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ORIGINAL ARTICLE

Comparison of Frequency of Union between Intramedullary Solid Nailing (Sign Nailing) with Cannulated Nailing Via Open Reduction for the treatment of Fracture Shaft of Tibia

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ABSTRACT

Background: Fractures involving the shaft of long bones are common worldwide and tibial fractures are among the most common lower limb injuries to be treated by an orthopedic surgeon. The most common fracture of the lower limb occurs at the tibial diaphysis.
Aim: To compare the frequency of union between intramedullary solid nailing (SIGN nailing) with cannulated nailing via open reduction for the treatment of fracture shaft of tibia.
Study design: The study was a randomized controlled trial conducted at the Department of Orthopedic Surgery, Allied Hospital, Faisalabad, involving 130 patients with closed diaphyseal fracture shaft of tibia and type 1 open fractures. The study lasted six months, from July 1st, 2014, to December 31st, 2014. Patients were divided into two groups: 65 patients in group A underwent solid nailing and 65 patients in group B underwent cannulated nailing via open reduction. The union of bones was assessed on x-rays at six months. The data was analyzed using SPSS version 16, with descriptive statistics, gender, and union of bones presented as frequency and percentage. A P-value less than 0.05 was considered significant.
Results: In our study, out of 130 cases (65 in each group), 32(49.23%) in Group A and 30(46.15%) in Group B were between 14 and 30 years of age, while 33(50.77%3) and 35(53.85%) in respective groups were between 31 and 60 years of age. The mean + sd was calculated as 35.38±12.49 and 37.49±12.59, respectively. 50(76.92%) in Group A and 52(80%) in Group B were male, while 15(23.08%) and 13(20%) in respective groups were females. Comparison of frequency of union between intramedullary solid nailing (sign nailing) with cannulated nailing via open reduction for the treatment of fracture shaft of tibia was done which shows union in 51(78.46%) in Group-A and 59(90.77%) in Group-B while remaining 14(21.54%) and 6(9.23%) respectively had non-union, p value was calculated as 0.05 which shows a significant difference.
Practical Implication: The study highlights the importance of understanding the age distribution and gender disparities in the treatment of tibial shaft fractures. Patients aged 14-60 are more likely to require treatment, indicating a need for tailored treatment plans. The study also highlights the need for equitable access to care and rehabilitation services for all patients.
Conclusion: We concluded that the frequency of union was significantly higher in cannulated nailing via open reduction when compared with intramedullary solid nailing (SIGN nailing) for the treatment of fractured shafts of the tibia.
Keywords: Fracture shaft of tibia, management, intramedullary solid nailing (SIGN nailing), cannulated nailing via open reduction, union

INTRODUCTION

Tibia is the most frequently fractured long bone due to its superficial position. Tibial fracture is common in all ages and is a major source of morbidity in patients with lower-edge injuries. Generally, these fractures are sustained during high-energy trauma, such as motorcycle accidents, pedestrian accidents, falls from height, motor vehicle accidents, and rarely gunshot injuries. Delayed union, malunion, nonunion, and infections are general complications of tibial shaft fractures[1].

In mocare, trauma care the treatment of unstable distal tibia fracture challenging. hallenging. The treatment options available for diaphyseal tibial fractures include plaster cast immobilization, a dynamic compression plate, external fixation, and an intramedullary interlocking nail[1].

In the last few years, intramedullary nailing has become the treatment of choice for most displaced diaphyseal tibia fractures because it provides high mechanical stability and provides higher resistance to axial and torsional forces[3] and can be performed in a minimally invasive manner but is accompanied by complications like decreased biomechanical stability due to the anatomical conditions of the distal tibia, 4 superficial wound infection, deep wound infection, compartment syndrome, deep vein thrombosis, delayed union, non-union, and implant failure[1]. By using cannulated intramedullary nailing union, 96% of patients[5].

The Surgical Implant Generation Network (SIGN) solid, stainless steel nail was designed for use in the tibia, and it is strong enough for slots rather than holes to accommodate the interlocking screw[6]. Solid nail like SIGN nail has advantage of less chances of implant failure as nail is more stronger. Jigs for both proximal and distal interlocking screws decrease dependence on the image intensifier and also decrease operating time. The union rate by intramedullary solid nailing was 82%[1].

