ORIGINAL ARTICLE

Comparison of Two Techniques of Interlocking Intramedullary Nailing in Fractures of Tibia

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ABSTRACT

Objective: To compare the results of reamed and unreamed interlocking intramedullary nailing in fractures of tibia in terms of their advantages and disadvantages, fracture stabilization, maintenance of alignment, complications and functional outcome.
Design: Comparative prospective study
Place and Duration: The study was carried out at the Department of Orthopaedic Surgery, Jinnah Hospital, Lahore between March 2012 to December 2012.
Patients and methods: A total of 40 patients having closed or grade1 open fractures of tibia that presented within 12 hours of injury were admitted through emergency department. The detailed history was taken. The patients were evaluated both clinically and radiologically. Complete physical and systemic examination was performed to rule out associated injuries. The laboratory investigations were carried out and surgery was planned. Long leg splint was applied. By random selection Unreamed interlocking intramedullary nailing was performed in one group of 20 patients and in the 2nd group intramedullary interlocking nailing was done after reaming of the medullary cavity. Patients were informed about the nature, cost, advantages and limitations of the procedure.
Results: The patients treated by the unreamed method of interlocking intramedullary nailing had better results regarding the rehabilitation, functional outcome, as scored by the evaluation criteria and radiological union time in comparison with the reamed method of interlocking intramedullary nailing which in relation to patients rehabilitation, functional outcome residual deformities, and post operative complications, scored less. There were no cases of nonunion resulting from either technique. Two patients developed superficial wound infection, both treated by the reamed method of intramedullary nailing but none developed chronic osteomyelitis.
Conclusion: Unreamed interlocking nailing in tibial shaft fractures is a better option as it is associated with less complications, better rehabilitation, less incidences of developing residual deformities and thus better functional outcome.
Keywords: Reamed, unreamed, intramedullary, nail

INTRODUCTION

Fractures of tibia are common presentation in the emergency room than any other long bone[1,4,11]. Increase in the volume of traffic has led to ever increasing incidence of accidents and extremity injuries. Tibia being subcutaneous on its medial aspect poses a special challenge with respect to treatment especially in cases of open fractures[21]. Proponents can be found for treatment with casts or functional cast braces, by open reduction and internal fixation with plates and screws, or locked or unlocked intramedullary nails and by external fixation techniques. The best treatment remains controversial but should be determined by thoughtful analysis of the morphology of the fracture, the amount of energy imparted to the extremity, the mechanical characteristic of the bone, the age and general condition of the patient and most importantly the status of the soft tissue[3,7,17]. Nonoperative treatment with casts and braces, while minimizing the risk of infection, often results in un-acceptable shortening, malrotation and/or angulation[16]. Fixation with plates and screws has yielded unacceptably high rate of infection and implant failure[5,6]. External fixators provide rigid fixation, relatively lower rates of deep infection but this technique has disadvantage of pin tract infection, malunion, nonunion, unacceptable appearance[2].

Interlocking Intramedullary nailing have solved most problems because it provides the ability to control the length, angulation and rotation and also makes the rehabilitation easier[4,8,9]. Reaming of Medullary cavity allows cortical and marrow elements to extravsate into fracture hematoma. This serves as osteogenic, Osteoconductive and perhaps osteoinductive stimulus to fracture healing[2,10]. Reaming however destroys the endosteal blood

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supply, further devascularizing already compromised bone, which results in higher infection rate and instances of bone sequestration in case of comminuted fractures[12,22]. However, insertion of a larger diameter nail after reaming of the medullary cavity has been found to be associated with less incidences of implant failure.

Intramedullary nailing without reaming is less damaging to the endosteal blood supply and historically has resulted in lower rates of infection[24,25,26]. However nails inserted without reaming afford less stability to the bone and may thereby retard healing compared to that achieved with larger diameter nails, and also problems with delayed union and hardware failure with smaller implants used in unreamed nailing have led some investigators to return to the use of reamed nailing in open tibial fractures[13,15,23].

