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Comparing the Techniques for Management of Closed Tibial Fractures

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Abstract
Objective: The objective is to compare the radiological outcome of closed interlock intramedullary nailing versus dynamic compression plating in closed tibial fracture. **Methodology:** The study took place in Department of orthopedics Nishtar Hospital Multan from 9th July 2016 to March 2017. Study design is randomized controlled trials. There were 302 patients divided in two equal groups of 151. Permission was taken from the ethical committee of Nishtar Hospital. The 302 patients in age group 20-50 years of both genders meeting the inclusion and exclusion criteria attending the outpatient clinic or admitted to the orthopedics department through emergency were included in the study. All the data entered and analyzed using computer software SPSS version 10. For quantitative variables like age and duration of fracture mean and standard deviation was calculated. For categorical variables like gender, malunion and infection frequency and percentage were calculated. Chi-square test was applied to compare the malunion and infection in both groups. A p value 0.05 was considered statistically significant. **Results:** The 100% (n=302) patients were divided into 2 groups equally, 151 in each, i.e. intramedullary nail (group 1) and dynamic compression plating (group 2). The main outcome variables of this study were the malunion and infection. It was observed that malunion presented as 57% (n=86) and 70.9% (n=107) in group 1 and group 2 respectively. It was also observed that infection presented as 23.2% (n=35) and 37.1% (n=56) in group 1 and group 2 respectively. After applying chi-square test, it was noted that malunion associated with groups having p-value 0.012. But it was not associated with gender, stratified age and duration of fracture having p-values 0.497, 0.800 and 0.218 respectively. Similarly, after applying chi-square test, it was noted that infection associated with gender and groups having p-values 0.007 and 0.008 respectively. But it was not associated with stratified age and duration of fracture having p-values 0.565 and 0.344 respectively. **Conclusion:** Closed interlock intramedullary nailing has malunion and infection rates less than dynamic compression plating. So closed interlock intramedullary nailing is preferred method of closed tibia diaphyseal fracture treatment.
Keywords: Intramedullary nailing, closed tibia diaphyseal fracture, dynamic compression plating.

Introduction

Tibial diaphyseal fracture is the most common fracture of long bones [1]. Minor trauma can lead to the fracture of tibia; because of its location and as one third of its surface is subcutaneous, the tibia is exposed to frequent injuries. The knee and ankle joints are of hinge variety, so rotational deformity is difficult to compensate [2, 3]. Infection, delayed union, malunion and nonunion are the leading complications of fracture of tibia diaphysis. Therefore these fractures require good techniques and special care in their management [4]. There are different non operative and operative methods of treatment of close fracture of tibia. The non operative method is cast splintage functional bracing. It is an effective method of treating close fracture of tibial diaphysis that avoids operative complication but it has higher incidence of ankle stiffness [5]. The operative method includes a variety of procedures like open reduction, external fixation, intramedullary nailing and internal fixation using dynamic compression plate and screws [6]. Internal fixation with dynamic compression plating and open reduction often necessitate extensive dissection and tissue devitalisation especially of the periosteum, creating an environment more prone to bone infection and less favorable for fracture union. Therefore other, less invasive methods were introduced to treat tibial diaphyseal fracture. The most thriving one, closed intramedullary nailing, has been described to be related with shorter duration of 'disability before working' compared with closed reduction, open reduction and internal fixation with dynamic compression plating but the complications like knee pains, malunion, non union and delayed union have been consistently reported in many studies over the year[7,8,9].

Although closed Intramedullary nailing has been the preferred method of treating closed tibial fractures worldwide for many years with reported primary union rates of up to 97.5% [10], more recently the development of new biological procedures and implants has again restored the interest towards plate fixation and open reduction with union and complication rates comparable to those with Intramedullary nailing [11]. For example in one study [12], Intramedullary nailing provide just slightly higher union rates of up to 93.3% with complication rates of 17.4 and infection rate was 13.3%, as compared to 90% union rates, complication rates of 16.7% and infection rates of 13.3% with dynamic compression technique. In another Iranian study [13], the

mean time to union with Intramedullary nailing was 16 weeks as compared to 14.3 weeks with plate screw fixation and there was 8% and 6% non union rate after nailing and plating respectively while malunion rate (radiological angulations) was reported to be present in 6% of patients. None of the patients with nailing developed infection but 2/50 (4%) with plating technique developed infection. Thus, the exact current role of intramedullary nailing and dynamic compression plating in the treatment of closed tibial shaft fracture is still under debate in the literature. By conducting this study we want to compare the success rate and complication rate of these two established techniques in our patient population to identify whether dynamic compression plating carries similar success rates and complication rates as interlocked Intramedullary nailing. This will add to our local database as well as will enable us to use this technique more confidently in our patients with closed tibial shaft fractures.

