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Original Research Article

Reamed versus unreamed intramedullary nailing for the treatment of closed tibial fractures- A comparative study

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Abstract

Tibial fractures were the most common long bone fracture. These were treated by intramedullary nailing. Treatment of reamed versus unreamed intramedullary nailing was still controversial. This comparative study was conducted in the department of orthopaedic surgery in Mahatma Gandhi Memorial Hospital, Warangal, Telangana state, India with an aim to know the efficacy of both treatments. In this study the average duration of surgery was 72±12 min, the average time to full weight-bearing was 9.2 weeks and the average time to union of the fracture was 14 weeks. The unreamed intramedullary nailing group demonstrated a significantly higher rate of fracture non-union (R 3%, U 6%) and malunion (R 6%, U 9%). The significantly higher incidences of implant exchange, a higher risk of screw failure and dynamization were noticed in the unreamed intramedullary nailing group. Regarding the adverse effects like infection, compartment syndrome and knee pain there was no significant difference between two groups.

Keywords: Reamed, Unreamed intramedullary nailing, closed, tibial fracture

1. Introduction

Fractures of long bones constitute the majority of emergency operating room procedures in most trauma centers. Among these, tibial fractures are the most common. Fractures of the tibial shaft have a recorded incidence of 17 to 21 per 100,000 population, representing 2% of all fractures and 36.7% of all long bone fractures in adults [1,2]. The publications of Kuntscher[3] opened the era of modern intramedullary nailing with metallic nails. Although this technique has been reported as highly successful in terms of fast union, good alignment, low shortening, good functional results, and low complication rates [4].

However, the choice between reamed or unreamed intramedullary nailing of tibial fractures remains controversial. Unreamed nailing preserves the endosteal blood supply and may therefore improve fracture-healing and decrease the risk of infection. Reamed nailing with use of larger nails, while destructive to the endosteal blood supply, affords greater stability [5].

Reamed intramedullary nailing, compared with unreamed intramedullary nailing, significantly reduced the risk of non-union and implant failures but led to no significant differences in compartment syndrome, malunion, or infection rates in closed tibial fractures [6].

Therefore, the study was aimed to know the clinical efficacy of reamed intramedullary nailing vs. unreamed intramedullary nailing in terms of average operative time, weight-bearing time, non-union, delayed union, malunion, secondary procedures like implant exchange, dynamization, bone grafting and adverse effects like implant failure (nail breakage and screw breakage), compartment syndrome, infection, and knee pain in the treatment of closed tibial fractures.

2. Materials and methods

The study was conducted at Mahatma Gandhi memorial hospital, Warangal from 2010-2014. All the patients (142) enrolled for closed tibial fractures were included. Forty patients were lost to follow-up. Two patients were died. One hundred patients who had closed fractures of the shaft of the tibia manageable with interlocking intramedullary nailing either with or without reaming available for follow-up at an average of twelve months (three to thirty months) postoperatively were analysed.

Skeletally mature patients aged between 18 to 72 years of either sex who had sustained a closed fracture of the tibial shaft (Tscherne Type 0 to 3)[7] that was amenable to operative fixation with an intramedullary nail after taking informed consent included in this study. We excluded patients with fractures that were not amenable to either reamed or unreamed intramedullary nailing techniques, those with pathologic fractures, or those who were likely to have problems with maintaining follow-up.

All patients were followed for one year after the time of injury at each follow-up visit, including at the time of hospital discharge, two weeks after discharge, six weeks postoperatively, and three, six, nine, and twelve months postoperatively.

In the reamed nailing group, intramedullary reaming was conducted over a guide wire with use of cannulated power reamers. First, the surgeon reamed the intramedullary canal until the first detection of cortical chatter, forming the basis for the nail diameter. Following the appearance of cortical chatter, the surgeon reamed 1 to 1.5 mm larger than the chosen nail's diameter. In the unreamed nailing group, the surgeon inserted the nail, without reaming, across the fracture site, with particular attention being paid to the prevention of over distraction and the achievement of cortical contact of the fracture ends. An upper diameter limit of 10 mm and a nail measuring at least 2 mm less than the diameter measured at the isthmus of the tibia on anteroposterior and lateral radiographs were stipulated. In both groups, required interlocking of all nails, both proximally and distally, as well as the use of at least one proximal locking screw and one distal locking screw.

Preoperative antibiotic administration was continued for twenty-four hours postoperatively. Cortical contact of the fracture ends guided weight-bearing. If cortical contact was achieved, the patient was allowed to bear weight as tolerated. However, if cortical contact was not achieved, the patient was allowed to partially bear weight on the affected limb until a definitive procedure to achieve contact was performed. Dynamization of the nail was allowed prior to six months only if the fracture was distracted following nail insertion.

The data collected were tabulated and analysed by using the statistical package for social sciences, Windows-based version 16.0 (SPSS Inc., Chicago, IL, USA). The patients' characteristics were analysed by using one-way analysis of variance and chi-square test was used for comparison of the categorical data. Level of significance was 0.01.

3. Results

A total of 100 tibial cases were included, 60 were treated with reamed intramedullary nailing and the others (40) with unreamed intramedullary nailing.

Included patients were predominantly male and involved in motor-vehicle-related accidents. The two groups were similar with respect to age, sex and fracture site. The groups also were similar with regard to aspects of the operative procedure, including the nail manufacturer and the antibiotic protocol. The demographic data and site of fractures were mentioned in table 1.

