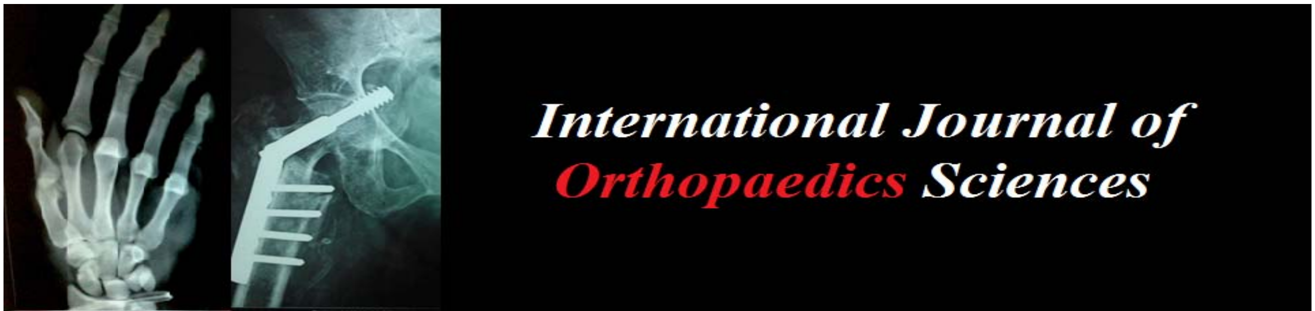

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Comparative study of static versus dynamic intramedullary nailing of tibia

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Abstract
Introduction: Reamed intramedullary nails have become the treatment of choice for the majority of these fractures. Rates of union in both femoral and tibial shaft fractures have been reported to range from 90% to 100% with the use of intramedullary nails. Intramedullary nailing is synthesis and consolidation of fracture fragments with the main goal to gain strength and permanent placement of the implants. Two techniques of intramedullary osteosynthesis are used: with dynamic or with static intramedullary nail. Dynamisation include conversion of static nail by removing screws from the longest fragment.
Materials & Methods: This was a retrospective case–control study of closed or type I open tibial diaphyseal fractures (types A and B according to the AO classification) treated with dynamic nailing (30 cases) or static nailing (30 cases). The type of intramedullary nail, the surgical technique and the postoperative protocol were similar for both groups, with the exception of the locking mode and the time of weight bearing. Time to union, mechanical and biological complications, and the number and type of re-operations needed until union were recorded and analysed.
Results: The mean time to union was 21 weeks in the dynamic group and 26 weeks in the static group. A strong trend was seen in favour of the dynamic nailing group. ($p < 0.01$) statistically significant difference was observed. Sixteen out of the 60 patients (26.9%) had at least one complication
Conclusions: Dynamic nailing assembly in intramedullary nailing in closed or type I open tibial diaphyseal fractures with limited comminution (types A and B according to the AO classification) is safe when used for these fracture types.

Keywords: Dyanimization, tibial fractures, intramedullary nailing

1. Introduction

In the modern world with the increase in speed and number of fast moving vehicles there is a great increase in number and severity of fractures. The goal of fracture treatment is to obtain union of the fracture in the most compatible anatomical position which allows maximal and full restoration of the extremity [1].

Tibia is one of the most commonly fractured long bone of the body. Considering its anatomy, it is commonly difficult to achieve and maintain reduction of distal tibia fractures [2].

Since their introduction, reamed intramedullary nails have become the treatment of choice for the majority of these fractures. Rates of union in both femoral and tibial shaft fractures have been reported to range from 90% to 100% with the use of intramedullary nails [3, 4].

Despite improved treatment and union ratesproblems with delayed union and nonunion continue to occur. Treatment options for delayed union and nonunion include nail dynamization, bone grafting, exchange nailing, compression plating, external fixation, and amputation. Although the treatment algorithm differs in each case, nail dynamization can be a quick, cost-saving, and effective method to promote healing [5].

Treatment principle is to restore the original anatomical position of fractured fragments by different techniques, without direct access to the bone and without further traumatizing of tissues. Intramedullary nailing is synthesis and consolidation of fracture fragments with the main goal to gain strength and permanent placement of the implants. Two techniques of intramedullary osteosynthesis are used: with dynamic or with static intramedullary nail.