The rationale of this study is to compare the union rate between intramedullary solid nailing and cannulated nailing for the treatment of fractured shafts of the tibia. In the literature, a lot of work has been done on intramedullary nailing, but there is no local study in comparison of both of these types of intramedullary nailing, as per my knowledge. So the results of this study will add knowledge to the existing literature and will also be helpful in ruling out which type of intramedullary nailing is better than others, as mostly solid nailing is performed locally in routine practice.

Tibial fractures occur in both high-energy trauma, such as motor vehicles, winter sports (e.g., skiing), and cycling accidents, and low-energy trauma, such as falls, contact sports, distance running, and other endurance or repetitive impact activities. Injuries caused by high energy trauma are more likely to involve complex and open tibia fractures and fractures in certain locations, such as the tibial plateau[7,8] injuries caused by low energy trauma more often result in simple transverse or linear tibia fractures. Open fractures of the tibia have high rates of complications and long-term problems with limitations in function and pain.

In adults and children, closed tibial shaft fractures are the most common long-bone fractures. With greater than 70,000 hospitalizations, 800,000 office visits, and 500,000 hospital days, they have major economic consequences. The elderly suffer many of these fractures from simple falls, and those with significant osteoporosis incur open or more complex fractures, often with high morbidity[10,11].

Tibia fractures occur during contact and noncontact sporting events. Several studies demonstrate that a direct, low-velocity

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blow (e.g., tackling, kicking) causes approximately 95% of sports-related tibial fractures[12]. In a five-year retrospective study of 244 tibial fractures seen at a major trauma center, 24(9.8%) occurred during football (i.e., soccer) games[13]. Even when low-energy trauma is the cause, concomitant fibular fractures develop in approximately 60% of cases. Nevertheless, significant complications develop in fewer than 5% of sports-related tibial fractures, and the prognosis is generally good.

Avulsion fractures of the lateral and medial tibia may have diagnostic significance in looking for ACL or PCL ligament injuries. The Segond fracture occurs just below the iliotibial band attached to the fibers of the lateral capsule and is associated with an ACL tear. Proximal tibial avulsion fractures at the medial aspect of the bone may be a marker of PCL injury[9].

The incidence of tibia fractures among football (soccer) players appears to be declining, although the reasons for this remain unclear. Some claim that increased use of shin guards accounts for the decline. However, studies of other contact sports and a case series in which 85 of 100 football-related tibia fractures were sustained by athletes wearing shin guards argue against this claim. Case reports suggest that tibial fractures are occurring in snowboarding, mixed martial arts, and "X-game" type sports (e.g., skateboarding), although demographic data is scant[10].

Long-term bisphosphonate use, particularly in elderly patients, may contribute to tibial fractures. Case reports document insufficiency-type fractures of the tibia without known trauma.

The objective of this study was to compare the frequency of union between intramedullary solid nailing (SIGN nailing) with cannulated nailing via open reduction for the treatment of fracture shaft of tibia.

MATERIALS AND METHODS

Study design: Randomized controlled trial
Setting: Department of Orthopedic Surgery, Allied Hospital, Faisalabad
Sample size: By using the WHO sample size calculator for two proportions
P_1 = 82%[1], P_2 = 96%[5], Power of study = 80%, Level of significance = 5%, Sample size: 130 (65 in each group)
Study duration: 6 months after approval of synopsis from July 1st, 2014 to December 31st, 2014
Sampling technique: Non-probability consecutive sampling
Inclusion Criteria

- Gender: both male and female
- Age: 14–60 years
- All the patients with closed diaphyseal fracture shaft of tibia (confirmed on x-ray) and type 1 open fractures (Gustillo Anderson classification) confirmed clinically with wound size < 1cm (as per operational definition) located 7cm below the knee joint and 7 cm above the ankle joint.

Exclusion Criteria

- Fractures were previously treated with an external fixator.
- Patients with type 2 open fractures (wound size > 1cm but < 10cm) and type 3 open fractures (wound size > 10 cm with neuromuscular damage) were confirmed clinically (Gustillo-Anderson classification).
- Pathological fractures confirmed by history and x-rays.
- Multifractured patients were confirmed clinically.

