

Comparison of intramedullary nail and plate fixation in distal tibia diaphyseal fractures close to the mortise

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ABSTRACT

BACKGROUND: In this study, we aimed to compare the functional and radiological results of intramedullary nailing and plate fixation techniques in the surgical treatment of distal tibia diaphyseal fractures close to the ankle joint.

METHODS: Between 2005 and 2011, 55 patients (32 males, 23 females; mean age 42 years; range 15 to 72 years) who were treated with intramedullary nailing (21 patients) or plate fixation (34 patients) due to distal tibia diaphyseal fracture were included in the study. The average follow-up period was 27.6 months (range, 12-82 months). The patients were evaluated with regard to nonunion, malunion, infection, and implant irritation. The AOFAS (American Orthopaedic Foot and Ankle Society) scale was used for the clinical evaluation.

RESULTS: No statistically significant difference was found between the two surgical methods with respect to unification time, AOFAS score, accompanying fibula fracture, material irritation, and malunion. Nine patients had open fractures, and these patients were treated with plate fixation ($p=0.100$). Nonunion developed in three patients who were treated with plates. Infection occurred in one patient. Anterior knee pain was significantly higher in patients who were treated with intramedullary nails. There was no malunion in any patient.

CONCLUSION: As the distal fragment is not long enough, plate fixation technique is usually preferred in the treatment of distal tibia diaphyseal fractures. In this study, we observed that if the surgical guidelines are followed carefully, intramedullary nailing is an appropriate technique in this kind of fracture. The malunion rates are not significantly increased, and it also has the advantages of being a minimally invasive surgery with fewer wound problems.

Key words: AOFAS; distal tibia fracture; intramedullary nail; plate.

INTRODUCTION

Surgical treatment of displaced distal tibia fractures provides appropriate alignment and stability as well as protection of bone and surrounding soft tissues. It also allows early mobilization of nearby joints. Intramedullary nailing and plate fixation have been accepted as two effective options in the surgical treatment. Intramedullary nailing has been accepted as the standard treatment in displaced tibia shaft fractures. However, it is difficult to achieve alignment with intramedullary fixation in proximal and distal shaft fractures, which leads to increasing rates of malalignment.^[1-3] There are also publi-

cations reporting higher rates of anterior knee pain occurring after nailing.^[4-6] Although plate fixation is preferred more in distal tibia fractures close to the joint, infection, wound problems and implant-related problems are more common in patients treated with plate.^[1,2,7,8]

In this study, we aimed to compare the functional and radiographic results of distal tibia shaft fractures treated with plate fixation or intramedullary nail.

MATERIALS AND METHODS

Fifty-five patients (32 males, 23 females) who presented to our hospital with distal tibia shaft fractures and underwent surgical treatment were evaluated retrospectively between 2005 and 2011. The mean follow-up period was 27.6 months (range, 12-82 months). The mean age of the patients was 42 years (range, 15-72 years). Twenty-one (38%) patients were treated with intramedullary nailing technique and 34 (62%) were treated with plate fixation. Orthopaedic Trauma Association (OTA) staging was performed before the surgery in all patients. Patients were evaluated with respect to age, time to surgery, fracture type, sagittal and coronal alignment, AO-

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FAS hindfoot-ankle score, infection, anterior knee pain, and implant problems. Patients with fractures in the proximal metaphyseal tibia, distal tibia fractures extending into the joint line, knee ligament injury, fractures with soft tissue coverage, fractures with vascular injury, and pathological fractures were excluded from the study.

A transpatellar approach was preferred for intramedullary nailing. After intramedullary reaming, a nail of appropriate diameter was used. Open reduction was not applied in any of the patients. As the fracture was too distal, two parallel locking screws were inserted in the distal side of the nail. A medial longitudinal approach was used on the medial malleolus for plate fixation. Stainless steel or titanium plates were implanted. Intravenous antibiotic prophylaxis was used pre- and postoperatively for three days, and first-generation cephalosporin was preferred.