Table 1: Demographic data and site of fractures

S. No	Parameter	Reamed group	Unreamed group
1	Age	38.4±14.26	39.8±10.52
2	Male/female	42/18	28/12
3	Fracture site		
A	Proximal	2	2
B	Proximal middle	8	6
C	middle	22	14
D	Distal middle	20	12
E	Distal	6	7

The injured patients brought to hospital for treatment about 6-9hours later the accidents. There was moderate to severe blood loss in patients which was not calculated in most of cases. Hence average blood loss was not analysed. The average duration of surgery was 72±12 min. The average time to full weight-bearing was 9.2 weeks. The average time to union of the fracture was 13 weeks (range, 6-40weeks). There was no significant difference in duration of surgery, weight bearing capacity and average time to the union of fractures in two groups.

The non-union of fracture was seen in 3% of reamed and 6% of unreamed intramedullary nailing groups and it is significantly higher in unreamed. Delayed union was seen in 6% and 9% cases of reamed and undreamed groups respectively. There was no significant difference in malunion of fractures in two groups.

Failure of screws was observed in 11%cases of undreamed group which was significantly higher than reamed group (6%). Distal screw breaking was seen in four cases probably because of the early weight-bearing, but the fracture healed uneventfully. Nail failure was found in two cases of undreamed intramedullary pinning. . The proximal migration of the nail was seen in one case, and the distal migration was seen in one case with screw breakage. Implant exchange was required in 1% and 3% cases of reamed and unreamed groups respectively. Bone grafting needed in one case of unreamed intramedullary nailing and not required in reamed intramedullary nailing. Implant exchange needed in 1% case of reamed and 3% cases of undreamed cases. Dynamization in outpatient needed for 6%cases of unreamed and 4%cases of the reamed group. All these parameters were shown in table 2.

Return of a functional range of motion in the knee and ankle, as measured at 6-monthly follow-up, was 80% of them range on the uninjured side. The fracture healed in varus angulation in seven cases. The angle ranged from 3-10°(mean, 5°), but that did not affect the appearance and the functional demands of the patients.

Knee pain was seen in seven patients of the reamed, and 8 of unreamed group along with infection in one patient and compartment syndrome in two patients. No statistically significant differences were found between the 2 groups regarding infection rate, compartment syndrome and knee pain

Table 2: Summary of study parameters in two groups

Parameter	Reamed	Unreamed
Non union	3	6
Delayed union	6	9
Malunion	1	1
Failure of screws	6	11
Failure of nail	0	2
Implant exchange for union	1	3
Dynamization	4	6
Bone grafting	0	1
Infection	0	1
Compartment syndrome	0	2
Knee Pain	7	8

The values were given as the number of patients.

4. Discussion

Non-union was significantly high in the unreamed rather than reamed group in this study but some studies 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 [8,9]. 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 [10,11]. 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 [12].

Malunion was observed in most of patients of unreamed group. This may be due to larger reamed intramedullary nailing tended to correct malalignment, whereas the thinner, more flexible unreamed intramedullary nailing might increase the risk of malunion[8,11]. Result of delayed union was comparable in two groups.

Reamed intramedullary nailing did not increase the incidence of bone grafting compared with unreamed intramedullary nailing, whereas unreamed intramedullary nailing led to a higher risk of implant exchange and dynamization. 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 replacement and dynamization[13]. Annual reoperation rates following tibial fracture repair with the use of nails had been reported to be between 12% and 44% [14]. Treatment options include dynamization of the interlocked nail, bone grafting, implant exchange, and electrostimulation[15].

In our study the screw failures were seen in both groups but significant in unreamed group. The increased risk of screw breakage of unreamed intramedullary nailing was directly related to its smaller diameter, which was more prone to fatigue failure [16]. 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 [17]. The relatively high incidence of screw breakage may also be related to the fact that patients were allowed to bear weight too early [18].

In this study infection was seen in one patient. Infection rates were lower when unreamed intramedullary nailing was used in open tibial fractures compared with reamed intramedullary nailing; however, for closed tibial fractures, reported infection rates vary widely [16]. Preservation of the blood supply to the cortex helps reduce infection [19].

No significant difference was observed in the incidence of compartment syndrome between unreamed intramedullary nailing and reamed intramedullary nailing. Reaming before tibial nail insertion was found not to increase the incidence of complications in either open or closed tibial fractures [16].

Knee pain was observed in most of patients (15%) in this study. Knee pain, always due to the prominence of screws after surgery, is an indication for removal of screws[19]. Because loosening usually occurs in the distal locking screws in both reamed intramedullary nailing and unreamed intramedullary nailing, it has limited effect on range of movement of the knee [13].

Limitations of the current study was small sample size, lack of uniform definitions for delayed union and non-union, union time, weight-bearing time, operative time, and blood loss, and variations in reporting baseline patient characteristics. These may varied with others so there was need to conduct randomized clinical studies.

5. Conclusion

The unreamed intramedullary nailing group demonstrated a significantly higher rate of fracture non-union, malunion. The significantly higher incidences of implant exchange, a higher risk of screw failure and dynamization were noticed in the unreamed intramedullary nailing group. Regarding the adverse effects like infection, compartment syndrome and knee pain there was no significant difference between two groups

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