Data collection procedure: After receiving approval from the hospital ethical committee, patients coming through an emergency fulfilling the inclusion criteria were enrolled, and informed consent was obtained. After initial treatment following the ATLS protocol, an x-ray was taken from the hospital radiology department, and then patients were treated with intramedullary nailing. Patients were randomly allocated by a computer-generated random number table into two equal groups: 65 patients in group A underwent solid nailing, and 65 patients in group B underwent cannulated nailing via open reduction. Both procedures were performed by a consultant orthopedic surgeon.

Union of bone was assessed on x-ray (as in operational definition) at 6 months. An X-ray was performed by the hospital radiology department, and it was reported by the radiologist. The patients were followed for 6 months by taking their contact number. All the information was collected on a specially designed proforma.
Data analysis: The collected information was entered in SPSS version 16. Descriptive statistics, including the mean and standard deviation of quantitative variables like age, were evaluated. Gender and union of bones were presented as frequency and percentage. The union of bones was compared using the chi-square test between both groups. A P-value less than 0.05 was considered significant.

RESULTS

A total of 130 cases fulfilling the inclusion/exclusion criteria were enrolled to compare the frequency of union between intramedullary solid nailing (SIGN nailing) and cannulated nailing via open reduction for the treatment of fractured shafts of the tibia.

The age distribution of the patients was done, which shows that 32(49.23%) in Group A and 30(46.15%) in Group B were between 14 and 30 years of age, while 33(50.77%) and 35(53.85%) in the respective groups were between 31 and 60 years of age. The mean+SD was calculated as 35.38±12.49 and 37.49±12.59, respectively (Table 1).

The gender distribution of the patients was done, which shows that 50(76.92%) in Group A and 52(80%) in Group B were male, while 15(23.08%) and 13(20%) in the respective groups were female (Table 2).

Comparison of frequency of union between intramedullary solid nailing (sign nailing) with cannulated nailing via open reduction for the treatment of fracture shaft of tibia was done which shows union in 51(78.46%) in Group-A and 59(90.77%) in Group-B while remaining 14(21.54%) and 6(9.23%) respectively had non-union, p value was calculated as 0.05 which shows a significant difference (Table 3).

Stratification by age shows that 26 out of 51 cases in Group A and 27 out of 59 cases in Group B were between 14 and 30 years old; the p value was calculated as 0.47, while 25 out of 51 cases in Group A and 32 out of 59 cases in Group B were between 31 and 60 years old; the p value was calculated as 0.47 (Table 4).

The stratification by gender shows that 42 out of 51 cases in Group A and 48 out of 59 cases of union in Group B were male; the p value was calculated as 0.19, while 9 out of 51 cases in Group A and 11 out of 59 cases of union in Group B were female; the p value was calculated as 0.22 (Table 5).

Table 1: Age distribution (n=130)

Age (in years)	Group-A (n=65)		Group-B (n=65)	
	n	%age	n	%age
14-30	32	49.23	30	46.15
31-60	33	50.77	35	53.85
Total	65	100	65	100
Mean±sd	35.38±12.49		37.49±12.59	

Table 2: Gender distribution (n=130)

Gender	Group-A (n=65)		Group-B (n=65)	
	n	%age	n	%age
Male	50	76.92	52	80
Female	15	23.08	13	20
Total	65	100	65	100

Table 3: Comparison of frequency of union between intramedullary solid nailing (sign nailing) with cannulated nailing via open reduction for the treatment of fracture shaft of tibia (n=130)

Union	Group-A (n=65)		Group-B (n=65)	
	n	%age	n	%age
Yes	51	78.46	59	90.77
No	14	21.54	6	9.23
Total	65	100	65	100

P value=0.05

Table 4: Stratification for frequency of union between intramedullary solid nailing (sign nailing) with cannulated nailing via open reduction for the treatment of fracture shaft of tibia with regards to age

Age: 12-30

Group	Union	
	Yes	No
A	26	6
B	27	3

P value 0.47

Age: 31-60

Group	Union	
	Yes	No
A	25	8
B	32	3

P value 0.07

Table 5: Stratification for frequency of union between intramedullary solid nailing (sign nailing) with cannulated nailing via open reduction for the treatment of fracture shaft of tibia with regards to gender

