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STABILIZATION OF TIBIAL SHAFT FRACTURES BY REAMED AND UNREAMED INTERLOCKING NAILS - A COMPARATIVE STUDY

Orthopaedics

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ABSTRACT

Background: Tibial fractures were the most common long bone fracture. Closed intramedulary nailing is the treatment of choice in stabilizing displaced diaphyseal fractures of tibia but treatment by reamed versus unreamed intramedullary nailing was still controversial.
Purpose: The aim of the study was to assess relative merits of reamed and unreamed interlocking nails for tibial shaft fractures.
Methods : 40 patients with tibial shaft fractures who satisfy the inclusion criteria were selected. Among the selected, 22 patients were treated with reamed interlocking nailing and 18 patients treated with unreamed interlocking nailing. During the study period we did not lose any patient to follow up and results of all the 40 patients were assessed and analysed.
Results: The unreamed group demonstrated a significant higher rate of nonunion, higher incidence of implant exchange and screw breakage. Malunion was high in unreamed group but not statistically significant. The operating time was almost the same for both reamed and unreamed nails. Regarding the adverse effects like infection, compartment syndrome, and knee pain there was no significant difference between two groups.
Conclusion : From this sample study, we conclude that reamed interlocking nailing have a better edge over unreamed interlocking nailing in closed and open type 1 tibial diaphyseal fractures.

KEYWORDS:

reamed , unreamed ,interlocking nail, tibia

INTRODUCTION

Tibia and fibula have the highest incidence of the diaphyseal fractures of the long bones . They are frequently caused by high energy trauma. Because of the subcutaneous location throughout the diaphyseal length, open fracture ensues. In an average population there are about 26 tibial diaphyseal fractures per 1 lakh population per year. Males are more commonly affected than females with male incidence being about 41 per 1 lakh, and female incidence about 12 per 1 lakh per year. There is a bimodal distribution of tibial fractures with a preponderance of young males.

The aims of treatment for tibial shaft fractures are re-establishing pre-injury anatomy and function with lower complication rates. Several methods have been used for treatment of this fracture, including plaster casts, functional braces, compression plating, reamed or unreamed intramedullary nailing and external fixation .Among them, intramedullary nail fixation has been shown to be an effective method for treating both open and closed tibial fractures. Closed interlocking nailing helps in faster healing of fractures because the fracture haematoma is not disturbed and also periosteal callus formation is not disturbed. Interlocking nails also allow early mobilization and its advantages over other modes of fixation are many.

However, the choice between two alternative intramedullary nailing approaches, reamed or unreamed, is an ongoing controversy. Reamed intramedullary nailing has the advantage of providing optimal biomechanical stability, rapid fracture union, low incidence of secondary procedure; however, reaming of the medullary canal may also lead to endosteal blood flow damage, bone necrosis, compartment syndrome and infection . In theory, unreamed intramedullary nailing does not have the above-mentioned problems associated with reaming, but has higher rate of implant failure, longer time of union due to poor mechanical stability. Both of them have strong rationales and controversy between them still exists.

Keeping this in mind, a study was attempted to compare results between reamed and undreamed nails in closed and open type-I tibial diaphyseal fractures.

MATERIALS AND METHODS:

The present study was conducted in department of orthopaedics at Alluri Sitaramaraju Institute of Medical Sciences, Eluru, between September 2014 to February 2016. 40 patients with tibial shaft fractures who satisfy the inclusion criteria were selected. Among the selected, 22 patients were treated with reamed interlocking nailing and 18 patients treated with unreamed interlocking nailing. During the study period we did not lose any patient to follow up and results of all the 40 patients were assessed and analysed.

Inclusion criteria

- Greater than 18years of age.
- Closed and open type- 1(Gustillo Anderson) fractures.

Exclusion criteria

- Less than 18 years of age.
- Open type-2, 3 fractures (Gustillo Anderson).
- Pathological fractures, fracture non-union and delayed union.