The measurements were taken from radiographs obtained in the pre-operative, early postoperative and the last follow-up periods. The distance from the distal-most point of the fracture line to the ankle joint was measured in millimeters. The fracture was accepted as unified if unification was observed in at least three planes. If unification was not observed at the end of the sixth month, it was accepted as non-union. The criteria for malunion were angulation of more than 5° and translation of more than 5 millimeters.

The American Orthopedic Foot and Ankle Society (AOFAS) foot and ankle scoring system was used to evaluate the clinical results related with the ankle joint.

Statistical analysis was made using a computer software program, the Statistical Package for the Social Sciences (SPSS) ver. 13. For parametric measurements, Mann-Whitney U test was used, and for non-parametric measurements, chi-square test was used. A value of $p < 0.05$ was accepted to indicate statistical significance.

RESULTS

Fifty-five patients with distal tibia fractures who were treated with intramedullary nailing or plate fixation were evaluated. The mean age was 42 years (range, 15-72 years). According to the OTA classification, 33 (60%) patients were classified as 42-A1, 11 (20%) as 42-A2 and 11 (20%) as 42-A3. The patient groups were homogeneous with regard to age, gender and fracture classification.

Nine of the patients had an open fracture. According to Gustilo-Anderson classification, 7 patients were type 1 and 2 patients were type 2; none of the patients was type 3. Six of the patients were treated by plate fixation and three by intramedullary nailing.

The mean distance between the joint and fracture line was 72.9 mm (range, 42-89 mm) in the patients treated by intramedullary nailing and 56.5 mm (range 33-90 mm) in the patients treated by plate fixation. The two groups were considered statistically homogeneous ($p=0.188$).

The mean time to surgery was 4.5 days (range, 1-15 days) in the patients treated by intramedullary nailing and 4.8 days

Table 1. Demographic data of the patients

	Nail		Plate		Total	
	N	%	N	%	N	%
Male	13	23.6	19	34.6	32	58.2
Female	8	14.5	15	27.3	23	41.8
Age (range)	38	17-67	44	15-72	42	15-72
Follow-up (months)	27	12-82	27.9	12-78	27.6	12-82
OTA classification						
42-A	18	32.8	29	52.8	47	85.6
42-B	2	3.6	3	5.4	5	9
42-C	1	1.8	2	3.6	3	5.4
Mean distance to mortise (mm) (range)	72.9	42-89	56.5	33-90	62.7	33-90
Open fracture	3	5.4	6	10.8	9	16.2
Fibula fracture	14	25.4	26	47.3	40	72.7
Fibula fixation	3	5.4	12	21.8	15	27.2
Time to operation (day)	4.5	1-15	4.8	1-17	4.7	1-17

OTA: Orthopaedic Trauma Association.

Table 2. Findings at the final follow-up and the statistical comparison

	Nail	Plate	Total	p
Union time (months)	4.9	5.5	5.3	0.894
AOFAS	88.3 (71-96)	88.1 (55-100)	88.2 (55-100)	0.794
Infection	0	3 (%5.4)	3 (%5.4)	0.100
Nonunion	0	3 (%5.4)	3 (%5.4)	0.100
Malunion (Degree)				
Valgus	0.84 (0-3.8)	1.67 (0-8.3)	1.36 (0-8.3)	0.484
Varus	1 (0-4.2)	1.31 (0-8)	1.19 (0-8)	0.977
Recurvatum	0.7 (0-6.7)	1.13 (0-10)	0.97 (0-10)	0.450
Procurvatum	0.71 (0-5)	0.84 (0-5.6)	0.79 (0-5.6)	0.846
Material irritation	7 (%12.7)	14 (%25.4)	21 (%38.1)	0.211
Anterior knee pain	14 (%25.4)	0	14 (%25.4)	0.001

(range, 1-17 days) in those treated by plate fixation, and there was no significant difference between the groups ($p=0.760$). The mean union time was 5.3 months (2-12 months) for all patients, 4.9 months for the intramedullary nailing group, and 5.5 months for the plate fixation group, and there was no significant difference between the groups ($p=0.894$).

