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MANAGEMENT OF COMMINUTED TIBIAL DIAPHYSEAL FRACTURES BY MEANS OF INTERLOCKING NAILS

Orthopaedics

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ABSTRACT

Introduction: This study assesses the outcome of interlocking tibia nail in comminuted fractures of tibial diaphysis.

Objectives: To study the functional outcomes of interlocking tibia nail in comminuted tibial diaphyseal fractures, with respect to time to bony union, mobility achieved, complications of the procedure and secondary procedures.

Material and Methods: The present prospective study included 25 patients of comminuted fracture shaft of tibia admitted to the Department of Orthopaedics at MMIMSR, Mullana and at Civil Hospital, Rajpura who were managed with interlocking tibia nail.

Results: All 25 cases united with interlocking nailing. 1 case needed additional exchange nailing and bone grafting. 3 cases had a malunion but had an acceptable functional outcome.

Conclusions: Due to the simple surgical technique, good healing rate and minimum complications, it is recommended that interlocking tibia nail should be used in comminuted fractures of tibial diaphysis.

KEYWORDS

comminuted fractures, tibial diaphysis, interlocking nail

INTRODUCTION

The management of tibial diaphyseal fractures has always held a particular interest for orthopaedic surgeons.[1] The simple spiral fractures, isolated to the tibia, are the most common fracture pattern (34% of tibial shaft fractures), although there is a higher prevalence of high-energy trauma and complex fracture patterns in young, adult males.[2] Comminuted fractures of the shaft of tibia are the most commonly encountered fractures in high energy trauma cases. The treatment of comminuted fractures of tibial diaphysis are challenging because there is a higher risk of nonunion, malunion and infection. Hence, the treatment options are varied ranging from bridge plating to external fixators to intramedullary nailing. There is a significant increase in complications as open reduction and internal fixation with plates and screws.[3] The complications increased from 9.5% from Group A fractures to 18.1% for group B fractures to 48.3% for group C patients (comminuted) fractures.[3]

Intramedullary nailing techniques yielded a 98% union rate, 3.3% infection rate and no malunions compared to a 90.1% union rate 1.4% infection rate and 43% malunions in the cast immobilisation group.[4]

In view of the comminution of bone and subcutaneous nature of the tibia, the risk of infection at fracture site and risk of loss of soft tissue cover, surgical options could be confounding. The advantages of plating are that it gives an anatomic reduction of fracture but there is an increased risk of soft tissue envelope failure. The advantage of putting an external fixator is that there is no soft tissue trauma or risk of skin blackening as with plating. However, the reduction of fracture fragments is not so good because reduction is primarily achieved by ligamentotaxis and there is risk of pin site infections and loss of reduction due to poor construct strength. The advantage of nailing is that it produces a stable fixation with minimal soft tissue damage, preservation of endosteal blood supply leading to early union.

Duwelius et al[5] concluded that the tibial nails provided adequate stabilisation of displaced tibial shaft fracture either open or closed. Static locking is required in axially unstable fractures.

This study was planned to see the utility of interlocking tibia nail in successfully treating comminuted fractures of tibial diaphysis.

MATERIAL AND METHODS

The present prospective study included twenty-five patients of fracture shaft of tibia (Type B&C, AO/OTA classification) admitted to the Department of Orthopaedics at Maharishi Markandeshwar Medical College, Mullana and from Civil Hospital Rajpura from June 2010 to July 2014. The patients admitted with comminuted fracture shaft tibia were evaluated in the emergency with attention to airway, breathing and circulation of trauma care. Primary survey of the patient was conducted regarding the presence of other associated injuries and complications. The patients with epiphyseal injuries, epiphyseal plate not fused and the patients who had associated head injury/abdominal injury requiring surgery were excluded form the study. The patients with poor skin condition and who had Gustilo Anderson compound Grade IIIc injuries were also not included in the study.

Preoperative treatment was given in the form of splintage, antiseptic dressing, antibiotics, analgesics, anti-inflammatory drugs, intravenous fluids as required.

Surgical Technique: Patient was put in supine position and draping was done under all aseptic and antiseptic conditions. For interlocking nailing, nail insertion site was located just proximal to the tibial tuberosity in the line with the medullary cavity of the tibia by patellar tendon splitting or retracting approach. Medullary cavity was opened by reciprocating movement of the curved bone awl. A ball tipped guide wire was inserted through the entry point into the canal and passed across the fracture site under fluoroscopic guidance.

