ORIGINAL ARTICLE

A COMPARATIVE STUDY OF REAMED AND UNREAMED INTRAMEDULLARY INTERLOCKING NAILING IN COMPOUND FRACTURES OF SHAFT OF TIBIA

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ABSTRACT: INTRODUCTION: Whether to ream the compound tibia fractures witle intramedullary interlocking nailing or not has been an eternal debate. So we have conducted a study to compare the functional outcomes, rate of infection and time needed for union in reamed and unreamed interlocking nailing on open tibia fractures. **METHODOLOGY:** This study was carried out as a prospective, comparative study. 100 patients with open fractures of tibial shaft admitted in our hospital between June 2011 and January 2013 were enrolled in the study. Patients outside the age group of 20-50years of age, severely ommuniated fractures and fractures classified under Gustilo Anderson type IIIb and IIIc were excluded. 100 fractures were divided into two groups (reamed nailing and unreamed nailing) n=50 in each with simple randomization technique. Evaluation in the form of radiological union was done with serial x-rays and functional grading according to Klemm & Borner's criteria for tibial shaft fractures was done at the end of 6 months. **RESULTS:** Average fracture healing time was 16-20 weeks in both in undreamed nailing radiologically. Also, differences in rates of clinical union, clinical outcome, time for weight bearing and complication in both groups were not significant. Post-operative infection was found in 5 cases in reamed group and 3 cases in unreamed group. **CONCLUSION:** There are no clear indications or contraindications or advantage/disadvantage to favour either reamed or unreamed nailing over each other. Fracture union, functional outcome and rate of complications are similar in both groups.

KEYWORDS: Reamed versus unreamed intramedullary interlocking nailing; fractures of shaft of tibia.

INTRODUCTION: With increasing number of vehicles on the roads in India, complex trauma cases caused by traffic accidents have increased progressively. Tibia is one of the most common bones to sustain open injury. Because of its subcutaneous position, fractures of the tibia more commonly result in an open fracture than any other long bone. Indirect injuries are usually low energy and the open fracture occurs from within. Direct injury is usually high energy and result in open fracture. The treatment of open fractures requires the simultaneous management of both skeletal and soft tissue injury.[1] Controlling the instability of the bone provides a number of benefits. The continued damage to the surrounding tissue by displaced bone fragments is decreased, care of the soft tissue injuries is facilitated, and the patients comfort is increased. The major factors affecting the prognosis of open tibial fractures after high-energy trauma are the

severity of soft-tissue injuries, degree of contamination, fracture configuration, and the extent of commination. The optimum method of skeletal stabilization for open fractures of the tibial shaft continues to be source of controversy.

These goals must be met for the successful treatment of open fractures of tibia, the prevention of infection, the achievement of bony union and the restoration of function. These goals are interdependent and usually are achieved in chronologically order given.[2] For example, failure to prevent infection promotes delayed union or non-union and delays functional recovery of the limb.

Intramedullary nails have been employed as a successful option for treatment of open tibial fractures and have been associated with low rates of postoperative infection as compared to plate osteosynthesis and casting. However, the unlocked nails were contraindicated for comminuted fractures as there tends to be shortening or displacement of such fractures around this small nails.[3]

The emergence of the interlocking intramedullary nails has changed the scenario. It gets fixed to the major proximal and distal fragments and decreases the prevalence of mal union of comminuted fractures. But intramedullary nailing with reaming of the medullary canalis generally considered to be contraindicated for open fractures of the tibia, as the damage to the endosteal blood supply caused by reaming may theoretically increase the risks of non-union and deep infection. It has, therefore, been suggested that insertion of nails without reaming is safer. Recent studies have indicated, however, that nailing either with or without reaming can be used for open tibial fractures with acceptable results**.**

This debate of whether to ream or not in open tibial fractures has been a major one recently. So we have conducted this study to try to put some valuable information in this ongoing debate.

MATERIALS AND METHODS: The present study is a prospective comparative study. 100 patients with open fractures of tibial shaft admitted in our hospital between June 2011 and January 2013 were enrolled in the study. All the open fractures were classified according to Gustillo- Anderson's classification system. Patients less than 20 years and more than 50 years and patients with any other lower extremity fracture were excluded from the study. Patients with Gustilo Anderson's type IIIb and IIIc fractures and with heavy commination were also excluded. Patients were divided into two groups with simple random technique. All fractures were operated with closed interlocking intramedullary nailing. 50 patients in group A were treated with debridement and reamed interlocking intramedullary nailing and 50 patients in group B were treated with debridement and unreamed interlocking intramedullary nailing.