Materials and Methods

The study took place in Department of orthopedics Nishtar Hospital Multan from 9th July 2016 to March 2017. Study design is randomized controlled trials. There were 302 patients divided in two equal groups of 151. With P1=0%, P2=4%, Power=80% and using consecutive non probability sampling technique, sample size was calculated from the reference study. Patients of all genders, patients in age group 20-50 years and patients diagnosed clinically and radiographically with closed tibial diaphyseal fracture as per operational definition were included in our study. Exclusion criteria was fracture duration >2 weeks, comminuted fractures, multiple fracture of tibia or associated fibular fractures, open fractures, pathologic fractures, previous deformity in tibia and unwillingness of the patients. Permission was taken from the ethical committee of Nishtar Hospital. Written informed consent was taken from the patients. Complete history and physical examination was carried out in all the patients and antero-posterior as well as lateral radiographs of the affected leg were obtained to diagnose closed tibial fractures. Patients were randomized to receive either closed IM nailing or DC plating by envelop method. All the patients were operated by an orthopedic consultant surgeon with a fellowship experience of 5 years. Patients were kept in ward post operatively then followed up regularly for 16 weeks. Antero-posterior and lateral radiographs of the affected leg were obtained at each follow up. Final outcomes were assessed at 16 weeks for presence or absence of union, malunion or infection as per operational definition. All the data was entered on a specially designed Performa by the researcher.

Computer software SPSS version 23 was used to enter and evaluate all the data. For quantitative variables like age and duration of fracture, mean and standard deviation was calculated. For categorical variables like gender, malunion and infection, frequency and percentage were calculated. Chi-square test was applied to compare the malunion and infection in both groups. A p value 0.05 was considered statistically significant. Effect modifier like age, gender and duration of fracture was controlled by making cross method stratified tables. Post stratification chi-square test was applied.

Results

In our study, a total number of 100% (n=302) patients were included, from both genders. There were more males than females in gender distribution i.e. 57.6% (n=174) and 42.4% (n=128) respectively. The mean age and duration of fracture of the patients was 35.099±7.22 years and 4.9±3.27 days respectively. The age distribution showed 30.5% (n=92) patients between 21-30 years, 44.7% (n=135) between 31-40 years and 24.8% (n=75) between 41-50 years. It was noted that majority of the patients i.e. 53.3% (n=161) had duration of fracture less than or equal to five days, 39.1% (n=118) had between 6-10 days and only 7.6% (n=23) had between 11-14 days of duration of fracture.

These 100% (n=302) patients were divided into 2 groups equally, 151 in each, i.e. intramedullary nail (group 1) and dynamic compression plating (group 2). The mean age and duration of fracture of the patients of group 1 was 35.24±7.02 years and 4.48±3.26 days respectively. While the mean age and duration of fracture of the patients of group 2 was 34.95±7.44 years and 5.31±3.22 days respectively.

The main outcome variables of this study were the malunion and infection. It was observed that malunion presented as 6% (n=9) and 6.6% (n=10) in group 1 and group 2 respectively (Table 1) (Figure.1). It was also observed that infection presented as 2.6% (n=4) and 4% (n=6) in group 1 and group 2 respectively. (Table 2) (Figure.2).

After applying chi-square test, it was noted that malunion was not associated with gender (p=0.614), stratified age (p=0.264), stratified duration of fracture (p=0.395) and groups (p=0.813). (Table 1)

Similarly, after applying chi-square test, it was noted that infection was not associated with gender (p=0.620), stratified age (p=0.760), stratified duration of fracture (p=0.297) and groups (p=0.520). (Table 2).