Reaming of canal was done with knee in flexion over the custom made knee flexion frame which was C-Arm compatible. After completion of reaming, the exchange of ball tipped guide rod was done with smooth tip for nail insertion. Comminuted fractures required preoperative radiographic measurement of the contra-lateral tibia to assess the proper length of affected tibia. The distal tip of the nail lied approximately 0.5 to 2.0 cm from the subchondral bone of the ankle joint. Distal locking was done by using free hand technique. The nails were statically locked. Patellar tendon was repaired by suturing the paratenon with an absorbable suture, and skin sutured using a non absorbable suture. Crepe bandage was applied after aseptic dressing.

Post-operatively, non weight-bearing toe-touch ambulation was started as soon as pain was bearable. Check X-rays were done at regular intervals. More than 50% visible bridging callus across the fracture on plain radiograph was regarded as indicator of fracture healing. Complications like non-union, shortening, infection were recorded.

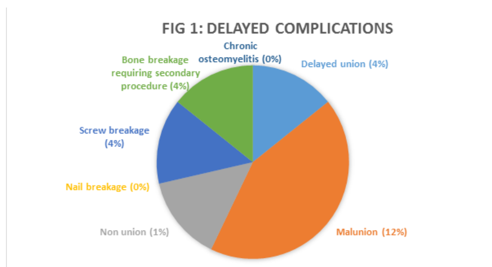
RESULTS

The study included 25 patients, with mean age of 31.88 years. The right sided fractures were 15 (60%) and the rest 10 (40%) were left sided fractures. The fracture cases included in the study were classified, based on OTA classification, as shown in Table1.

Table1: Types of fractures seen in the 25 patients

OTA classification	No of patients	Percentage
B (Wedge)	17/25	68%
B1 (Wedge spiral)	4	23.5% of all Type B
B2 (Wedge bending)	9	53% of all Type B
B3 (Wedge 2 part)	4	23.5% of all Type B
C (Complex)	8/25	32%
C1 (Complex spiral)	2	25% of all Type C
C2 (Segmental)	5	62.5% of all Type C
C3 (Complex comminuted)	1	12.5% of all Type C

Intra-operative complications: The difficulty in locking was encountered in 7 of the patients. Superficial infection was observed in four cases, who presented as local redness with sero-sanguinous discharge. The infection was treated by appropriate intravenous antimicrobials and daily aseptic dressings. The delayed complications were as shown in Fig 1.



In our study, there was one patient of non union. Exchange nailing was done with onlay cancellous bone grafting providing a stable fixation but had malunited fracture. The fracture united in all cases. All fractures united with the average time interval of 18.5 weeks for closed fractures and 27.8 weeks for compound fractures. In our study, 3 cases with delayed union were encountered.

Table 2: The time to union of fractures.

In weeks	No of closed cases	No of open cases	Percentage
Less than 12	0	0	0%
13-16	3	0	12%
17-20	9	0	36%
21-24	9	0	36%
25-28	2	2	4%
>28	2	1	8%

DISCUSSION

The type of open fractures treated in our study were compared to 4 other studies by Mansoor et al6, Lefaivre et al7, Whittle AP 8, Bone et al9, as explained in Fig 2.

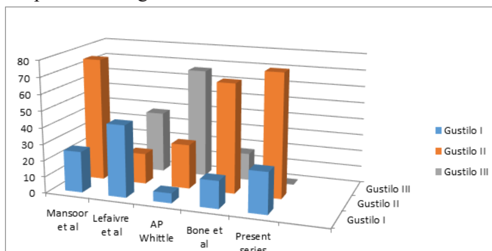


Fig 2: Open fracture type in present study as compared to other studies

The open fractures were classified according to the Gustilo Anderson Open Fracture classification. Bone et al[9] and Mansoor et al[6] showed Grade II being the most common open fractures, being treated by interlock nailing. In a study by Whittle et al[8], where treated Grade III open fractures were more common, followed by Grade II and Grade I being the least common type.

