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A study on management of tibial diaphyseal fractures by interlocking intramedullary nailing

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Abstract
Background: Tibia is the most commonly fractured long bone in the human body. Operative treatment is indicated for most tibial shaft fractures caused by high-energy trauma. Locked intramedullary nailing currently is considered the treatment of choice for most tibial diaphyseal fractures. The purpose of this study was to evaluate the effectiveness of intrerlocking intramedullary nailing in the management of tibial diaphyseal fractures in relation to achievement of union and functional results.
Methods: This was a prospective observational study conducted on 40 patients of either sex with an average age of 41.6 years presenting to the Orthopaedic department of SHKM Government Medical College Hospital, Nalhar, Nuh, Haryana between September 2015 and November 2017, with a diagnosis of fracture shaft of tibia. All the patients underwent internal fixation with interlocking intramedullary nails. The patients were followed up for a period of 1 year. The patients were analysed for union and functional results using the Johner and Wruh's criteria.
Results: All the fractures united and the average time of union was 19.45 weeks. According to Johner and Wruh's criteria, the results were excellent in 28(70%), good in 8(20%), fair in 3(7.5%) and poor in 1(2.5%) of the patients respectively in our study.
Conclusions: Thus results of our study demonstrate that interlocking intramedullary nailing is a safe and effective surgical procedure for the treatment of tibial diaphyseal fractures.

Keywords: tibia, diaphyseal fractures, internal fixation, intramedullary, interlocking nail, union

Introduction

The tibia because of its location, is the most commonly fractured long bone. Because one third of the tibial surface is subcutaneous throughout most of its length, open fractures are more common in the tibia than in any other major long bone. The blood supply to the tibia is more precarious than that of bones enclosed by heavy muscles. High-energy tibial fractures may be associated with compartment syndrome or neural or vascular injury. The presence of hinge joints at the knee and the ankle allows no adjustment for rotatory deformity after fracture, and special care is necessary during reduction to correct such deformity. Delayed union, nonunion and infection are relatively common complications of tibial shaft fractures [1, 2].

The management of tibial diaphyseal fractures is decided taking into account several factors which include velocity of trauma, amount of displacement, degree of communition, associated injuries, soft tissue conditions and neurovascular status of the limb [3]. Nonoperative treatment is indicated for closed, stable, isolated, minimally displaced fractures caused by low-energy trauma and some stable low-velocity gunshot fractures. Closed treatment with casting or functional bracing has been found to be quite effective in these fractures [4-9]. Operative treatment is indicated for most tibial fractures caused by high-energy trauma. These fractures usually are unstable, comminuted, and associated with varying degrees of soft-tissue trauma. Operative treatment allows early motion, provides soft-tissue access, and avoids complications associated with immobilization. The various modalities of operative management of tibial diaphyseal fractures include plate and screw fixation, external fixation and intramedullary nailing. Locked intramedullary nailing currently is considered the treatment of choice for most type I, type II, and type IIIA open and closed tibial shaft fractures and is especially useful for segmental and bilateral tibial fractures. Intramedullary nailing preserves the soft-tissue sleeve around the fracture site and allows early motion of the adjacent joints. The ability to lock the nails proximally and distally provides control of length, alignment, and rotation in unstable fractures and permits stabilization of fractures located below the tibial tubercle or 3 to 4 cm proximal to the ankle joint. The effectiveness of interlocking intramedullary nailing in the management of tibial diaphyseal fractures has been demonstrated by several clinical studies over the years [10-16].

In the present study we evaluated the effectiveness of interlocking intramedullary nailing in the management of tibial diaphyseal fractures through the assessment of attainment of union of the fracture and functional results of the limb, using the Johner and Wruh's criteria.

2. Materials and methods

After approval by the institutional ethics committee and informed written consent, the study was started. This was a prospective observational study conducted on 40 patients of either sex with an average age of 41.6 years presenting to the Orthopaedic Department of SHKM Government Medical College Hospital, Nalhar, Nuh, Haryana between September 2015 and November 2017, with a diagnosis of fracture shaft of tibia. The sex distribution was 26 males and 14 females.

2.1 Inclusion criteria

1. Age greater than 18 and less than 70 years.
2. Closed tibial diaphyseal fractures.
3. Open grade Ⅰ, Ⅱ and ⅢA fractures.
4. Injury to presentation interval less than 3 weeks.

