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The study of Treatment of distal tibial fractures: plate versus nail in Shyam shah medical college Rewa MP

[1]Dr. Chiranjib Mishra, [2]Dr. Jayant Kothale, [3]Dr. Anubhav Shukla, [4]Dr. Priyesh Nayak, [5]Dr. P K Lakhtakia

[3,4]Junior Resident, [,1,2]Senior Resident, [5]Head of Department, Department of Orthopaedics, Shyam Shah Medical College, Rewa, Madhya Pradesh, India

Corresponding author :Dr. Priyesh Nayak
Junior Resident, Department of Orthopaedics, Shyam Shah Medical College, Rewa, Madhya Pradesh, India

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Abstract

A study of 24 patients who sustained an extraarticular fracture of the distal third of the tibial shaft was performed to determine the effect of the type of treatment, open reduction and internal fixation (ORIF) or closed reduction and intramedullary (IM) nailing, on the occurrence of malalignment. All patients were treated in shyam shah medical college rewa department of orthopaedics 2021 and 2022 for a fracture in the distal third of the tibia. Twelve patients treated with ORIF were matched to 12 patients treated with IM nailing, with regard to gender, age decade, and the AO classification of the fracture. The group treated with IM nailing was assessed after a mean 6.0 years versus ORIF after a mean of 4.5 years. Two patients treated with ORIF versus six patients treated with IM nailing had a malalignment of the tibia. Furthermore, we found no difference with regard to time to union, non-union, hardware failure or deep infections between ORIF and IM nailing. Our results suggest that control of alignment is difficult with IM nailing of distal tibial fractures. For optimal alignment we advise considering the use of ORIF for closed and type I open extra-articular fractures in the distal third of the tibia.

Introduction

Fractures of the tibial shaft traditionally have been treated with closed reduction and a cast. Since the late 1950s, open reduction and internal fixation (ORIF) was reserved for situations in which an adequate reduction could not be obtained or maintained by conservative means. ORIF often necessitates extensive dissection and tissue devitalisation, creating an environment less favourable for fracture union and more prone to bone infection. As a result, other, less invasive methods were developed to treat diaphyseal fractures of the tibia. The most successful, closed intramedullary (IM) nailing, has been associated with shorter time to union and a shorter period of disability
before working compared with closed reduction and fixation with a cast [1, 5, 10]. IM nails have been greatly improved in recent years and indications for their use have been extended to fractures closer to the ankle joint [12, 14]. The purpose of this retrospective study was to compare the radiographic and clinical results of patients with unstable extra-articular unilateral closed or type I (Gustillo and Anderson) open fractures of the distal third of the tibial shaft, treated with ORIF with those treated with closed reduction and IM nailing. We

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postulated that ORIF leads to less malalignment, the same time to union, the same functional outcome, and no increase in complications versus IM nailing

Materials and methods

From January 2021 to dec. 2022, 24 patients with a fracture of the tibia with or without fibula fracture received operative treatment at the departments of orthopaedic and general surgery of the Shyam shah medical college Rewa MP.

The criteria for inclusion

In the study were being aged at least 18 years at the time of diagnosis and having a closed or type I open fracture of the distal third of the tibial diaphysis.

Exclusion criteria

Were earlier fractures of the tibial shaft on the same side, proximal intraarticular or distal intra-articular fractures of the tibia, fractures within 6 cm of the ankle joint, and temporary treatment with an external fixator. Trauma radiographs were used to determine the location and AO classification of the fractures in the selected patients. One hundred and twelve patients met our inclusion criteria. All patients received treatment with ORIF or IM nailing depending on the surgeon's choice. Twenty were treated with ORIF and 92 with IM nailing. Of the patients treated with ORIF, 8 patients were lost to follow-up for various reasons. The remaining 12 patients treated with ORIF were matched to 12 patients treated with IM nailing on the basis of gender, age decade, and the AO classification of the fracture. Eventually, 12 matched pairs of patients were assessed from January 2021 to dec. 2022 (Table 1).

