



Comparison of Intramedullary Nail Fixation and Minimally Invasive Plate Osteosynthesis in Distal Tibial Fractures in Geriatric Patients

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Introduction: Minimally invasive plate osteosynthesis (MIPO) and intramedullary nails are two accepted and effective methods in the treatment of tibial fractures. This study was aimed to evaluate the surgical treatment and complications of distal tibial fractures not related to the ankle joint with MIPO and intramedullary nails in the geriatric group retrospectively.

Materials and Methods: Between 2019 and 2020, 42 patients in the geriatric group with distal tibia fractures that did not extend to the ankle joint and who underwent surgical treatment were evaluated retrospectively. The patients were divided into two groups: those who underwent MIPO and those who underwent osteosynthesis with an intramedullary nail. Patients were evaluated according to JoVhner Wrush criteria.

Results: This study enrolled 42 patients. The mean age of the patients was 70 ± 3.4 years. 22 of these patients underwent osteosynthesis with intramedullary nailing. MIPO was performed in the treatment of 20 patients. Based on the Johner Wrush criteria, the intramedullary nail group evaluated 16 patients as very good, 5 as good, and 1 as bad. The MIPO group evaluated 15 patients as excellent, 3 as good, 1 as moderate, and 1 as poor.

Conclusion: In geriatric age groups, there was no significant difference in clinical outcomes or complications from surgical treatment of closed tibial distal fractures that do not extend to the ankle joint. Both surgical treatment methods can be applied effectively to geriatric patients.

Keywords: Fracture, Geriatric, Tibia

1. INTRODUCTION

Distal tibia fractures are commonly seen fractures and their incidence is 10-13% among all tibial fractures.^{1,2} Distal tibia fractures occur after high-energy trauma. Torsional forces are effective in the formation of distal tibia fractures. After treatment of these fractures, many complications such as malunion, delayed union, nonunion, and wound infection may occur.³

Minimally invasive plate osteosynthesis (MIPO) and intramedullary nails are two accepted and effective methods in the treatment of tibial fractures. Both treatment methods have complications. Alignment disorders and anterior knee pain are the most

common complications after osteosynthesis with intramedullary nailing. Wound complications can be seen after plate osteosynthesis.^{4,5}

The purpose of this study was to evaluate the surgical treatment and complications of distal tibial fractures not related to the ankle joint with MIPO and intramedullary nails in the geriatric group retrospectively.

2. Material Method

This study was approved by the Ethics Committee of Bahcesehir University (Decision No 2022-11/02). All patients provided informed consent. The study includes patients in the geriatric age



group who were operated on between 2019 and 2020 with a fracture of the distal part of the tibia that did not extend to the ankle joint. Inclusion criteria for the study were geriatric patients with closed distal tibia fractures that did not extend to the ankle joint and who were treated surgically and evaluated with Johner Wrush criteria in their follow-up files. 42 patients who met the criteria of the study were included in the study.⁶

2.1.Surgical technique

2.2.Fixation with intramedullary nail

Surgeries of the patients were performed under a pneumatic tourniquet, and prophylaxis was performed with 1 gram of cefazolin sodium before the surgery. With the knee flexed, longitudinal incisions were made from the midline of the patellar tendon, and the patellar tendon fibers were dissected longitudinally. The entry hole of the nail was opened from the proximal end of the tibia, and the fracture was reduced under fluoroscopy control, the guide wire was sent from the medulla, and the fracture line was passed and sent distally. Appropriate nail lengths were determined over the guide wire. The reaming was performed by sending the medullary reamers over the guide wire. After the reaming process was completed, the appropriate nail was adapted to the medulla. Fixation is completed with locking screws.

2.3.Surgical treatment of MIPO

Surgeries of the patients were performed under a pneumatic tourniquet, and prophylaxis was performed with 1 gram of cefazolin sodium before the surgery. A distal incision was made approximately 4 cm long from the distal medial of the anterior border of the tibia to fit the proximal end of the plate. The plate was retrogradely adapted from distal to proximal subperiostally. After checking the compatibility of the bone and plate under the fluoroscope. Distal and proximal

screws were locked, then the other screws were adapted to the plate through 1 cm incisions.