2.2 Exclusion criteria

1. Age less than 18 and greater than 70 years.
2. Open grade ⅢB and ⅢC fractures.
3. Patients with anatomical deformities of tibia.
4. Patients with burns or wounds over the entry portal.
5. Injury to presentation interval greater than 3 weeks.
6. Non unions.
7. Polytrauma patients.

At presentation all the patients were thoroughly examined and neurovascular assessment of the limb was done. Standard anteroposterior and lateral radiographs of the injured leg, along with the ipsilateral knee and ankle joints were obtained. Above knee plaster of Paris slab was applied. In the case of open fractures, thorough lavage of the wound with normal saline was done, intravenous antibiotics and tetanus toxoid were administered. The patients were admitted and preoperative anaesthetic checkup was done. The surgery was done as soon as the patients obtained anaesthetic clearance. The surgical procedure was explained to the patients in detail and informed written consent was taken.

2.3 Surgical technique

After administration of spinal anaesthesia, the patients were placed in supine position on a standard fluorescent operating table. The painting and draping of the surgical site was done. A 5-cm incision was made along the medial border of the patellar tendon, extending from the tibial tubercle in a proximal direction. The entry portal was made via curved awl, which was introduced anteriorly proximal to the tibial tubercle at the level of the tip of the fibular head (approximately 1.5 cm distal to the knee joint) and in line with the centre of the medullary canal. Proper placement of the awl was confirmed fluoroscopically. Now the guide wire was inserted and closed reduction was done by traction and manipulation at the fracture site. The guide wire was passed across the fracture site into the distal fragment. If closed reduction could not be attained, then open reduction was done by a small anterolateral incision given at the fracture site. Reduction was confirmed under C arm. Reaming was done and an interlocking intramedullary nail of appropriate size was inserted. Proximal locking was done with the help of zig and distal locking was done freehand with the help of image intensifier. Haemostasis was achieved and the wounds were closed in a standard fashion. Antiseptic dressing was done and the patients were shifted out of the operation theatre.

Standard postoperative care pathway was followed for these patients. Antiseptic dressing was done after 48 hours and anteroposterior and lateral radiographs of the leg were obtained. Knee and ankle range of motion was started and non-weight bearing ambulation with walker was allowed. The average duration of hospital stay was 5 days. At the time of discharge patients were instructed about physiotherapy and weight bearing protocols. The sutures were removed after 15 days of surgery. For the first 2 months patients were asked to follow up at 2 week intervals and later on once a month for a period of 1 year following surgery. At follow ups standard AP and lateral radiographs of the leg were taken. Weight bearing was gradually increased according to callus formation visible on radiographs. Walking aids were discarded at 6 to 8 weeks after surgery. The fracture was defined as united if a minimum of 3 cortices showed bridging callus on radiographs. The patients were followed up for a period of 1 year and after this period all the data collected was subjected to analysis.

2.4 Statistical methods

The data was analysed with SPSS version 17.0 software. The demographic variables were assessed by number and percentage. Simple arithmetic mean was used for the description of the values of the time taken for union in weeks. Johner and Wruh's criteria(Table1.) were used for assessment of results.

Table 1: Johner and Wruh's criteria for assessment of results.

S. No	Criteria	Excellent(Left=Right)	Good	Fair	Poor
1.	Non-unions,osteitis, amputation	None	None	None	Yes
2.	Neurovascular disturbances	None	Minimal	Moderate	Severe
3.	Deformity				
	Varus/ Valgus	None	2-5°	6-10°	>10°
	Anteversion/ Recurvation	0-5º	6-10º	11-20º	>20º
	Rotation	0-5º	6-10º	11-20º	>20º
4.	Shortening	0-5mm	6-10mm	11-20 mm	>20mm
5.	Mobility				
	Knee	Normal	>80%	>75%	<75%
	Ankle	Normal	>75%	>50%	<50%
	Subtalar	>75%	>50%	<50%	-
6.	Pain	None	Occasional	Moderate	Severe
7.	Gait	Normal	Normal	Insignificant Limp	Significant Limp
8.	Strenuous activities	Possible	Limited	Severely Limited	Impossible
9.	Radiological Union	Consolidated	Consolidated	Union	Not Consolidated

3. Results

This was a prospective observational study. The fractures of all the patients in this study united with an average duration of 19.45 weeks. According to Johner and Wruh's criteria the results were excellent in 28(70%), good in 8(20%), fair in 3(7.5%) and poor in 1(2.5%) of the patients respectively in our study. Two patients developed superficial skin infections which resolved with antibiotics and local drainage. One patient had delayed union and bone grafting was done to achieve union.