Table 1

Characteristics of the 12 matched pairs of patients. *ORIF* open reduction and internal fixation, *IM* intramedullary

ORIF				IM nailing			
Case	Gender/age (years)	AO class 42 A/B/C	Follow-up (years)	Case	Gender/age (years)	AO class 42 A/B/C	Follow-up (years)
1A	Female, 84	A2	2	1B	Female, 75	A2	9.5
2A	Female, 58	A1	2	2B	Female, 51	A1	7
3A	Female, 53	A1	4	3B	Female, 52	A1	5
4A	Female, 42	A1	4	4B	Female, 41	A2	8
5A	Female, 39	A3	3.5	5B	Female, 31	A2	9
6A	Female, 35	B2	6	6B	Female, 25	B2	3
7A	Male, 38	A1	2	7B	Male, 37	A2	3.5
8A	Male, 34	A1	2	8B	Male, 33	A1	3
9A	Male, 25	A3	6	9B	Male, 26	A3	5
10A	Male, 39	A3	7	10B	Male, 38	A3	5
11A	Male, 37	A1	7.5	11B	Male, 37	A2	8
12A	Male, 36	A1	8.5	12B	Male, 43	A1	6

All patients but 2 had a fracture of the tibia and the fibula. In each group 1 patient had an isolated fracture of the tibial shaft. All fibula fractures were left unfixed. In 7 of the 12 patients managed with closed reduction and IM nailing the nail was inserted after reaming. In all patients the static locking mode was used, with 2 proximal and 2 distal locking screws. All 12 patients managed with ORIF were treated with a dynamic compression plate and screws. The size and shape of the plate depended on the comminution and classification of the fracture. In most patients 1 or more lag screws were used to optimise contact between the fracture parts. All operations were performed by attending staff with the assistance of residents. There was no protocol for routine follow-up of the patients. In general, patients were seen 2 weeks after the operation and every 6 weeks thereafter. Hardware was removed

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only when patients experienced pain or irritation. Radiographs were used to determine the time to union of the fractures. Radiographic union was defined as the presence of bridging callus in 3 of the 4 cortices as seen on anteroposterior and lateral radiographs. There was no standardisation of the radiographs. Delayed union was defined as radiographic union after >24 weeks. At follow-up all patients were interviewed according to protocol and examined by the first author. Each patient completed a short version of the Knee Society Rating [7], with exclusion of the alignment criteria. Alignment was determined radiographically.

The patients graded anterior knee pain during kneeling and squatting on a 100-mm visual analog scale (VAS), with 0 denoting no pain and 100 denoting the worst pain that the patient could imagine. Active range of motion of the ankle and the knee were assessed clinically. Rotational alignment was assessed clinically by recording the position of the patient's feet. Patients were asked to sit on the examining table with their patellae pointing forward and to relax their feet. Then a model (a disc for marking the position of the feet) was placed under their feet to record the rotation difference. For alignment measurement anteroposterior and lateral radiographs were made from both legs. All radiographs were assessed digitally. The length of the tibia was defined as the distance between the anterior intercondylar area and the inferior articular surface of the tibia. Shortening was defined as a left/right difference in the length of the tibia of >1 cm. Malalignment was defined as >5° ante-/ recurvation, >5° varus/valgus deformity or >15° rotation difference. First, the angle between the distal part and the proximal part of the contralateral tibia was determined by measuring the angle between the line through the centre of the tibial plateau down the middle of the proximal shaft, and the line from the centre of the ankle up the middle of the distal shaft. Thereafter, the angle between the distal part and the proximal part of the consolidated tibia was measured. This was done in two directions, on anteroposterior and lateral radiographs. The difference between these angles, measured digitally with Impax 4.1 software, was considered to be ante-/recurvation and varus/valgus malalignment. Patients with a clinical rotation difference of >15° and a clear rotation difference as assessed on the radiographs by a senior orthopaedic trauma surgeon were considered to have rotational malalignment. The surgeon was blinded for patient information.

Statistical analyses were performed in SPSS with use of the paired t test to compare differences between the two groups with regard to the time to union, time to weightbearing, the Knee Society Rating score, the VAS scores on kneeling and squatting (to assess anterior knee pain), the time patients were unable to work, the hospital stay, and the operating time. McNemar's test was used to compare the difference in malalignment between the two groups. For all tests significance was defined as $p<0.05$.