All the selected patients had a minimum follow up of atleast6 months. All the patients in both the groups were assessed for fracture union and post-operative complications. These were assessed for radiological union during follow up by serial x-rays on interval of 6weeks, 12 weeks, 18 weeks, 4 months & 6 months. Functional outcome according to Klemm & Borner's criteria was documented in all patients at the end of 6 months.[5]

In group 1 (unreamed), after reduction, an interlocking tibia nail of 8 mm or 9 mm was inserted without reaming. In group 2 (reamed) maximum reaming was done, and a snugly fitting nail of appropriate size (1-1.5 mm smaller than amount of reaming) was inserted.

RESULTS: In our study, most of the patients were males (68%) in their active age. Majority of the fractures were caused by road traffic accidents (87% of cases), and 13% were due to other causes like fall and assault.

AGE	REAMED	UNREAMED
20-35	27	26
35-50	23	24

TABLE 1

Fracture union was assessed radiologically with serial X-rays. Majority of fractures in both groups started showing early signs of union in form of bridging callus by 8 weeks and 98% of fractures in both groups equal, progressive and satisfactory union by 12-16 weeks. Only one fracture in reamed group and 2 fractures in undreamed group were found with delayed union. (Table 2)

FRACTURE UNION	REAMED	UNREAMED
6-8 week	47	46
16-20 week	49	48
26-28 week	1	2

TABLE 2

Complications with open fractures are a major concerns considering the high velocity nature of trauma and other associated systemic complications. Following complications were found in the 100 patients we operated. Pulmonary emobolism was diagnosed in one patient in reamed group, which was treated further. In present series, no patient developed fat embolism, compartment syndrome. No patient was found with implant failure. (Table 3)

Complications	REAMED	UNREAMED
PULMONARY EMBOLISM	1	0
INFECTION	5	3
DELAYED UNION	1	2
IMPLANT FAILURE	0	0
KNEE STIFFNESS	2	2

TABLE 3

Infection following the operative treatment has been a major concern for compound tibial shaft fractures historically. We encountered almost similar number infected cases in both reamed and undreamed group. Thought the number was slightly more in reamed group[(5)] compared to unreamed group[(3)] it was not statistically significant. (Table 4)

	REAMED	UNREAMED	P value
G.A. Type I	1	0	
G.A. Type II	0	1	0.3678
G.A. Type IIIA	4	2	
Total	**5(10%)**	**3(6%)**	

TABLE 4

All patients were evaluated according to Klemm & Borner's criteria for tibial shaft fractures at the end of 9 months. The results were similar in both groups with patients having excellent results in 68% of patients in reamed group and 64% of patients in unreaned group.[5] (Table 5)

	REAMED	UNREAMED
EXCELLENT	34 (68%)	32 (64%)
GOOD	13 (26%)	15 (30%)
POOR	03 (6%)	03 (6%)

TABLE 5

CASE 1: Reamed interlocking nailing (Figure 1).

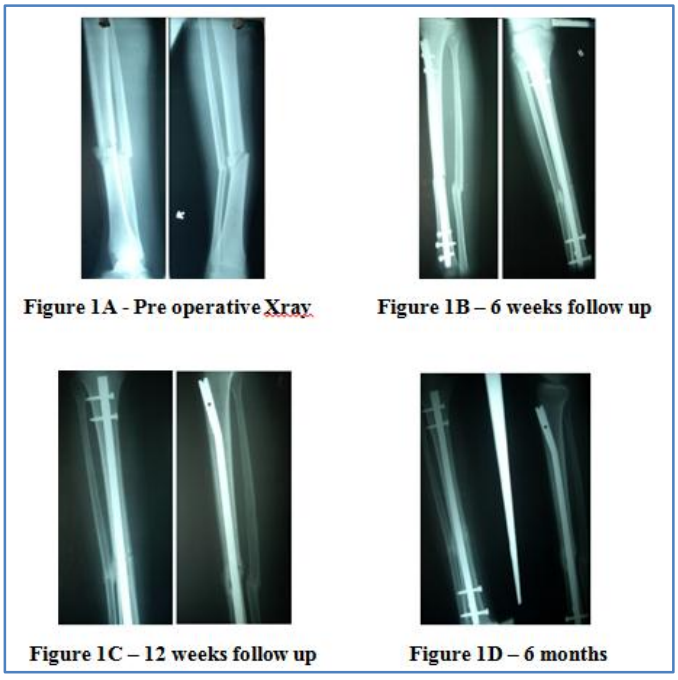

Figure 1A - Pre operative Xray

Figure 1B – 6 weeks follow up

Figure 1C – 12 weeks follow up

Figure 1D – 6 months

Figure 1E- Complete knee and hip flexion at 6 months

CASE 2: Unreamed interlocking nailing (Figure 2)

Figure 2A - Pre operative Xray

Figure 2B – 6 weeks follow up

Figure 2C – 12 weeks follow up

Figure 2D – 6 months.