Table No. 1
Association of Malunion with Gender, Groups, Stratified Age and Duration of Fracture
(n = 302)

Effect Modifiers		Malunion		Total	P-value
		Present	Absent		
Gender	Male	12	162	174	0.614*
	Female	7	121	128	
Total		19	283	302	
*P-value is statistically insignificant with Pearson Chi-Square value = 0.255, d.f=1					
Groups	Group 1	9	142	151	0.813*
	Group 2	10	141	151	
Total		19	283	302	
*P-value is statistically insignificant with Pearson Chi-Square value = 0.056, d.f=1					
Stratified Age	21-30 Years	4	88	92	0.246*
	31-40 Years	12	123	135	
	41-50 Years	3	72	75	
Total		19	283	302	
* P-value is statistically insignificant with Pearson Chi-Square value = 2.809, d.f=1					
Duration of Fracture	≥ 5	13	148	161	0.395*
	6-10 Days	5	113	118	
	11-14 Days	1	22	23	
Total		19	283	302	
* P-value is statistically insignificant with Pearson Chi-Square value = 1.86, d.f=1					

Table No. 2
Association of Infection with Gender, Groups, Stratified Age and Duration of Fracture
(n = 302)

Effect Modifiers		Infection		Total	P-value
		Present	Absent		
Gender	Male	5	169	174	0.620*
	Female	5	123	128	
Total		10	292	302	
*P-value is statistically insignificant with Pearson Chi-Square value = 0.246, d.f=1					
Groups	Group 1	4	147	151	0.520*
	Group 2	6	145	151	
Total		10	292	302	
*P-value is statistically insignificant with Pearson Chi-Square value = 6.936, d.f=1					
Stratified Age	21-30 Years	2	90	92	0.760*
	31-40 Years	5	130	135	
	41-50 Years	3	72	75	
Total		10	292	302	
* P-value is statistically insignificant with Pearson Chi-Square value = 0.548, d.f=1					
Duration of Fracture	≥ 5	4	157	161	0.297*
	6-10 Days	4	114	118	
	11-14 Days	2	21	23	
Total		10	292	302	
* P-value is statistically insignificant with Pearson Chi-Square value = 2.43, d.f=1					

Figure-1

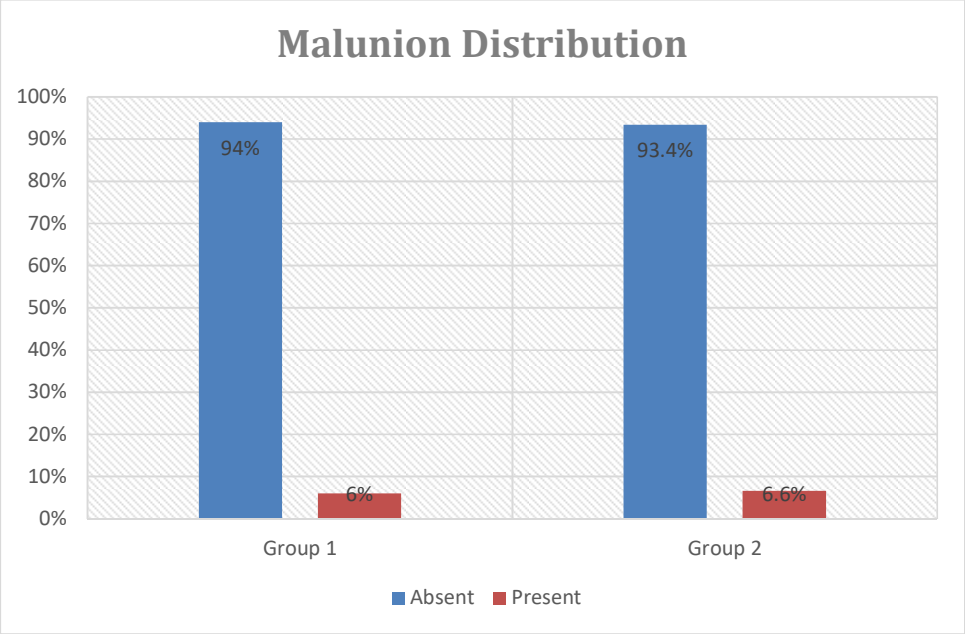
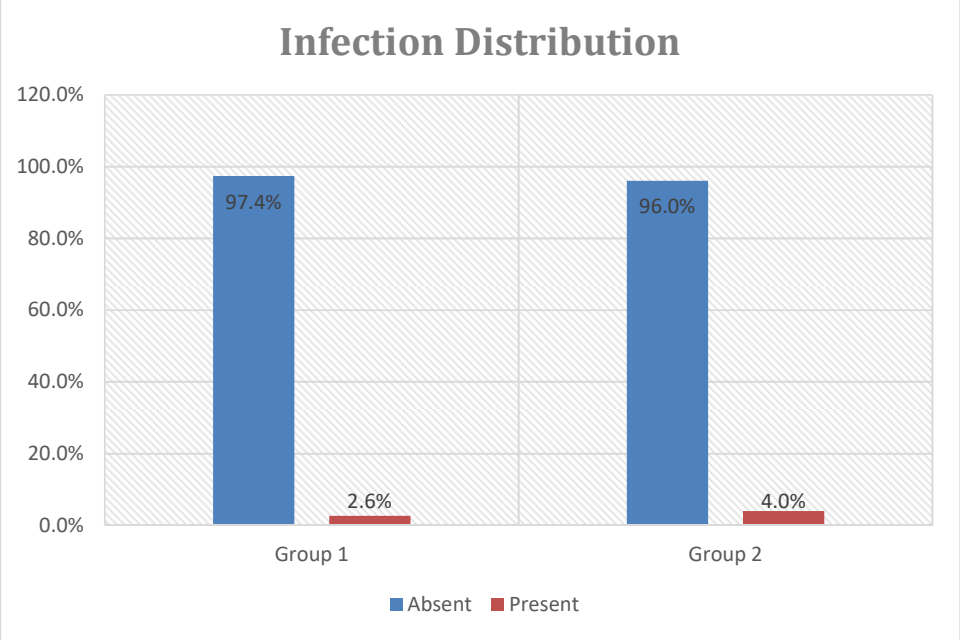


