Osteosynthesis (LORPPO) and the data was analysed.

In terms of demographic details, our study had a mean age of 45.38 ± 16.16 years with maximum subjects i.e.5 (23.8%) belonged to <30 age group i.e., the younger population. 17 patients were males (80.9%) and 4 females (19.04%), indicating a male preponderance.

The most common cause of injury in our study was Road Traffic Accidents (RTA) and accounted for 71.4% of the cases. We noticed that other causes of distal tibia fracture were by a low-impact injury such as fall from stairs in 2 patients (9.5%) and self-fall in 2 patients (9.5%).

Apart from RTA, other high-impact injuries were as a result of assault in 2 patients (9.5%). A similar study by Mohammed A. *et al*., the average age was 42 years with male to female ratio of 4:1 and the most common mode of injury was RTA [6].

The duration since injury (i.e. the time interval between injury and hospital visit) was calculated for all the cases. It was 17.38 ± 5.66 hours none of our patients presented to the hospital after 24 hours or more of their injury, hence the standard deviation is acceptable in our study.

Mean ankle ROM at 1 month was found to be 7.75±2.55 and 21.25±5.82 for dorsiflexion and plantar flexion respectively, while at 6 months it was found to be 20.5±4.26 and 35.25±4.13. In a study by Im GI *et al*., mean dorsiflexion at final follow-up was 7 degrees in plating which is similar to our findings [59]. In our study, only 4 out of 21 patients (19%) returned with decreased ROM of ankle. In the remaining 80.9% of the subjects, on comparison of ankle ROM in terms of dorsiflexion as well as plantar flexion at 1 month and 6 months, there was found to be statistically significant improvement in ROM at 6 months ($p<0.001$). In a study by Mudgal Ashwani *et al*., ankle stiffness was the main complication. W *et al*. had 2 cases (16.7%) of delayed union with their study population and Sean *et al*. also reported similar incidence (19.44%) of delayed union [7]. The complications encountered in our study were implant failure in 1 patient (4.8%) and valgus deformity in 3 (14.3%). None of the patients developed infections, non-union requiring bone grafting or postoperative neuro vascular complications. No patient was lost to follow up either.

The mean VAS scores in our study showed a steady decline in values at 3 weeks, 6 weeks, 12 weeks and 6 months. Pain was assessed among the subjects of both groups using the Visual analogue score at intervals of 3, 6, 12 weeks and at 6 months. The analysis of pain scores at each of these intervals revealed good outcomes in terms of bone healing and weight bearing with statistically significant results ($p<0.001$). The p-value was <0.001 for follow-ups right from 3 weeks up to 6 months which is a clear advantage of a less invasive procedure such as LORPPO.

Summary

- This was a prospective observational study conducted on 21 patients with extra articular fractures of distal tibia.
- All 21 patients with distal tibia fractures were managed with Limited Open Reduction and Percutaneous Plate Osteosynthesis (LORPPO).
- The mean age of the patients was 45.38 ± 16.16 years.
- Maximum subjects i.e. 23.8% belonged to <30 age group.
- The study included 17 males (80.9%) and 4 females (19.04%).
- The distal tibia fracture was caused by a low-impact injury such as fall from stairs in 2 patients (9.5%), self-fall in 2 patients (9.5%) and by a high-impact injury in 17 patients i.e. 2 cases of assault (9.5%) and 15 cases of RTA (71.4%).
- RTA was found to be the most common cause of injury leading to distal tibia fractures.
- There were 11 cases of right sided fractures (52.4%) and 10 cases of left sided fractures (47.6%).
- The mean time interval between injury and surgery was 17.38 ± 5.66 days.

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- The distal tibial fractures were classified as per the AO/OTA classification into A1 (9.5%), A2 (52.4%) and A3 (38.1%).
- Of all the patients, 20 patients (95.2%) underwent Limited open reduction and percutaneous plate osteosynthesis (LORPPO) whereas 1 patient underwent LORPPO with lag screw fixation (4.8%).
- 1 patient in our study returned with complications of implant failure (4.8%).
- 3 patients returned with valgus deformity (14.3%).
- None of the patients developed infections, non-union requiring bone grafting or postoperative neuro vascular complications.

Conclusion

LORPPO is an effective method for treatment of closed, extra articular, distal tibial fractures. It yields favourable results for acute complications, union rates, functional outcomes, patient satisfaction and return to full activity based on the basis of various scoring systems.

No significant difference was observed in radiological appearance of callus formation and hence weight bearing between ORIF and LORPPO.

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