Figure 2E- Complete knee and hip flexion at 6 months

DISCUSSION: The optimal management of open tibial shaft fractures continues to be a problem with several unanswered questions. Those fractures, usually caused by high energy trauma, have numerous problems resulting from the poor soft tissue coverage and limited vascular supply of the tibia and cause malunion, non-union, infection and sometimes resulting in amputation. Recent improvements in wound coverage techniques and fixation devices have decreased the prevalence of these complications, but the optimum management of open fractures of the tibial shaft is still evolving.[4]

There are two major factors related to the lesion that alter final outcome in tibial shaft fractures. The first is the severity of the fracture, characterized according to Nicoll[6]by the degree of initial displacement, commination and soft tissue injury. Accordingly, the more sever the fracture, the higher the rate of complications, and the longer the periods of healing will be, whatever the method of fixation used. The second factor is the damage of the tibial blood supply. In open fractures, not only is the endosteal but even the periosteal circulation after sever soft tissue damage and periosteal stripping from the bone. This emphasizes the necessity to preserve as much vascularity of the endosteal vessels as possible, using stabilization techniques that avoid additional disruption of this blood supply.

Application of a plaster cast has been the most common method of treatment for open fractures of the tibia, but it has several disadvantages. Nicoll reported a rate of infection of 15 per cent after the treatment of 140 open tibial fractures with a cast.[6] Brown and Urban reported that 27 per cent of sixty-three open fractures of the tibial shaft had healed with more than ten millimeters of shortening and 6.3 per cent, with more than thirty millimeters of shortening.[7] More recently Puno et al reported a 12.5 per cent rate of mal union in a series of twenty-four open tibial fractures treated with cast.[8] Immobilization in a plaster cast, therefore, should reserve for stable fractures with minimum injury the soft tissue. We didn't for opt this method in any cases, taking in consideration the difficulty of wound care with this method.

Plate osteosynthesis provides rigid fixation of an unstable fracture, and that reduces the problems of non-union. Smith studied 219 open fractures treated by internal fixation on the day of injury, delayed union occurred in 48% and infection in 20%.[9] Johner and Wruhsreported non-union was twice as common and infection five times more likely when open fractures were treated with plating, so use of a plate an unattractive treatment option.[10] We did not do osteosynthesis with locking or non-locking plates taking in any of the cases considering the known evil named infection in a large post-operative wound.

External fixation is the most widely accepted method of stabilization of Gustilo grade-II and grade-III open fractures of the tibial shaft. External fixator provide rigid fixation with a relatively low rate of deep infection, but they have the disadvantages of frequent pin-track infections and mal unions, a poor appearance, and loss of reduction after removal. Bach and Hansen found a 13 per cent rate of wound infection, a 10 percent rate of pin-track infection, and a 10 per cent rate of mal union in their series.[11]

Of the various intramedullary devices available, the unreamed unlocked nails had produced good results in open tibial fractures but the implant did not adequately stabilize the comminuted or segmental fractures. Interlocking intramedullary nailing with reaming solves the problem of mal union because it provides the ability to control length, angulation and rotation.

The success of locking nails for the treatment of closed tibial fractures has stimulated interest in their use for open tibial fractures. Intramedullary nailing after reaming is now accepted as the method of choice to treat open femoral fractures, but its use remains controversial with regard to open tibial fractures. Reaming, however, destroys the endosteal blood supply, further devascularizing already compromised bone and this leads to delay in fracture healing. In our study, we reamed the intramedullary camal to the maximum possible diameter and inserted a snugly fitting nail in all 50 patients of reamed group. We found incidence of delayed union in only one case, which was even less than the incidence in undreamed group. In undreamed group 2 patients out of 50 had delayed union and took almost 28 weeks to unite. We had no incidences of non-union or malunion in our study. 49 fractures in reamed group and 48 fractures in undreamed group united in optimal period of 16 to 20 weeks.

