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Research Article

ROLE OF DYNAMIZATION IN INTRAMEDULLARY NAILING OF TIBIA

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ABSTRACT

Objectives: This study aims to know the functional outcomes of intramedullary nailing (IMN) osteosynthesis in long bone shaft fractures among adult patients with stable internal fixation and union. Additionally, it seeks to assess the specific and general complications experienced by both groups.

Methods: The study was conducted at the Department of Orthopedics, Government Medical College, and Rajindra Hospital in Patiala, spanning from March 2021 to December 2022. It was a prospective, manipulative, controlled study involving a total of 40 cases of tibia diaphyseal fractures that were presented to the orthopedics department. Fractures were classified according to the AO fracture classification.

Results: The average time for union in the dynamic group was 15.60 weeks (with a standard deviation of 1.27). A significant statistical difference was observed, favoring the dynamization nailing group ($p<0.01$), indicating a strong trend toward faster union. Out of the 40 patients, 16 (40%) experienced at least one complication. In conclusion, dynamic IMN osteosynthesis permits micromotion between fracture fragments, directly stimulating bone formation and the development of callus.

Conclusion: For closed or open tibial diaphyseal fractures with minimal comminution (types A and B based on the AO classification) up to Gustilo 3A, dynamic IMN assembly is considered a safe and effective treatment option.

Keywords: Tibia fracture, Dynamization, Intramedullary nailing.

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INTRODUCTION

With the increasing number of vehicles on Indian roads, complex trauma cases caused by road traffic accidents have increased progressively.

Tibia being subcutaneous in location makes it one of the commonest bones to be fractured and is seen commonly in orthopedic practice [1]. Open fractures are more common, as most of the tibial surface is subcutaneous throughout most of its length. The blood flow of the tibia is also less secure than that of bones encased in dense muscles. The existence of hinge joints at the knee and ankle prevents any modification for post-fracture rotatory deformity [1]. Delayed union, non-union, and infection are relatively frequent complications, especially after open fractures of the shaft of the tibia. It has developed into a significant source of temporary disability and morbidity due to its frequency, topography, and method of injury. Hence, the widest experience, the greatest wisdom, and the nicest clinical judgment are required to choose the most appropriate treatment for a particular pattern of injury [1].

The major goal in the treatment of fractured tibias is to achieve a functionally useful and stable extremity and early mobilization. Yet, the spectrum of injuries is so great that no single method of treatment is applicable to all fractures. Management of these fractures has remained a controversial subject despite advances in both non-operative and operative care.

The constant dilemma in modern orthopedic surgery is what type of intramedullary osteosynthesis to use, static or dynamic, rhymed or unrhymed nail, because it is obvious that the indication area of their application is constantly expanding due to technological advances in the development of implants and because of the progress of operational techniques.

In 1961, Sir John Charnley said that there was still a long way to go before the best approach to treating a fracture of the tibia shaft could be determined definitively. Numerous published articles regarding the treatment of fractures of the shaft of the tibia have shown that closed treatment of fractures has excellent results. The use of closed interlocking intramedullary nailing (IMN), which has produced outstanding results, was ultimately decided upon due to the drawbacks of prolonged healing time, fracture disease, malalignment, and patient non-compliance [2]. Nowadays, the well-laid principle of biological osteosynthesis is rightly applied in long bone fracture healing, and hence we selected closed intramedullary interlocking nailing in this study [3].

The aim of lower limb and thigh fracture treatment is to initiate physical therapy and determine the integrity of the bone as soon as possible. Every fracture's recovery depends on the effectiveness and caliber of the operation. Consequently, every osteosynthesis implant has benefits and drawbacks in regard to three fundamental issues with bone mending: (a) contamination; (b) Unsteadiness; and (c) the flow of blood. High contact fragment strength and durability, a low infection rate, and the potential for the patient's early mobilization while maintaining soft peripheral circulation and structure are assurances of the effectiveness and standard of femur fracture healing and tibia managed by intramedullary static and dynamic osteosynthesis.

The study aimed to analyze and compare the clinical and functional outcomes of shaft tibia fractures treated with IMN using a static or dynamic locking option in the North Indian population, which had not been carried out in previous studies.

METHODS

The present study was carried out in the Department of Orthopedics, Government Medical College, and Rajindra Hospital, Patiala. The study was prospective, manipulative, and controlled. The study was performed on 40 patients with tibia diaphyseal fractures involving different

segments of bone. The fractures were classified according to the AO [4] classification system. The study included patients irrespective of their gender and age (excluding patients <18 years of age). All closed and open fractures up to Gustilo 3A [5] were included in our study; shaft fractures with intra-articular extension and periarticular fractures were excluded.

The clinical and radiological findings of fracture healing in each patient are used to determine the success and length of time for tibia fractures treated with intramedullary osteosynthesis. A clinical examination was performed by a single examiner. Clinical signs of healing emphasize: rigidity and lack of crepitation at the fracture site; no tenderness at the site of the fracture with palpation and percussion; and the absence of pain in full weight bearing, irrespective of support. Radiological analysis by mRUST [6] (modified radiographic union score for tibia) in which a score is given to the visible cortices in 2 orthogonal radiographs (anteroposterior and lateral) taking into consideration the callus and visible fracture line, the final score is a sum of 4 cortex scores, and a united fracture was considered with a score of 4 (Table 2).