All patients on admission were clinically assessed and stabilized hemodynamically. Radiographs of entire leg including knee and ankle were taken in two planes. Preliminary above knee slab was applied to fractured limb and immobilized till surgery. Routine laboratory investigations were done for all patients. Fitness was obtained for anaesthesia and surgery. Hospital ethical committee permission was secured. They were all operated as per the standard surgical technique.

Routine antibiotics and anti inflamatory drugs were given after the surgery. Active quadriceps exercises are started on 1st post operative day with active ankle and toe movements as far as patient is comfortable. They were assessed radiologically on 2nd post operative day , at 6 weeks ,12 week, and at every 6 weeks interval till radiological union was noted, and more frequently in between if required. **MODIFIED JOHNER AND WRUH'S CRITERIA** (table 1) is used for evaluation of final results.

Table 1: MODIFIED JOHNER AND WRUH'S CRITERIA

S.No	Criteria	Excellent (Left=Right)	Good	Fair	Poor
1	Non-unions, Osteitis, Amputation	None	None	None	Yes

2	Neurovascular Distrubances	None	Minimal	Moderate	Severe
3	Deformity				
a)	Varus / Valgus	None	2^0 - 5^0	6^0 - 10^0	> 10^0
b)	Anteversion / Recurvation	0^0 - 5^0	6^0 - 10^0	11^0 - 20^0	> 20^0
c)	Rotation	0^0 - 5^0	6^0 - 10^0	11^0 - 20^0	> 20^0
4	Shortening	0-5 mm	6-10 mm	11-20mm	>20mm
5	Mobility				
a)	Knee	100%	>75%	>50%	<50%
b)	Ankle	100%	>75%	>50%	<50%
6	Pain	None	Occasional	Moderate	Severe
7	Gait	Normal	Normal	Insignificant limp	Insignificant limp
8	Strenuous activities	Possible	Limited	Severel Limited	Impossible
9	Radiological union	Consolidated	Consolidated	Union	Not consolidated

RESULTS

In our study, 22 patients underwent reamed and 18 patients underwent unreamed interlocking nailing for closed and type-I open fractures of the shaft of tibia from July 2014 to Feb 2016.

Majority of the patients were among the age group of 20-50 years in both the groups (Reamed – 90.9%; Unreamed -94.4%).There was high degree of male preponderance in both groups (Reamed -80%, Unreamed -75%). Left side was more involved than right in both the groups (Reamed -68.1%, Unreamed – 61.1%). Low velocity injuries and falls were the main mode of injury in both the groups (Reamed -68.1%, Unreamed – 61.1%). 17 (77.2%) fractures were closed and 5 (22.7%) fractures were open type-I among reamed group and 12(66.6%) fractures were closed and 6(33.3%) fractures were open type-I among unreamed group. Majority of fractures were located in the middle third of the shaft tibia (45.4% among reamed group and 61.1% among unreamed group).Spiral and Comminuted fractures were predominantly seen among both the groups (reamed – 45.4% spiral and 36.6% comminuted, Unreamed – 33.3% spiral and 55.5% comminuted). Associated fibula fracture was present in all cases

In our study, all the cases were done only after 3 days following the injury and surgery on open fractures were delayed till soft tissues healed; the average delay was 9.4 days. Mean operating time in reamed group was 90 min and in the unreamed group it was 85 minutes. All fractures in reamed and undreamed group are statically locked but not all screw holes were used.Difficulty in fracture reduction was the commonest problem encountered intra operatively among unreamed group.

Most of the patients were able to walk without bearing weight on operated leg within 10 days of surgery in both groups. 95.4% in the reamed group and 77.7% among unreamed group could bear full weight and walk without support by the end of 24 weeks. Complete radiological union was note at the end of 24 weeks in 100% of cases in reamed group and 83.3% in the unreamed group. Exchange nailing was done after 36weeks in 3 cases (16.6%) of unreamed which showed persistent signs of hypertrophic nonunion. All these fractures united after exchange nailing with mean time of union of 48 weeks. Superficial wound infection was noted in 2 patients from each group. Screw failures were noted in 3 patients (16.6%) of unreamed group. Valgus deformity was found in 1 patient (4.5%) in reamed group and 3patients (16.6%) in unreamed group.