2.4.Post-operative period

Cefazolin sodium and low molecular weight heparin were administered prophylactically to the patients after surgery. Wound care was performed every other day and sutures were removed 15 days after surgery. Isometric quadriceps exercises were started on the first postoperative day. Exercises to provide knee and ankle joint range of motion were started. The patients were evaluated in the outpatient clinic monthly with radiography controls. The presence of callus tissue in 3 cortices was considered a union. During the follow-ups, dynamization was performed between 8 and 16 weeks in 4 patients treated with intramedullary nails. The clinical evaluations of the patients were made according to the Johner Wrush criteria at the last follow-up.

2.5.Statistical analysis

The compliance of the data to normal distribution was tested, and since they were not normally distributed, the Mann-Whitney U test, which is a non-parametric method, was used to compare numerical variables, and the Chi-square-Fisher Exact test was used for categorical data. The value of $p < 0.05$ was considered statistically significant in the 95% confidence interval.

3.RESULTS

This study enrolled 42 patients, 16 were female and 26 were male. The mean age of the patients was 70 ± 3.4 years. Patients were divided into two according to treatment intramedullary nail and MIPO group and evaluated retrospectively. 22 of these patients underwent osteosynthesis with intramedullary nailing. MIPO was performed in the treatment of 20 patients.

The mean age in the intramedullary nail group was 72 ± 3.6 , and the mean age in the MIPO group

was 68 ± 3.1 . The mean follow-up period of the patients was determined as 14.9 ± 2.1 months. According to the Johner Wrush criteria, 31 patients were evaluated as very good, 8 patients as good, 1 patient as moderate, and 2 patients as bad. In the radiological evaluation, union was detected in all but one patient who did not. The patient without union was in the intramedullary nail group and re-operated, debridement was performed for the fracture ends, autografting was performed and fixed with a plate. Union was achieved in the further follow-up of this patient. The mean radiological union time was determined as 11.9 ± 3.1 weeks.

According to Johner Wrush criteria, 16 patients were evaluated to be very good, 5 patients were good and 1 patient was bad in the intramedullary nail group. The mean radiological union time was determined to be 11.7 ± 3 weeks. Nail removal was

performed in 4 patients in advanced follow-up. A pulmonary embolism was detected in 1 patient. Superficial infection was seen in 3 patients and they were treated with antibiotics, and no additional surgical intervention was needed. (Table 1)

The union time was determined as 12.4 ± 1.9 months in the MIPO group. According to the Johner-Wrush criteria, 15 patients were evaluated as excellent, 3 patients as good, 1 patient as moderate, and 1 patient as poor. Superficial infection was detected in 4 patients and the patients were treated with antibiotics. Delayed union was detected in 2 patients.

There was no statistically significant difference between the fixation with intramedullary nail and fixation with MIPO in terms of clinical outcomes, infection rates, and union times ($p > 0.05$ for all).

Table 1.

Demographic and clinical parameters of the patients

	All patients (n: 42)	Intramedullary nail (n: 22)	MIPO (n: 20)
Mean age (years)	70 ± 3.4	72 ± 3.6	68 ± 3.1 .
Healing time (weeks)	11.9 ± 3.1	11.7 ± 3	12.4 ± 1.9
Johner Wrush criteria (very good)	31	16	15
Johner Wrush criteria (good)	8	5	3
Johner Wrush criteria (moderate)	1	0	1
Johner Wrush criteria (bed)	2	1	1

MIPO: Minimally invasive plate osteosynthesis.

**p > 0.05 for all*

4.DISCUSSION

Mioc et al. showed no statistically significant difference between the two fixation methods according to the results of intramedullary nailing and MIPO comparison in extra-articular distal tibia fractures, but it was stated that the clinical results of the group treated with MIPO were better.⁷ Daolagupu et al. compared the results of osteosynthesis with intramedullary nails and plates in extra-articular distal tibia fractures. While the mean time to union was 18.26 weeks in the group fixed with the intramedullary nail, the mean union time was determined as 21.70 weeks in the group fixed with the plate, and there was a statistically significant difference. There were fewer complications in terms of implant irritation, ankle stiffness, and infection in the group that underwent intramedullary nailing compared to the group that underwent osteosynthesis with a plate.⁸ According to the results of our study, no significant difference was found between the two techniques in terms of clinical outcomes and complications.