Dynamisation include conversion of static nail by removing screws from the longest fragment [6].

The Aim of this study was to define the efficacy of nail dynamization for the treatment of tibial shaft delayed union and nonunion. In the case of failed dynamization, we have tried to identify risk factors for failure that were not identified in previous studies.

Material & methods

It was a hospital based retrospective- prospective comparative study carried out to study the efficacy of nail dynamization for the treatment of tibial shaft delayed union and nonunion. To determine whether there is a difference in the speed and quality of healing of the type A and B fractures of the tibia treated by static or dynamic intramedullary nails and to compare the results.

We retrospectively reviewed records with Current Procedural Terminology for intramedullary nailing of tibial shaft fractures, and to identify patients who were treated with nail dynamization. The study was conducted at the OPD for Orthopedics and Traumatology,

Strategy

The study was conducted on a total of 60 patients with closed fractures of the diaphysis of the tibia type A and type B, with different segments of bone, regardless of sex and age structure, with the exception of patients under 18 years of age. There were 62 patients with tibial fractures of closed or type I open tibial diaphyseal fractures (types A and B according to the AO classification) out of which 30 patients were selected treated with dynamic nailing (as group 1) or static nailing (30 cases group 2). The type of intramedullary nail, the surgical technique and the postoperative protocol were similar for both groups, with the exception of the locking mode and the time of weight bearing. Follow up clinical evaluation was repeated every month for 1year. Time to union, mechanical and biological complications, and the number and type of re-operations needed until union were recorded and analysed. Delayed union was defined as the failure of the fracture to progress to union by 6 months, whereas nonunion was defined as no progression of the fracture to osseous healing by 9 months and a secondary intervention being necessary. Malunion was defined as any angular deformity >5°, a rotational deformity >10°, or a shortening of >1 cm.

A) Patients with fracture of the tibia treated with static method of intramedullary nailing, where the static intramedullary nail fastened cross screws (3 or 4 screws) on both ends, and by that controls the axial and rotation instability and bending.

B) Patients with fracture of the tibia treated with dynamic method of intramedullary osteosynthesis (or patients whom had performed "dynamization"), which allows the complete axial pressure with control of bending and rotation.

The success and healing time of fractures of the femur and tibia treated using static or dynamic intramedullary osteosynthesis is declared on the basis of clinical and radiological results of fracture healing in each of the respondents.

Evaluation and data analysis for the retrospective variables were noted and evaluated from the available data of MRD. For a prospective variables questionnaire was used. It included clinical examination, clinical signs of healing, the rigidity and lack of crepitation at the point of fracture, pain at the site of the fracture with palpation and percussion, and the absence of pain in full support and walk on limb fractures healed were recorded. Patients were regularly followed up at our outpatient service by the surgeon in charge at 4, 8, 12, 16 and 20 weeks and at 9 and 12 months as indicated by the patient's condition, or longer if necessary. Radiological union was defined as the presence of bridging callus in at least 3 out of 4 cortices as revealed by anteroposterior and lateral projections.

Student's paired t test and Chi Square test was applied to the results of both the groups for comparison.

Ethical clearance was obtained from the ethics review committee of the institute. Data was analysed using SPSS 21.0 (SPSS Inc., Chicago, IL, USA), paired t test was used compare within the groups and unpaired t test was applied to compare between the 2 groups.

Results

Out of 105 patients with tibial fractures who were treated in our institution during the study period, 60 met the inclusion criteria, and were assigned to one of two groups depending on the osteosynthesis technique used: the "static" group (30 cases), with at least one locking screw in each fragment, and the "dynamic" group (30 cases) with one or two locking screws in only one of the fragments.