Final assessment was done after 32 weeks, taking into account pain, deformity, movement of knee and ankle, ability to do strenuous activity, shortening and radiological union, among both the groups. Among reamed group, 63.3% (14 patients) have got excellent, 31.8% (7 patients) have good, 4.5% (1 patient) have fair and none have poor results. Among unreamed group, 55.5% (10 patients) have got excellent, 16.6% (3 patients) have good, 11.1% (2 patients) have fair and 16.6% (3 patients) had poor results.

DISCUSSION

The outcome of tibial fracture is dependent on many factors, the most important being the type and severity of the fracture and with the type of treatment done. With the advent of interlocking intra-medullary nails, the indications of closed nailing for femur and tibial fractures have greatly expanded. Stabilisation of fractures by intra-medullary nailing has allowed early ambulation of the patient, early mobilization of hip, knee and ankle joints thereby preventing deep vein thrombosis, reducing the hospital stay and early return to work. As rigid internal fixation is never achieved by nailing secondary bone healing with callus is seen due to dynamic controlled motion. As various controversies still exists between reamed or unreamed nailing for closed and open fractures with no conclusive results, this study was attempted to find out whether reamed or undreamed nails would be best for closed and open type-I fractures.

In this study, male patients showed a higher preponderance in both groups and mean age was 36.5 in reamed and 36.6 in undreamed group. Majority of fractures are due to low velocity injuries and and rest are due to RTA. Similar results have been noted by Court-Brown et al (1996)[1]. Most of the patients in the reamed (77%) and undreamed (67%) groups had closed fractures, while in reamed group (23%) and unreamed group (33%) had open type –I fractures.

As intra-medullary nailing helps in early ambulation of the patient, 59% of the patients in the reamed group and 50% of the patients in the unreamed group were able to walk within the first ten

days non-weight bearing with support. It was noted that after 24 weeks 95% of reamed group and 77% of undreamed group are able to weight bear and walk without support. Schemitsch et al (1995)[2] found that cortical vascularity took 6 weeks in unreamed and 12 week in reamed nailing to return to normal. However there is 6 fold increase in periosteal blood supply in reamed nailing according to reichert et al (1995)[3] which helps in fracture union. In this study 77.2% of reamed and 61.1% unreamed patients had clinical union at 6 weeks. The average time for radiological union in reamed group is 18.8 weeks and in unreamed group is 23.8 weeks. This is comparable to Court Brown et al.[1] (1996), Larsen LB et al4 (2004), Bhandari M et al[5] (2008), Liheng Xia et al6 (2014) studies which demonstrated better union rates in reamed nailing compared to unreamed nailing

In this study Nonunion was significantly high in the unreamed (16.6%) rather than reamed group (0%). But some studies of Anglen JO et al (1995)[7] and Klein MP et al (1990)[8] shows that reamed intramedullary nailing might destroy the nutrient artery, which is the main source of blood for 70% of the tibial cortex would impair fracture healing and increase infection. According to Nassif JM et al (2000)[9] and Larsen LB et al (2004)[4] reamed intramedullary nailing results in increased contact area between the implant and the bone surface and thus increases stability, permitting early weight bearing and eventually facilitating fracture union. Reichert IL et al (1995)[3] found that although reaming disrupted the blood flow to the cortex, it induced a 6-fold increase in the periosteal blood flow to overcome lack of endosteal blood flow and improve fracture healing.

Malunion was observed in most of patients of undreamed group. According to Anglen JO et al (1995)7 and Larsen LB et al (2004)4 this

may be due to larger reamed intramedullary nail tending to correct malalignment, whereas thinner more flexible unreamed nailing might increase risk of malunion. In this study, malunion was observed in 1 patient of reamed group (8^0 valgus), and 3 patients of undreamed group (2 patients had 8^0 valgus and 1 patient had 50 valgus). There are no rotational deformities or significant shortening in both the groups.