Table 2: Age Distribution.

Age in years	No. of patients	Percentage (%)
18-20	2	5
21-30	9	22.5
31-40	9	22.5
41-50	10	25
51-60	6	15
61-70	4	10
Total	40	100

Table 3: Sex Distribution.

Gender	No. of patients	Percentage (%)
Male	26	65
Female	14	35
Total	40	100

Table 4: Table depicting the results of the study

Parameters	Mean age of the patients in years.	Mean time taken for union in weeks	Johner and Wruh's criteria at follow up in various patients by number and percentage			
Values of the parameters	41.6	19.45	Excellent	Good	Fair	Poor
			28(70%)	8(20%)	3(7.5%)	1(2.5%)

Fig 1: Anteroposterior and lateral radiographs of a displaced tibial diaphyseal fracture.

Fig 2: Postoperative anteroposterior and lateral radiographs of a tibial diaphyseal fracture fixed with an interlocking intramedullary nail.

Fig 3: Follow up anteroposterior and lateral radiographs of a tibial diaphyseal fracture fixed with interlocking intramedullary nail depicting union at the fracture site.

4. Discussion

Interlocking intramedullary nailing is considered the mainstay in the management of most of the unstable, displaced, high velocity trauma induced tibial diaphyseal fractures in the adults. The advent of interlocking intramedullary nails has revolutionized the management of tibial diaphyseal fractures. This method of fixation allows appropriate reduction, stable fixation, maintanence of alignment, attainment of length and control of rotation by the insertion of locking screws [17-19]. These advantages of interlocking intramedullary nails coupled with protection of the soft tissue sleeve around the fracture site, in contrast to other fixation techniques like plate and screw fixation which involves soft-tissue stripping, which can lead to wound complications and infection, have made them the implant of choice for fixation of tibial diaphyseal fractures [20].

In our present study we evaluated the effectiveness of interlocking intramedullary nailing in the management of tibial diaphyseal fractures in relation to achievement of union and functional results. Johner and Wruh's criteria(Table1.) were used for assessment of results. This was a prospective observational study conducted on 40 patients of either sex (Table 3.) with an average age of 41.6 years (Tables 2,4), with the diagnosis of tibial diaphyseal fractures (Fig 1.). All the patients underwent interlocking intramedullary nailing (Fig 2.). The fractures of all the patients in this study united (Fig 3.) with an average duration of 19.45 weeks (Table 4.). Majority of the patients in our study had satisfactory functional results at follow up. According to Johner and Wruh's criteria the results (Table 4.) were excellent in 28(70%), good in 8(20%), fair in 3(7.5%) and poor in 1(2.5%) of the patients respectively in our study. Two patients developed superficial skin infections which resolved with antibiotics and local drainage. One patient had delayed union and required bone grafting for attainment of union.

The results of our study are quite comparable to other studies [21, 22, 23, 24]. done about this procedure. In the study by Kurupati *et al*, [21] the average time of union was 17.35 weeks and the Johner and Wruh's criteria were excellent in 13 (59.09%), good in 5(22.72%) and fair in 2(9.09%) of the patients, which compares quite favourably to our study. In the study by Chauhan, *et al*[22] the average time of union was 20.13 weeks and the Johner and Wruh's criteria were excellent in 23 patients (76.67%), good in 5 (16.67%) and fair in 2(6.67%) of the patients,which also compares favourably to our study. In the study by Patel *et al*. [23] the average time of union was 17.68 weeks, while in the study by Brown *et al*. [24] the average time of union was 15.4 weeks, which compares quite favourably to our study.

5. Conclusion

From the above analysis we can infer that interlocking intramedullary nailing is a safe and effective surgical procedure for the management of tibial diaphyseal fractures with a high rate of union and excellent functional results.

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