Delayed post-operative complications were seen in 3 of our cases, whereas other studies mentioned had more number of complications. A study by Joshi et al[10] showed delayed union in six of its cases and also non-union with osteomyelitis in six of its cases. There was implant failure in ten of its cases. Ali et al[11] showed delayed union in three of its cases with non union in seven of its cases with none having osteomyelitis. They also had 2 cases with implant failure. The study conducted by AS Dogra[12] showed nineteen cases showing delayed union, with nine showing implant failure. However, they reported union in all of their cases

Schandelmaier et al[13] while studying nailing and fixators reported insignificant difference in the number of cases of delayed union. Tornetta et al[14] reported 2 cases of delayed union for nailing as well as that for external fixator. They had no case of non-union in their study.

In present study, there was malunion in three of our cases. In one case the fixation was inappropriate and resulted into non-union. Exchange nailing was done and onlay cancellous bone graft was applied from anterior aspect. The fracture united after 42 weeks in malunion.

A study conducted by Bonnevialle et al[15] included 142 cases in which fibula was intact in 10 cases and fractured in 132. The tibia was surgically treated (126 fractures), the fibular lesion was not treated in 79 cases. In their study, nine were treated with intramedullary pinning and 38 with plate and screws.[15] The rate of pseudo-arthrosis of the fibular fracture was 4.7% at 1 year; in all these cases, fibular treatment had been conservative.[15] All treatments combined, the tibial axes were statistically better corrected when the fibula was treated with fixation.[15] The consequences of fibular fixation perpetuating a tibial reduction abnormality or on the contrary the absence of fibular fixation appeared as probable factors of residual reduction defects, lack of stability of tibio-fibular complex, and tibia non-union.[15]

According to Jinn Lin et al[16], mal-alignment of the fractures, tends to occur at the proximal or distal part of the tibia. Mal-alignment of the proximal fractures resulting from eccentric insertion of nails could be prevented by aiming the nails precisely at the centre line of the medullary canal[17]. It is essential that the alignment of the fractures be meticulously examined with a fluoroscope before the locking screws are applied.[16]

In our study, all fractures united with the average time interval of 18.5 weeks for closed fractures and 27.8 weeks for compound fractures with an overall mean union of 23.15 weeks.

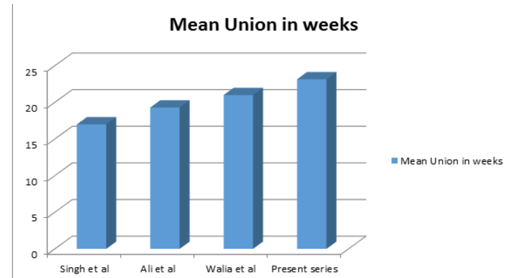


Fig 3: Mean union (in weeks) of fractures in cases

A study by Singh et al[18] included 15 men and 3 women aged 25-58 years (mean age 37 years) underwent unreamed intramedullary nailing. In their study, 16 patients had bone union within 20 weeks (with open mean: 17; range: 14-27).[18]

According to Ali et al[11] study, the mean time of union of closed fractures and Gustilo type I fractures of diaphysis was 16.4± 2.13 weeks (13 to 19 weeks). It is similar to the study of Court-Brown and co-workers[19], who reported union time as 16.9 weeks, Bostman and Hanninen[20] reported 15.3 weeks of union time. Tornetta and co workers[14] reported in their studies that all open fractures of type IIIB unite in an average time of 23 weeks.

According to Walia et al[21], all cases in their study united with an average time interval of 21 weeks. The authors believed that reaming helps to shorten the union time. This has been supported by other studies also. Bone et al[9], in one of the earliest, a large study of interlock nailing, reported an average healing time of 17.8 weeks and concluded that the reamed nail was best used for closed unstable fractures. Court-Brown CM et al[19] made a prospective study in 50 cases and concluded that reamed nailing is better than unreamed nailing in tibial closed fractures. Blachut et al[22] concluded that there is a high prevalence of delayed union and breakage of screws after nailing without reaming. Larsen et al[23] studied 45 patients and concluded that the average time of fracture healing was 16.7 weeks in reamed group and 25.7 weeks in unreamed group.

CONCLUSION

The study asses the ability of comminuted tibia fractures to unite satisfactorily with interlocking nailing. There was union in about 90% cases at 6 months and superficial infection was noted in 4 patients which healed satisfactorily. Taking into consideration the simple surgical technique, good healing rate and minimum complications, it is highly recommended that interlocking tibia nail should be used in comminuted fractures of tibial diaphysis.

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