The objectives of this study was to compare the results of reamed and unreamed closed static interlocking intramedullary nailing in fractures of tibial shaft in terms of its functional outcome, residual deformities, radiological fracture healing time, need for additional procedure and to assess the advantages and disadvantages of either technique.

PATIENTS AND METHODS

This comparative invasive prospective study based on random selection of 40 patients with fractures of tibia was carried out at the department of Orthopaedic Surgery, Jinnah hospital Lahore, between March 2012 and December 2012.All closed and grade1 open fractures of tibia, in which closed reduction was not possible or was unsatisfactory were included in the study.

Patients were divided into two groups at random. Group A and group B of 20 patients each. Odd serial Numbers were placed in group A and even serial numbers in group B. The patients in group A were treated by static interlocking Intramedullary nailing after reaming of medullary cavity and patients in group B were treated by the interlocking Intramedullary nailing without reaming of the medullary cavity. The post-operative care and rehabilitation was similar in both the groups.

Inclusion Criteria

1. This study included both adult male and female patients of ages between 14-80 years having closed or grade 1 open fractures of the shaft of tibia (simple, wedge and complex) located from 7cm below the knee joint to 7 cm above the ankle joint and who presented within 2 weeks of injury.
2. Fractures in which closed reduction was not possible or was unsatisfactory.

Exclusion criteria

1. Patients who had old fractures in which closed reduction had failed were excluded from the study.
2. Patients having fractures of the tibial plateau, ankle fractures and dislocations and associated fractures of the tibial plafond.
3. Patients with Pre-existing deformities of the limb
4. Patients having infected fractures and fractures previously treated with external fixator were also excluded from the study.

Anteroposterior and lateral X-rays of the injured limb showing full length of tibia and fibula were done. In patients having grade 1 open fractures with superficial wounds and minor skin laceration, wounds were thoroughly irrigated with normal saline and dressing was applied. Patients were splinted in long leg splint during the time interval between admission and Intramedullary nailing which was done on the subsequent operative list. Base line investigations were done to rule out any co-existing pathology.

Each patient received a preoperative dose of 1st generation cephalosporin 1gm and patients with grade 1 open fractures received an additional dose of injection gentamycin 80mg. Patients were operated in the supine position on the fracture table with a well-padded bar beneath the distal thigh and the knee flexed to 90 degrees. Incision was given medial to the patellar tendon and after carefully dissecting out the infrapatellar pad of fat, a curved bone awl was inserted through the metaphysis anteriorly to gain access into the medullary canal.

When nailing was to be done by the reamed method, 3.2mm curved guide wires with beaded tips were passed into the cavity uptil 1cm proximal to the ankle joint. Reamers of various diameters starting from the lowest to the appropriate maximum diameter were threaded over the guide wire and reaming of both the proximal and distal segments was done. The nail whose diameter was 1 to 1.5 mm less than the last reamer used was chosen. Care was taken to ensure that the fracture was properly aligned as the nail entered the medullary canal of the distal segment.

When nailing was done by the unreamed method only 6-8 cm of the medullary canal of the proximal segment was reamed to accommodate the proximal flare of the nail. The diameter of the canal was measured from the preoperative radiographs from the narrowest part of isthimus after deducting 10% magnification. A nail of diameter 1mm less than the actual diameter was chosen for insertion.

The proximal locking screws were inserted from medial and lateral positions through portals of the insertion jig. The distal screws were then inserted from medial to lateral with the use of the distal freehand jig, guided by the image intensifier. After

insertion of then nail, the wound was thoroughly irrigated and closed over suction drain and aseptic dressing was applied.

All patients received their antibiotic doses for 3 days post operatively. Drains were removed 24-48 hours post operatively. Non-weight bearing ambulation was started in most of the patients. Weight bearing was dictated by the fracture pattern, the size of the nail, and patient comfort. Range of motion exercises of the knee and ankle were started immediately as well. Patients usually were discharged form hospital on 4th or 5th post op day. Evaluation of patients started soon after surgery, strictly monitoring for postoperative complications of surgery and anesthesia. Stitches were removed after 14 days.