The AOFAS scoring system was used to evaluate ankle arthritis. The mean AOFAS score was 87.8 (range, 55-100). It was 88.3 (range, 71-96) in patients treated by intramedullary nailing and 87.5 (range, 59-100) in patients treated by plate fixation, and there was no significant difference between the groups ($p=0.794$). Forty of the patients had an accompanying fibula fracture. In 15 of them, the fibular fracture was fixed surgically. Three of them were in the intramedullary nailing group and 12 were in the plate fixation group. There was no significant difference between the patients who did or did not undergo fibular fixation with regard to AOFAS scores ($p=0.800$). Fibular fixation was applied more often in the

plate fixation group. In one patient, deep venous thromboembolism developed three months after the treatment. In four patients, unification delay occurred, and they were treated with open reduction and plate fixation ($p=0.010$). In one, autografting derived from the iliac crest was performed, and unification was observed one year later.

Closed reduction was performed in all patients treated by intramedullary nailing, and open reduction was required in nine of the patients treated by plate fixation. In three of them, there was a delay in unification. One developed infection, considered to be nosocomial. As debridement was performed but deemed insufficient, the implants were extracted, and external fixation was performed. At the end of the 20th postoperative month, the infection persisted. Two other patients had an AOFAS score of 76.5 and are able to walk with support. Although nonunion was observed radiologically, the patients refused surgery.

Malunion was determined in 13 patients. Two of them were treated by intramedullary nailing and 11 by plate fixation. None of the patients demonstrated malunion with more than 10° angulation. Four patients had valgus and three patients varus deformity, and all of them were in the plate fixation group ($p=0.484$; $p=0.977$). Four patients had recurvatum deformity. One of them was treated by intramedullary nailing and three by plate fixation ($p=0.450$). Three patients had procurvatum deformity. One of these patients was treated by intramedullary nailing and two by plate fixation (0.846). One patient had multiplanar deformity and was treated by plate fixation because it was an isolated tibia fracture.



Figure 1. (a) Preoperative radiographs of a 35-year-old male patient with right distal diaphyseal tibia fracture extending to the metaphysis, resulting from a fall. (b) Radiographs of the patient in the first year of follow-up, after intramedullary nailing.

In 21 patients, the implants were extracted. Seven of these were intramedullary nails and 14 were plates and screws. One of the extractions was performed due to infection. Ten of the patients who were treated by intramedullary nailing had anterior knee pain. Implant irritation occurred in three of the patients treated by plate fixation.

DISCUSSION

Tibial fractures are seen often, and successful results may be achieved with various surgical techniques.^[1-3,9] Distal tibia fractures are much more problematic because of the surrounding soft tissues being thinner than the proximal tissues and the poor vascularization.^[9-13] Furthermore, in these patients, knee and ankle pain is observed more.^[4,5] Our aim was to compare the results of intramedullary nailing and plate fixation techniques in the treatment of distal tibia fractures close to the joint.

In the previous studies, it was reported that 47.4% of the patients treated by intramedullary nailing had anterior knee pain.^[4,5,14,15] As the etiology is not obviously clear, it is suggested that anterior knee pain may be due to patellar tendon and retropatellar fat pad damage. On the contrary, in another study comparing the parapatellar approach and the transtendinous approach, no difference with regard to anterior knee pain was reported.^[18] We used a transpatellar approach in all our patients. In our study, anterior knee pain was in acceptable limits according to the literature, and pain did not affect life or working quality in any of our patients. We suggest that protection of the patellar tendon, appropriate nail length, and correct nail entry point were essential for decreasing the complaints.

Three patients who were treated by plate fixation had AOFAS scores of ≤ 70 . In the literature, the requirement for secondary surgery in patients treated by plate fixation was reported as 20%, whereas this ratio was reported as 42% in patients treated by intramedullary nailing. In our study, three of our patients required secondary surgery. All of them were in the plate fixation group and had been treated with open reduction. When the results were evaluated, our study also verifies that protecting surrounding soft tissues and ensuring vascularization of the fracture site decrease both the infection risk and the need for secondary surgery.^[27,29]

Malalignment, which may occur after the treatment of fractures in close proximity to joints, may present with pain in the early postoperative period, and then as arthritis in the late phase because it disrupts the weight distribution of the joint. In patients with more than 5° of malalignment, it is observed that the complaints and degeneration in the ankle are increased,^[30] and this is suggested to be the result of increased contact at any point of the ankle joint.^[30-33] We used the AOFAS scale in order to clinically evaluate the consistent ankle pain and early osteoarthritis in our cases. When the scores of the intramedullary nailing and plate fixation groups

were compared, a statistical significance was found, and the results were good or perfect. When the above-mentioned results were evaluated, it was determined that malalignment up to 10° may be tolerated by the patients, and there was no significant radiological difference between the groups.