Figure-2



Discussion

Internal fixation and open reduction of distal tibial fractures frequently demands extensive dissection which may result in reduced blood supply of the tissue, creating an environment less favorable to increasing the risk of infection and union. In a recent study about locked intramedullary nailing versus dynamic compression plating for fractures of humeral shaft, it was concluded that nailing may cause more shoulder impartment and method-related complications than plating, although it may result in a lower risk of postoperative nerve palsy and infection. In near future, more high-class RCTs are essential to improve these conclusions [14]. In another study, it was concluded that dynamic compression plating is a superior mode of fixation for proximal and distal tibial facture and interlock nailing is best implant in diaphyseal and segmental fractures of tibia [15].

As far as in our knowledge, no prior prospective study has been conducted to compare IMN and DCP.

There have been four past randomized controlled studies in which the results of open reduction and internal fixation were compared with those of intramedullary nailing. In a study by Yang et al [16] both methods were compared in patients with type-43A fractures. They established that the duration for reunion was less in the intramedullary nailing group, with an increase in post-operative valgus by a mean of 3.7°. Janssen et al recommended that in distal tibial fractures control of alignment was difficult with an intramedullary nailing. In another previous study by Vallier et al [17] 111 patients were reviewed and treated by either a plate or intramedullary nailing over a period of four years. Malunion, delayed union, and secondary measures were more common after nailing. But, their studies were non-randomized, retrospective and included closed, open and fractures of fibula. Simultaneous internal fixation and open reduction of a fracture of fibula may add to nonunion of the fracture of tibia [18]. Im and Tae conducted a prospective stud in which Nailing showed an advantage in movement, operating time, and wound problems, but anatomical plates produced better alignment.

In this study stricter inclusion criteria was used, which required the presence of a distal tibial fragment of at least 3 cm with no articular incongruity. All the methods relied on internal fixation closed indirect reduction. Mostly the patients had a fracture of fibula. In our study those with internal fixation and open reduction of a fibular fracture were excluded because the essential benefit of closed intramedullary nailing and dynamic compression plating in order to avoid the soft tissue dissection might be compromised in this way. Misalignment which occurs postoperatively has not been a much of a problem in our study. Our study provides confirmation that reamed nailing was safe, even for distal tibial diaphyseal fractures, and was related with no risk of nonunion or very low risk of delayed union. This is similar to the previous studies with a mean AOFAS score between 91.0 and 87.3 points following union of distal fractures of tibia [19]. In the dynamic compression plating group wound complications were more common, delayed wound healing. Lau et al [20] reported 52% of their patients had the implant removed because of skin impingement and a rate of late infection of 15% in MIPO fixation of a locking plate in distal fractures of tibia. The need for routine removal of the implant is quite controversial [21] which can be complicated and involves all the general risks related to surgical techniques. Total complication rate of 20% has been accounted [22]. Old welding at the crossing point of four of the 11 locking screws in one less invasive stabilization procedures, all of which were fixed to the diaphyseal segment, as described by Cole, Zlowodzki and Kregor [23].

Conclusion

Closed interlock intramedullary nailing has malunion and infection rates less than dynamic compression plating. So closed interlock intramedullary nailing is preferred method of closed tibia diaphyseal fracture treatment.

Funding

Nil

Conflict of Interest

None

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