A retrospective comparison of patients with extra-articular distal tibia fractures and those who underwent MIPO fixation and intramedullary nailing were compared. As a result of the study, it was determined that the union time was earlier, the complication rates were lower, and the functional results were better in patients who were fixed with intramedullary nails compared to the MIPO group.⁹ As a result of a meta-analysis that evaluated studies with large series, it is stated that intramedullary nail fixation has fewer postoperative complications and may result in faster recovery compared to plate fixation.¹⁰ According to the results of our study, no significant difference was found in terms of union times and complications in both methods.

Skin entrapment is an important problem in distal tibial fractures treated surgically with MIPO, and

when such complications occur, plate extraction can be performed after a union is detected.¹¹ In our follow-ups, no complications related to the entrapment of the skin were detected in the group that underwent osteosynthesis with MIPO, and therefore plate extraction was not performed. The fact that the patients in the group included in our study were a geriatric group and their skin elasticity was high and this may be the reason that there was no skin entrapment complication.

In extra-articular distal tibia fractures after fixation with an intramedullary nail, it causes minimal alignment changes when weight-bearing is applied in the early period and is a reliable method for patients.¹² In the study, early weight bearing was allowed in patients who were fixed with intramedullary nails, and there was no need for surgical treatment secondary to malalignment in follow-ups.

The proximity of tibial intramedullary nail distal locking screw holes to anterior tibial artery variations carries a risk of iatrogenic vascular injury during distal locking. Coronal locking screws carry the greatest risk of iatrogenic injury for laterally located anterior tibial artery variation.¹³ We did not detect any anterior tibial artery iatrogenic injury while distal locking was performed during fixation with an intramedullary nail.

Alignment disorders in distal tibia fractures fixed with intramedullary nails may cause limitations in knee and ankle functions. It has been reported that fracture fixation stability is better and malalignment rates are lower after reaming intramedullary nailing and multi-planed distal locking.¹⁴ In our study, reamed nails were used in all surgeries performed using intramedullary nails, and distal locking was multiplanned. We did not detect any malalignment in geriatric patients.

It has been reported that the probability of malunion in tibial distal end fractures with surgical fixation with MIPO is lower than in patients with intramedullary nail fixation.¹⁵ Malunions, which are likely to cause functional problems, require surgical treatment again. In another study, high malrotation rates were found in tibial metaphyseal-diaphyseal fractures treated with the MIPO technique, but it was determined that this finding did not have a significant negative effect on knee and ankle joint functions.¹⁶ No malunion was detected that would require reoperation after the follow-up of the patients treated with both fixation methods. Re-surgery in geriatric patients makes surgical fixation with MIPO superior because it is likely to cause problems in the general condition of the patients, but it is not compatible with the results of this study.

Song et al. mentioned that MIPO would be associated with better functional results and fewer complications.¹⁷ No significant difference was found between complications and functional outcomes in both groups as a result of this study.

Jain et al. detected soft tissue problems in 10 patients at a rate of 22% among 45 patients treated with MIPO.¹⁸ Lau et al. detected late infection in 7 patients among 48 patients treated with MIPO.¹⁹ There was no statistically significant difference between superficial tissue infections of both groups. As a result of this study soft tissue problems are not a disadvantage of fixation with MIPO.

As a result of a study that compared intramedullary nailing and MIPO technique in open tibial fractures, it was determined that the MIPO technique has the same safety as intramedullary nail fixation technique in the treatment of Gustilo-Anderson type I, II, and III-A open tibial shaft fractures.²⁰ Since open fractures were not included in this

study inclusion criteria of the study is limited in determining the effectiveness of both fixation methods on open fractures.

It has been reported that during surgery of the distal tibia with intramedullary nails are exposed to significantly more radiation than those treated with MIPO.²¹ Fluoroscope was used during the surgeries, but the lack of dose measurements limits our study.

5.CONCLUSION

There was no significant difference in clinical outcomes and complications of surgical treatment of closed tibial distal fractures that do not extend to the ankle joint in geriatric age groups with intramedullary nailing and the MIPO method.

Ethics Committee Approval

This study was approved by the Ethics Committee of Bahçeşehir University with decision number 2022-11/02. It is conducted in accordance with the principles of the Helsinki declaration. Informed consent was obtained from patients.

Conflict of Interest

The authors declare that they have no conflict of interest.

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