All patients were followed at 3 weekly intervals in outpatient clinic after discharge from hospital with biplane radiographs and clinically assessing the patients regarding degree of ambulation, compliance with physiotherapy and subjective postoperative complaints. The collected patient data was reviewed after 6 months of surgery and results were scored according to the evaluation criteria proposed by Ahlo et al 1992.

RESULTS

The selected patients were in the age range of 15-60 years with a mean of 37.65±12.07 years. Out of 40 patients, 34 were male and 6 were female. Group A contained 16 male and 4 female patients. Group B contained 18 male and 2 female patients. Out of 40 patients, 26 had closed fractures of the tibia/fibula and 14 patients had grade I open fracture of the tibia/fibula. Final assessment was made after 6 months from time of surgery. All patients were evaluated radiologically and clinically and results were scored according to the derangement criteria proposed by Ahlo et al. The subjective complaints, mobility status and radiological record of the 3 weekly follow up visits was also reviewed and recorded in tables 1 and 2.

After scoring the derangements according to the selected criteria, the resultant data scores were analyzed by student t test and compared in both groups. The calculated mean scores of group B patients were significantly ($p < 0.05$) higher than group A patients.

In group A, the average time to radiological union was 20 weeks. The range was from 18-22 weeks. While in group B the average time was 18 weeks and the range was 16 to 20 weeks. There were no complications in our patients regarding anaesthesia. There was incidence of breakage of distal locking screws in two patients, treated by the unreamed method. There was incidence of superficial infection at site of distal locking screw in 2 patients both treated by the reamed method of nailing, which was treated with intravenous antibiotics.

Table 1:

Derangement	E	G	F	P
Varus or Valgus	3°	5°	10°	>10°
Ante or recurvatum	5°	10°	15°	>15°
Internal rotation	5°	10°	15°	>15°
External rotation	10°	15°	20°	>15°
Shortening	1 cm	2cm	3cm	>3cm
Knee flexion	>120°	120°	90°	<90°
Knee extension Deficit	5°	10°	15°	>15°
Ankle dorsiflexion	>20°	20°	10°	<10°
Ankle plantar flexion	>30°	30°	20°	<20°
Foot motion	5/6	2/3	1/3	<1/3
Pain or swelling	None	Minor	Significant	Severe

E: Excellent, **G**: Good, **F**: Fair, **P**: Poor

Table 2: Final Assessment

Derangement	E	G	F	P	Calculated Score
Valgus or varus					
Group A	16	4	0	0	76
Group B	13	7	0	0	73
Ante or recurvatum					
Group A	16	4	00	76	
Group B	18	2	0	0	78
Internal rotation					
Group A	17	3	0	0	77
Group B	19	1	0	0	79
External rotation					
Group A	20	0	0	0	80
Group B	20	0	0	0	80
Shortening					
Group A	15	4	1	0	74
Group B	18	2	0	0	78
Knee flexion					
Group A	1	15	4	0	57
Group B	18	2	0	0	78

E: Excellent, **G:** Good, **F:** Fair, **P:** Poor

Table 3: Final Assessment

Derangement	E	G	F	P	Calculated Score
Knee extension deficit					
Group A	11	8	1	0	70
Group B	18	2	0	0	78
Ankle dorsiflexion					
Group A	1	17	2	0	59
Group B	4	14	2	0	72
Akle plantarflexion					
Group A	8	10	2	0	70
Group B	18	1	1	0	77
Foot motion					
Group A	2	15	3	0	59
Group B	7	12	1	0	66
Pain or swelling					
Group A	4	7	8	1	54
Group B	10	9	0	1	69

E: Excellent, **G:** Good, **F:** Fair, **P:** Poor

DISCUSSION

Treatment of fractures of the tibial shaft may be complicated by problems of malunion, nonunion, infection and limb deformities. Recent improvements in fixation devices and surgical techniques and equipment available have decreased the prevalence of these complications.