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Results

Table 2

Comparison of the main results for the 12 matched pairs of patients. *R* >15° rotation, *VV* >5° varus/valgus, *AR* >5° ante-/recurvation

ORIF IM				Nailing			
Patients	Time to union (weeks)	Malalignment (°)	Anterior knee pain VAS (mm)	Case	Time to union (weeks)	Malalignment (°)	Anterior knee pain VAS (mm)
1A	15		0	1B	14	R	0
2A	14		0	2B	19	R	100
3A	14	R	0	3B	23		100
4A	16		50	4B	13		80
5A	32		0	5B	23	VV	0
6A	17		0	6B	22	AR	0
7A	18		0	7B	28	VV; AR	34
8A	25		0	8B	22		44
9A	21		0	9B	25		67
10A	21		8	10B	20		21
11A	18	R	25	11B	21		0
12A	21		0	12B	27	R	72

The results are presented in Table 2. The group treated with IM nailing was assessed at a mean time of 6.0 years (range 2.9–9.4 years) versus ORIF at a mean time of 4.5 years (range 1.7–8.5 years). Patients stayed in the hospital for an average of 10 days (mean: ORIF 9.5 days [range 4–15], IM nailing 9.8 days [range 4 to 20]). Operative management of a distal tibial fracture with ORIF took a mean total operation time (inclusive anaesthesia) of 107 min (range 60–195) and operative management with IM nailing took a mean time of 123 min (range 75–195; p=0.072). One patient who was treated with an IM nail had a broken screw. The mean time to radiographic union was 19 weeks (range 14–32 weeks) for the ORIF group versus 21 weeks (range 13–28 weeks) for the IM nailing group (p=0.44). Delayed union occurred in 2 patients (16.7%) managed with ORIF and in 3 patients (25%) who had IM nailing. There was no significant difference in time to weightbearing. (ORIF 3.8 versus IM nailing 3.3 months; p=0.14). Each group returned to work after a mean time of 6 months (ORIF 5.5 versus IM nailing 6.3 months; p=0.62). After fracture union, each group was able to practice sportsevenly well. Furthermore, each group received approximately the same mean number of physiotherapy treatments (ORIF 16 versus IM nailing 19). There were 6 smokers in each group. In each group 1 patient required a fasciotomy for a compartment syndrome. Both the ORIF and the IM nailing groups had good mean Knee Society Rating scores, 146 and 139 points respectively (maximum 150 points). The first score on Anterior Knee Pain (pain during kneeling) was significantly higher after IM nailing than after ORIF (mean 43 [range 0– 100] versus 7 [range 0–50]; p>0.05). The second score with regard to Anterior Knee Pain (pain during squatting) was also higher after IM nailing than it was after ORIF (mean 29 [range 0–95] compared with 9 [range 0–50]; p=0.14). None of the patients in the ORIF group and 1 patient in the IM nailing group had a knee flexion difference of >10°. Three patients (25%) in each group had an ankle dorsiflexion difference of >10°. There were no patients in either group who had shortening of >1 cm. None of the patients had varus/valgus malalignment of >5° after ORIF versus 2 (16.7%) after IM nailing and none had ante-/recurvatum malalignment of >5° after ORIF versus 2 (16.7%) after IM nailing. No patients in either group had >10° varus/valgus or ante-/recurvatum malalignment. Two (16.7%) patients had rotational malalignment of >15° after ORIF versus 3 (25%) after IM nailing. In the IM nailing group 11 of the 12 patients had the nail removed. In the ORIF group 9 of the 12 patients had the plate removed. Almost all these patients mentioned that they had the osteosynthesis material removed because they “felt” it was there or that they hoped that removal of the nail would relieve anterior knee pain. There were two

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complications in the ORIF group. One patient developed a superficial wound infection after the removal of the plate, which was successfully treated with antibiotics. One patient had persistent peroneal nerve palsy as a result of the fasciotomy. One patient had paralysis of the extensor hallucis longus muscle, which caused clawing of the foot. This was not considered to be a complication of the operation, but a consequence of the trauma that caused the fracture. In the IM nailing group there were four complications. One patient had an interposition of the flexor hallucis lingus tendon in the fracture, which necessitated a second operation to resolve the impingement. In 2 patients an extra fracture fragment developed during the introduction of the nail (iatrogenic comminution). In one of these patients it was still possible to achieve acceptable alignment of the tibia. In the other patient the fracture fragment dislocated in the hours following the operation and had to be revised to restore the alignment of the tibia. This patient developed a low-grade infection round a locking screw that was treated with antibiotics and healed successfully. Finally, 1 patient had a hyperaesthesia of the medial foot sole, because of peroperative damage to the medial plantar tibial nerve.