Surgical reduction of a fibular fracture accompanying a distal tibia fracture is a related subject. Fibular fixation must be done if syndesmosis tear is present,^[1,34] and it is suggested that it may facilitate indirect reduction of the tibia fracture. However, in some studies,^[3,34,35] fibular fixation is said to delay bone healing. We did not use fibular fixation except for displaced distal fibular fractures, which may cause valgus deformity. Whether fibular fixation was done or not, no significant difference was found with regard to bone healing, valgus deformity and AOFAS scores.

When the radiological and functional results were compared in the intramedullary nailing and plate fixation groups, both groups were found to have satisfying results. Evaluation of cost efficiency showed us that, as costs may differ between countries, intramedullary nailing was approximately 30% (range, 0-80%) less expensive. We think that intramedullary nailing instead of minimally invasive plate fixation, in some patients and with proper indication, may be useful in reducing health expenses.

Our study shows that intramedullary nailing in distal tibia diaphyseal fractures close to the ankle joint has no negative effect on malalignment and stability, and it also ensures more minimally invasive surgery, results in fewer wound problems, aids in earlier mobilization, and is more economical. We thus believe that intramedullary nailing should be considered in the treatment of this kind of fracture.

Conflict of interest: None declared.

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KLİNİK ÇALIŞMA - ÖZET

Mortise yakın distal tibia diafiz kırıklarının tedavisinde intramedüller çivi ve plak tedavisinin karşılaştırılması

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AMAÇ: Bu çalışmada ayak bileği eklemine (mortis) yakın distal tibia diafiz kırıklarının tedavisinde intramedüller çivi veya plak tedavisinin fonksiyonel ve radyolojik sonuçlarını karşılaştırmayı amaçladık.

GEREÇ VE YÖNTEM: 2005-2011 yılları arasında intramedüller çivi (21 hasta) veya plak (34 hasta) ile tedavi edilen 55 hasta (32 erkek, 23 kadın; ortalama yaş 42; dağılım 15-72 yıl) çalışmaya alındı. Ortalama takip süresi 27.6 ay (dağılım 12-82 ay) idi. Hastalar kaynamama (nonunion), yanlış kaynama (malunion), enfeksiyon, implant irritasyonu ve klinik açıdan AOFAS (American Orthopaedic Foot and Ankle Society) skoru ile değerlendirildi.

BULGULAR: Kırığın eklem uzaklığı, kaynama zamanı, AOFAS skoru, ilave fibula kırığı, malunion, materyal irritasyonu açısından istatistiksel fark gözlenmedi. Hastaların dokuz tanesinde açık kırık mevcuttu ve bu hastalar plak ile tedavi edilmişti (p=0.100). Plak ile tedavi edilen üç hastada kaynamama gelişti. Bir hastada enfeksiyon gelişti. Diz önu ağrısı çivi yapılan hastalarda istatistiksel olarak fazla idi. <10° malunion gelişen hastamız yoktu. Çivi veya plak uygulanan hastalar arasında minimal malunion (13 hasta) açısından karşılaştırıldığında fark yoktu.

TARTIŞMA: Distal tibia diafiz kırıklarının tedavisinde distal parça kısa olduğu için genellikle plak tercih edilmektedir. Çalışmamızda cerrahi kurallara dikkat edildiğinde çivi tedavisinin malunionu artırmadığı bununla birlikte kapalı cerrahi ve daha az yara yeri problemi nedeniyle avantajları olduğunu gördük.

Anahtar sözcükler: AOFAS; çivi; distal tibia kırığı; plak; sonuçlar.

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