In our study, the average time to radiological union in group A was 20 weeks while in group B was 18 weeks. In the serial radiographs of patients of group A, we did not find any evidence showing that the reamed material had been incorporated into the callus. Blachut[4] in a study on 152 patients, comparing the reamed and unreamed nailing techniques concluded that the beneficial effects of reaming could not be quantified.

Deep infection did not prove to be a problem in either group, particularly because the selected patients did not include patients with grade 2 and grade 3 open fractures and most importantly the surgery was carried out under best possible sterilization. Paige and Thomas[27] in their study found that among 50 patients with open fractures of tibia treated by unreamed intramedullary nailing, deep infection developed in patients with grade 3 open fractures particularly at the site of the wound whereas no infection was reported in grade 1 and grade 2 open fractures. Therefore any consideration regarding preservation of blood supply in the prevention of infection appears to be theoretical only and wound size and contamination does contribute to development of infection.

The varus and valgus deformity of the tibia may occur especially in comminuted or segmental fractures after nailing and especially when patient starts to bear weight. A smaller diameter nail in severely comminuted or segmental fractures may result in increased axial force to act across the fracture thus afftecting the shape of the soft callus and resulting in a varus/valgus angulation. In our study, the valgus/varus angulation was on an average less than 3 degrees in group A and less than 3.5 degrees in group B which is in accordance with international studies[14,18].

The range of flexion and extension deficit at the knee in different patients can be explained by the fact that the presence of the surgical wound just below the knee and disruption of fibers of the patellar tendon cause pain and swelling thus making the patient hesitant while performing knee exercises. In our study the results showed that knee range of motion at 20 weeks follow up was on an average 0-120 degrees flexion in group A and 0-135 degrees flexion in group B. These results are in accordance with results of international studies[19,20].

The derangements in ankle range of movements can be attributed the fact that even in the absence of pain, patient does not comply with the strict physiotherapy directions for the affected limb. If fracture heals in varus/varus angulation, it leads to development of inflammatory changes in the region of the subtalar joint and this may also affect the movement of the ankle and foot. In our study, the results regarding ankle and foot motion were better in group B.

There were incidences of breakage of distal locking screws in one patient, treated by the unreamed method. The screws because of their smaller size and different design were more at risk of breakage. It is conceivable that the locking screws used in nailing without reaming could be modified to reduce the prevalence of failure. There was incidence of superficial infection at site of distal locking screw in 2 patients both treated by the reamed method of nailing occurring at 13 weeks in one patient and at 18 weeks in the other patient, for which the distal screws were removed and patient was started on antibiotics. The time to full weight bearing depends upon fracture geometry, stability of fixation, strength of the implant, patient compliance and evidence of fracture union. On average, our patients were ambulant with full weight bearing at 12 weeks in group A and 13 weeks in group B. Delayed union and non-union can be related to biological as well as mechanical factors. Two of our patient in Group A had developed delayed union, which were dynamized (proximal locking screws were removed) and they healed successfully after that. Our results regarding fracture healing are satisfactory. The average time to fracture union in Group A was 22 weeks and 18 weeks in Group B with significant p value. This is in accordance with local and international studies[1,17].

Evaluating the results of this study we concluded that the technique of interlocking intramedullary nailing for treating fractures of tibia, done without reaming of the medullary cavity had better overall results as regards the functional outcome calculated by the criteria, devised by Ahlo et al, in comparison with the intramedullary nailing done after reaming of the medullary cavity. However it must be mentioned that success of either technique of intramedullary nailing and its final outcome is also dependant upon the morphology of the fracture, the site of fracture, and most importantly the compliance of the patient regarding rehabilitation.

CONCLUSION

On the basis of our study, we recommend the use of undreamed technique of static interlocking intramedullary nail for the treatment of closed and grade 1 open fractures of the tibial shaft.

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