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Figure 1 A 38-year-old man sustained a closed distal tibial metaphyseal fracture from a soccer injury. Closed reduction and intramedullary nailing was performed. At first sight there is a small valgus deformity. When measured digitally with the opposite tibia as a template there is a valgus angulation of 10°. The screw part is still in situ after screw breakage

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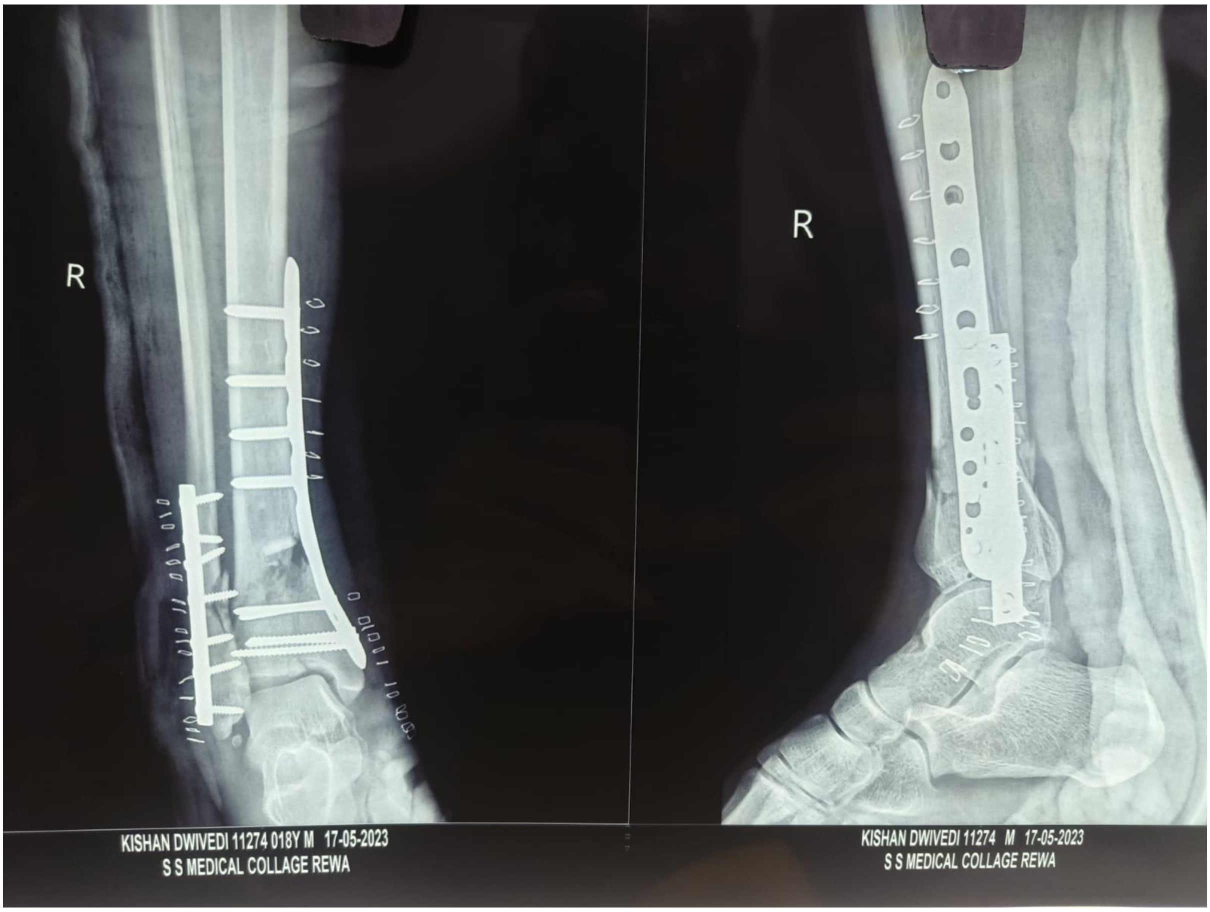