Gender: Male

Groups	Union	
	Yes	No
A	42	8
B	48	4

P value 0.19

Gender: Female

Groups	Union	
	Yes	No
A	9	6
B	11	2

P value 0.22

DISCUSSION

Fractures involving the shaft of long bones are common worldwide, and tibial fractures are among the most common lower limb injuries to be treated by an orthopedic surgeon. The most common fracture of the lower limb occurs at the tibial diaphysis. There are different methods of achieving skeletal stabilization that could vary considerably, depending on the configuration of the fracture line and the geographical location of the surgeons' practices. This study was planned to compare the union rate between intramedullary solid nailing and cannulated nailing for the treatment of fractures in the tibia. In literature a lot of work has been done on intramedullary nailing but there is no local study in comparison of both of these types of intramedullary nailing as per my knowledge. In our study, out of 130 cases (65 in each group) 32(49.23%) Group-A and 30(46.15%) in Group-B were between 14-30 years of age, while 33(50.77%) and 35(53.85%) in respective groups were between 31-60 years of age, mean$\pm$sd was calculated as 35.38±12.49 and 37.49±12.59 respectively, 50(76.92%) in Group-A and 52(80%) in Group-B were male, while 15(23.08%) and 13(20%) in respective groups were females.

Intramedullary nails require shorter operative times than plate and screw fixations. A randomized study comparing intramedullary nail (ILN) and laminar screw fixation (LCP) in humeral diaphysis fractures found a mean operative time of 59.5 minutes for ILN and 90.93 minutes for LCP. In the current study, operative times were significantly less in the ILN group compared to the LCP group. Hospital length of stay was shorter in the ILN group compared to the LCP group. Iatrogenic radial nerve palsy is more common in patients with humeral fractures, with 13% of cases. A meta-analysis by Zhao et al. found that ORPO had a higher risk of radial nerve palsy compared to MIPO, and DCP had lesser complications compared to ILN. Wang et al. reported that overall complications and functional measurements were significantly better for DCP, making it superior to ILN for humeral shaft fractures. However, ILN showed a significantly increased risk of shoulder impingement, movement restriction, higher incidence of implant failure, and higher risk of re-operation[15-19].

Comparison of frequency of union between intramedullary solid nailing (sign nailing) with cannulated nailing via open reduction for the treatment of fracture shaft of tibia was done which shows union in 51(78.46%) in Group-A and 59(90.77%) in Group-B while remaining 14(21.54%) and 6(9.23%) respectively had non-union, p value was calculated as 0.05 which shows a significant difference.

A recent study[1] evaluated the clinical and radiological outcome of a closed diaphyseal fracture of the tibia by doing open reduction and fixation with an inter-locking intramedullary (SIGN) nail without using an image intensifier and recorded that the union rate by intramedullary solid nailing was 82%. [1] is comparable with our study. Another study recorded that cannulated intramedullary nailing union was observed in 96% of patients[5]. Juan Paulo L. Panti and colleagues determined whether there is a difference in clinical outcomes for patients with isolated femoral shaft fractures treated with S.I.G.N. intramedullary nails versus cannulated intramedullary nails and recorded that the union rate for the S.I.G.N. group is 68.8%, while the cannulated group is 80%.

Our study had some limitations, including the non-evaluation of any complications of the procedures that may be done in the coming trials. The results of this study add knowledge to the existing literature and are also helpful in ruling out which type of intramedullary nailing is better than others, as mostly solid nailing is performed locally in routine practice. Some other trials may further validate our findings.

CONCLUSION

We concluded that the frequency of union was significantly higher in cannulated nailing via open reduction when compared with intramedullary solid nailing (SIGN nailing) for the treatment of fracture shaft of tibia.

Authorship and contribution declaration: Each author of this article fulfilled following Criteria of Authorship:

1. Conception and design of or acquisition of data or analysis and interpretation of data.
2. Drafting the manuscript or revising it critically for important intellectual content.
3. Final approval of the version for publication.

Authors agree to be responsible for all aspects of their research work.

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