RESULTS

Out of 40 patients in our study group who met the inclusion criteria, were operated on. Demographic details and clinical characteristics were homogeneous and comparable between the 2 groups of patients (Table 1).

In our study, the average fracture healing time was15.60 weeks.

Sixteen out of the 40 patients (40%) had at least one complication (Table 3). Five cases of non-union were detected. There were three cases of delayed union in which dynamization were done. In patients who underwent dynamization, there were three mechanical complications of shortening with collapse in an oblique fracture pattern. Overall, eleven patients required some form of surgical intervention throughout treatment. In 8 cases, an intervention was necessary due to a biological complication (delayed union and/or non-union), and in 3 cases due to a mechanical cause.

DISCUSSION

In this study, male patients were higher in number than females, which can be attributed to their increased involvement in outdoor activities. The most common cause of fracture in our study was road traffic accidents. The majority of patients were in the age group 31–45. The time to fracture union in our study was 16 weeks. Out of 40 participants, 16 had complications.

Of the 40 patients, 29 were males and 11 were females. The incidence of males is higher because of their more outdoor activities, while women confine themselves to domestic activities. Similar male involvement has been seen in a study conducted by Hernández-Vaquero *et al*. [7] In our study, the majority of the patients were in the age group of 31–45 years. There were 18 (45%) patients in this age group in our study. The average age of the patients in our study was 34.50 years. Diaphyseal fractures of the tibia were seen in the younger age group, as they are most physically active and engaged in increased various outdoor activities, and, as a result, most of the injuries sustained were high-velocity injuries. Similar results were seen in a study conducted by Khan *et al*. [8] The majority of the tibial diaphyseal fractures occurred due to road traffic accidents (35 patients). In the majority of cases, they involved patients who were motorists, while the remaining patients tended to be pedestrians or motor vehicle occupants. This can be attributed to the poor road traffic sense and poor quality of roads, leading to a higher incidence of road traffic accidents in our country. Similar results were reported by Reddy and Reddy [9].

Fracture union was considered when the patient was full-weight bearing without pain, the fracture site was not tender on palpation, and a radiograph showed osseous union. In our series, the majority of fractures united within 16 weeks. Similar results were observed by Hernández-Vaquero *et al*. [7] and Somani *et al*. [10] in their studies.

Table 1: Demographic details and clinical characteristics

Parameter	Patients
Male	29
Female	11
Age (Mean±SD)	34.50±10.99
Mode of Injury	
RSA	5
Fall	33
AO Classification	
A1-A3	28
B1-B3	9
C1-C3	3
Gustilo	
Closed	27
1	6
2	5
3a	2

Table 2: Fracture Union time (in weeks)

Parameter	Total patients
Union time in weeks	15.60±1.27
mRUST	
1	4
2	3
3	4
4	29

Table 3: Complications

Complications	Patients
Delayed union	3
Non-union	5
Valgus deformity	2
Varus deformity	3
Shortening	3
No complication	24
Total	40

Sixteen out of the 40 patients (40%) had at least one complication. Five cases (12.5%) of non-union were detected, which were treated with exchange nailing with fibula osteotomy and auto-graft. There were three cases of delayed union, which were treated by the removal of the proximal static locking screw and a fibular osteotomy. There were three mechanical complications of shortening with collapse in an oblique fracture pattern. 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. Similar results were obtained by Hernández-Vaquero *et al*. [7] and Somani *et al*. [10] in their studies.

It was one of the limited studies that studied the efficacy of nail dynamization. This study has limitations. This study did not investigate the cause of primary procedure failure. The follow-up of patients post-secondary surgery (dynamization) is not mentioned. The time period when dynamization is required is not clearly defined.

CONCLUSION

A minimally invasive surgical technique called IMN does not expose any bone fragments and does not cause significant bleeding. IMN has multi-purpose capabilities, is usually the definitive solution for the treatment of fractures of the femur and tibia, and allows early mobilization and

early rehabilitation, all of which contribute to an earlier load and reliance on a limb or the acceleration of bone healing. The inability to move between fragments caused by static IMN directly promotes the development of an angiogenic minimal callus with sharp edges and a dense structure. The best suggestions for treating comminuted fractures include static intramedullary osteosynthesis, which solves the issues of stabilizing the fracture, limb shortening, and fragment rotation. A large (stimulus) callus with hazy outlines and turbulent structure is produced by dynamic intramedullary osteosynthesis, which applies force to the fracture.

Our research confirms the idea that the dynamic mode configuration should be used with the new intramedullary nail designs that are currently accessible.

Despite the fact that not all patients with delayed union or non-union should receive dynamization, it is still preferred to compression plating or exchange nailing and bone grafting due to its low morbidity, speedy healing, and simplicity of use.

ETHICAL COMMITTEE APPROVAL

Ethical committee approval was obtained from the Institutional Ethics Committee.

CONFLICTS OF INTEREST

None.

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Self.

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