Discussion

The retrospective design of this study has some limitations. Selection bias is introduced by the fact that the surgeon decided which operative treatment was performed. Some of the bias was eliminated by the matching of patients. To maintain a sufficient number of patients, matching only included gender, age decade, and AO classification of the fracture. We found a higher percentage of malalignment after IM nailing than after ORIF. Duda et al. [3, 4] confirmed that biomechanical conditions in unreamed IM nailing of distal Fig. 1 A 38-year-old man sustained a closed distal tibial metaphyseal fracture from a soccer injury. Closed reduction and intramedullary nailing was performed. At first sight there is a small valgus deformity. When measured digitally with the opposite tibia as a template there is a valgus angulation of 10°. The screw part is still in situ after screw breakage 712 International Orthopaedics (SICOT) (2007) 31:709–714 tibial fractures are unfavourable, because of a large axial to shear strain ratio between the bone fragments. The use of locking screws is reported to prevent angular instability and/or malunion in these distal fractures [11]. In a prospective randomised trial Im et al. concluded recently that ORIF can restore alignment better than IM nailing [6]. They treated 64 consecutive distal tibial fractures with ORIF or IM nailing. They found an average angulation of 0.9° after ORIF versus 2.8° after IM nailing (p=0.01). Unfortunately, there is no description of the angulation measurements. Varus and valgus malalignment is usually determined by measuring the angle between the centre of the knee down the middle of the proximal shaft, and proximally from the centre of the ankle up the middle of the distal shaft. The slightly S-shaped tibial shaft in many normal individuals means that the mechanical axis of the tibia rarely passes down the middle of the medullary canal; this makes the conventional method of measuring the angulation of malunion potentially unreliable. We used the method of Milner, which avoids this problem by using a radiograph of the opposite tibia as a template [13]. Possibly, Im et al. would have found a

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larger angulation difference if they had used this method (Fig. 1). Im et al. did not assess rotational malalignment, although malrotation may cause functional deficits [9]. We assessed rotational malalignment clinically and radiographically. To minimise measurement bias we defined malalignment as a >15° clinically measured rotation difference. It remains difficult to assess rotational alignment clinically as well as radiographically. In the literature computer tomography (CT) is mentioned as the method of choice for determining rotational malalignment, because of its supposed reliability and reproducibility [17]. Unlike the clinical or radiographic evaluation for malalignment, the position of the patient does not influence the accuracy of CT measurement of malalignment. Nevertheless, Jaarsma et al. showed that even CT measurement of malalignment, after IM nailing of femoral fractures, is inaccurate [8]. We found malalignment in 2 of the 12 patients (17%) treated with ORIF and in 6 of the 12 patients (50%) treated with IM nailing (p=0.1). Malalignment can lead to complaints from the patient with regard to walking, practicing sports and so forth. Puno et al. evaluated 27 patients with 28 tibial fractures at an average of 8.2 years (range 6.0–12.3 years). They found a correlation between joint malalignment and clinical outcome for fractures of the tibia. Analysis showed that a greater degree of ankle malalignment produces poorer clinical results [15]. They concluded that there is merit in reducing tibial fractures as close to anatomical configuration as possible to lessen the chance of early degenerative arthritis. In a study by Van der Schoot et al. [16], 88 patients who had sustained a tibial fracture were evaluated clinically and radiographically between 13 and 17 years after the injury. Radiographic evidence of osteoarthritis was more common on the side of the fracture than on the uninjured site. Patients with angular malunion of >5° were significantly more likely to have radiographic osteoarthritis of the knee or ankle (p=0.02). Although this study is limited by the small number of patients and the retrospective design, our results suggest that especially in the distal third of the tibia, control of alignment in all directions is difficult with a nail alone. In view of this it is interesting to note that some authors advise performing an open reduction and plate stabilisation of the fibula to increase the rotational control [12]. Malalignment of the tibia can cause degenerative changes in the knee and ankle joint. We found that anterior knee pain is still an important complication of IM nailing [2]. Furthermore, we found no difference with regard to time to union, non-union, hardware failure or deep infections between ORIF and IM nailing. For optimal alignment we advise considering the use of ORIF for closed and type I open extraarticular fractures in the distal third of the tibia. More research is needed to assess the long-term effects of malalignments

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