Demographic details and clinical characteristics were homogeneous and comparable between the 2 groups of patients (Table 1). The initial interfragmentary gap was also similar between the two groups. The mean time to union was 21 weeks in the dynamic group and 26 weeks in the static group. A strong trend was seen in favour of the dynamic nailing group. ($p < 0.01$) statistically significant difference was observed.(Table 2)

Table 1: Demographic details and clinical characteristics

Parameters	Group		Total	p-value
	Static (n-30)	Dynamic (n-30)		
Male	21	22	43	1.00
	70.0%	73.3%	71.7%	
Female	9	8	17	
	30.0%	26.7%	28.3%	
Age (Mean+/-SD)	40.96+6.12	43.12+/- 6.78	42.01+/- 6.40	0.59
AO Claccification				0.60
A1-A3	15	18	33	
	50.0%	60.0%	55.0%	
B1-B3	15	12	27	

Table 2: Comparison of union time

Parameters	Group	N	Mean	SD	p- value
Union Time (wks)	Static	30	26.78	9.78	< 0.01
	Dynamic	30	21.97	10.01	

Sixteen out of the 60 patients (26.9%) had at least one complication (Table 3), with 12 patients belonging to the "static group" and 4 to the "dynamic" group (p=0.028). Five cases (8.3%) of nonunion were detected, three in static group and two in dynamic group. There were 5 cases of delayed union in the static group, compared to 1 in the dynamic group. In the dynamic group there was only 1 mechanical complication shortening with collapse in an oblique fracture pattern. Overall, fourteen patients required some form of surgical intervention throughout treatment. In 10 cases (7 from the static group and 3 from the dynamic group) an intervention was necessary due to a biological complication (delayed union and/or nonunion), and in 4 (3 from the static group and 1 from the dynamic group) due to a mechanical cause. This difference between the two groups did not reach statistical significance p = 0.138.

Table 3: Comparison of complication

Complications	Static (n-9)	Dynamic (n-3)
Varus deformity	2	0
Vulgus deformity	2	0
Delayed union	5	1
Non Union	3	2
Shortening	0	1

Discussion

The objective of Dynamisation from the start of the treatment was to allow the contact between the bone fragments in order to avoid inter fragmentary gaps. In present study, the patients were in the range of 19–50 years, Of the 60 patients, 43 were males and 17 were females. Predominant male involvement was seen in this study which can be attributed to more outdoor activities and heavier labor undertaken by males as compared to females in the Indian set up. Similar male involvement has been seen in study conducted by DanielHerna´ndez-Vaquero *et al*. [7] in spain.

In present study, the dynamic group exhibited a faster time to union and showed a smaller number of biological complications, and the results were statistically significant, compared to the static group. an another study conducted be Josh Vaughn *et al*. [8] have also published similar results demonstrating faster union in dynamic group. they in their study evaluated 35 instances of delayed union and nonunion of tibial and femoral shaft fractures treated with nail dynamization and found that dynamization was successful in promoting union in 53% of cases. similar results of better union with dynamization have also been observed by DanielHerna´ndez-Vaquero *et al*. although their results did not show statistical significance. various other studies have also shown similar results [9, 10].

Although dynamization was once routinely performed to help promote fracture healing, it is now performed selectively. 11, There are several reasons for this change. First, routine dynamization was found to be unnecessary for fracture healing, and it is associated with a risk of shortening, particularly in spiral and long oblique fractures. In 1997, Wu10studied the efficacy of dynamization in 24 cases of femoral delayed union and nonunion. They found a rate of success similar to that of the current study, at 58%, and also noted a greater than 20% rate of fracture shortening of more than 2 cm. we in our study have considered only tibial fractures. Several other studies noted the risk of shortening with dynamization, and it appears that the fracture pattern is the greatest factor in determining whether a fracture will shorten after dynamization [11-13].

The current study included only 2 patient who had a rotational deformity and 1 patient with shortening through the nonunion, and this was treated successfully with an exchange nail. In contrast to previous reports, the current study did not find a similar rate of shortening in case of dynamization. One reason for this finding may be selective use of dynamization because none of the fractures that were treated with dynamization.

Conclusion

Dynamic nailing assembly in intramedullary nailing in closed or type I open tibial diaphyseal fractures with limited comminution (types A and B according to the AO classification) is safe when used for these fracture types. It is possible that dynamic assemblies may reduce time to union, complications, and re-operations, and can facilitate early full weight bearing. Accordingly, our findings support the view that the dynamic mode configuration should be used with the new designs of intramedullary nails available. Despite its limitations, this study provides information that can help to predict success after nail dynamization. Although dynamization may not be indicated in all patients with delayed union or nonunion, its low morbidity, quick recovery, and ease of operation make it preferable to bone grafting, exchange nailing, or compression plating.

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