According to Liheng Xia et al (2014)[6] reamed intramedullary nailing may provide better stability to lower the incidence of implant exchange, and that unreamed intramedullary nailing may protect intramedullary blood supply but reduce the mechanical strength to increase the rates of both implant exchange and dynamization. Annual reoperation rates following tibial fracture repair with the use of nails had been reported to be between 12% and 44% according to Bhandari M et al (2008)[5]. Treatment options include dynamization of the interlocked nail, bone grafting, implant exchange, and electrostimulation. In our study 3 (16.6%) cases in unreamed group showed persistent hypertrophic nonunion for which implant exchange was done after 36 weeks. All fractures united after exchange nailing with mean time of union being 48 weeks which is comparable to Court-Brown et al (1996)[1].

Screw failures were noted in 3 patients (16.6%) of unreamed group. All the screws failed at the distal end but did not interfere with the union time of the fracture, probably because the nail would have functioned a dynamised one. Frequent failures of distal screws in statically locked nails have been reported by Whittle et al (1992)[10] (24%), Gregory P(15%) and Duweluis et al(24%), and was present in this study also. The increased risk of screw breakage of unreamed intramedullary nailing was directly related to its smaller diameter, which was more prone to fatigue failure (Finkemeier CG et al) [11]. unreamed intramedullary nailing and weak locking bolts could not offer a tight fit with the area of cortex that the nails contacted with, there was more cyclical loading and an increased chance of breakage for the distal locking screws . The relatively high incidence of screw breakage may also be related to the fact that patients were allowed to bear weight too early.

In this study, 2 patients in the reamed group and 2 patients in the unreamed group all with open fracture developed superficial infection after 10 days which subsided with local dressings and antibiotics. Management of infection after intra-medullary nailing is highly taxing for the surgeon and for the patient. The incidence of infection has been noted to the higher in open fractures and with reamed intra-medullary nailing. There is no major advantage to nailing without reaming compared to nailing with reaming for the treatment of closed fractures of the shaft of the tibia according Blachut *et al* (1997)[12].

The development of compartment syndrome after reamed intramedullary nailing has been reported and well documented by G J Tischenko et al (1990)[13]. In this study there was no incidence of compartment syndrome after surgery, in both the groups similar results are noted by vishwanath naik et al (2016)[14].

In this study there was no significant difference in knee pain. 4(18%) patients in reamed group and 3 (17%) patients in unreamed group had nail prominence producing anterior knee pain with restriction of movements in the knee. The implants were removed after the fractures have united. By the end of this study 4 patients in reamed group and 3 patients in undreamed group had their nails removed after consolidation of fracture.

Functional Outcome was assessd in our series at 6 months using the **Johner and Wruh's Criteria**. In our series, among reamed group, 63.6% (14 patients) have got excellent, 31.8% (7 patients) have good, 4.5% (1 patient) have fair and none have poor results. Among unreamed group, 55.5% (10 patients) have got excellent, 16.6% (3 patients) have good, 11.1% (2 patients) have fair and 16.6% (3 patients) had poor results. This study is comparable to Court Brown et al.[1] (1996), Larsen LB et al4 (2004), Bhandari M et al[5] (2008), Liheng Xia et al[6] (2014) and viswanath et al[14].(2016), studies which also concluded that reamed interlocking nail has better edge over undreamed nails in reducing rates of nonunion, exchange nailing and screw breakage.

CONCLUSION:

The incidence of tibial shaft fractures is on raise because of the fast and high speed transportation and modern hurried lifestyles. While there are several methods of therapeutic interventions for tibial shaft fractures, Interlocking nailing seemed to be an effective method in the treatment of closed and open type-I diaphyseal fracture.

This study is conducted to assess relative merits of reamed and unreamed interlocking nailing for tibial shaft fractures. In our study the unreamed group demonstrated a significant higher rate of nonunion, higher incidence of implant exchange and screw breakage. Malunion was high in unreamed group but not statistically significant. The operating time was almost the same for both reamed and unreamed nails. Regarding the adverse effects like infection, compartment syndrome, and knee pain there was no significant difference between two groups.

From this sample study, we conclude that reamed interlocking nailing have a better edge over unreamed interlocking nailing in closed and open type 1 tibial diaphyseal fractures.

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