The damaged endosteal blood supply is also believed to rise the rate of infection in the post-operative period in already contaminated open fractures. Early reports of the use of nails with reaming for open tibial fractures seemed to confirm this view.[13] Smith found a rate of infection of 33% in series of 18 open tibial fractures treated with intramedullary nailing with reaming, most of fracture associated with sever soft tissue injury.[9] But with recent advances in surgical techniques and advanced wound care techniques, Some traumatologists believe that intramedullary nailing with reaming may be used safety for fractures with less severe wounds. Court-Brown et al. recently reported a rate of infection of 6 per cent (one of eighteen) for type-IIIa fractures and 13 per cent (three of twenty-four) for type - IIIb fractures treated with reaming. Klemm & Borner reported six infections (6.5%) developed after the use of treatment of 93 grade - l open fracture with insertion of interlocking intramedullary nailing after reaming.[5] Bone and Johnson reported only 2 infection after treatment of grade II & grade III with nailing after reaming.[13] Kaltenecker et al. reported no infections after treatment of sixty-six type-I and II open tibial fractures with nailing after reaming.[14,15] Our study shows similar results compared to these recent studies. In our study, only 5(10%) patients in reamed group showed post-operative infection. 4 patients out of those had Type IIIa fractures. The rate of infection in the undreamed group was slightly less in the reamed group, 3 patients (6%) but the difference was not statistically significant. Also, there were only 2 patients with Type IIIa fractures in undreamed group. The functional outcome according to Klemm & Borner's criteria was comparable in both group, with 68% patients having excellent results with reamed nailing and 64% patients having excellent results with undreamed nailing. Only 3 patients in both groups had poor results. The functional in our study outcomes were comparable to the study conducted by Klemm & Borner.

On basis of these studies, one can conclude that insertion of a nail after reaming is not contraindicated for open tibial fractures anymore. So probably the criticism that nailing after reaming is associated with high rates of infection and non-union is theoretical and is based on limited reports with small numbers of patients managed mostly with unlocked nails.

CONCLUSION: Present study concluded that the clinical and radiographic results of nailing after reaming are similar to those of nailing without reaming for fixation of open fractures of the tibiae shaft. The over-all time to union was remarkably similar between the two groups, with no evidence that the reaming process delayed union. Operative care of the soft-tissue wound is

critical in the treatment of open fractures. The role of the endosteal circulation in fracture-healing may therefore be less critical than has been supposed. Also the functional outcomes in both groups of patients were almost equal in both groups at the end of 6th month and showed no difference.

Hence we conclude that with thorough debridement and proper wound care the reaming process is likely to have little detrimental effect on impending infection and fracture-healing. The fractures in both reamed and unreamed will unite in normal time, with less chances of post-operative infection.

REFERENCES:

1. Olson SA. Open fractures of the tibial shaft. Current instructional course lectures. The American academy of Orthopedic. J Bone Joint Surg 1996; 78: 1428-37.
2. Templeman DC, Gulli B, Tsukayama DT, Gustilo RB. Update on the management of open fracture of the tibial shaft. Clin Orthop Relat Res 1998; 350: 18-25.
3. Whittle AP, Russell TA, Taylor JC. Lavelle DG. Treatment of open fracture of tibial shaft of open fractures of the tibial shaft with the use of interlocking nailing without reaming. J Bone Joint Surg Am 1992; 74A: 1162-71.
4. Hooper GJ, Keddell RG, Penny ID. Conservative management or closed nailing for tibial shaft fractures shaft a randomized prospective trial. J Bone Joint Surg1991; 73: 83-5.
5. Klemm KW, Börner M. Interlocking nailing of complex fractures of the femur and tibia. Clin Orthop Relat Res 1986; 212: 89-100.
6. Nicoll EA. Fractures of the tibial shaft: A survey of 705 cases. J Bone Joint Surg 1964; 46B: 373-87.
7. Brown PW. Urban JG. Early weight bearing treatment of open fracture of the tibia: An end result of 63 cases. J Bone Joint Surg Am 1969; 51-A: 59-75.
8. Puno RM, Teynor JT, Nagano J, Gustilo RB Critical analysis of results of treatment of 201 tibial shaft fractures. ClincOrthop 1986; 212: 113-21.
9. Smith JE. Results of early and delayed internal fixation for tibial shaft fractures: A review of 470 fractures. J Bone Joint Surg Br 1974; 56-B: 469-77.
10. Johner R, Wruhs O. Classification of tibial shaft fractures and correlation with results after rigid internal fixation. ClinOrthop 1983; 178: 7-25.
11. Holbrook JL, Swiontkowski MF, Sanders R. Treatment of open fracture of the tibial shaft: Ender nailing versus external fixation: A randomized prospective comparision. J Bone Joint Surg 1989; 71: 1231-8.
12. Bone LB, Johnson KD. Treatment of tibial fractures by reaming and intramedullary nailing. J Bone Joint Surg Am 1986; 68: 877-87.
13. Kaltenecker G, Wruhs O, Quaicoe S. Lower infection rate after interlocking nailing in open fractures of femur and tibia. J Trauma 1990; 30: 474-9.
14. Court-Brown, C. M.; McQueen, M. M.; Quaba, A. A.; and Christie, J.: 1991; Locked intramedullary nailing of open tibial fractures. J Bone and Joint Surg**.** 73-B(6): 959-964.

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