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Original Research Article

Role of closed intramedullary interlocking nailing in comminuted fractures of long bones in lower limbs

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ABSTRACT

Background: Fractures are the most common form of skeletal injuries encountered in orthopaedic practice. Increase in mechanization and high-speed travel are accompanied by increase in the number and severity of the fracture. Our ultimate goal of femur and tibia fracture management is restoration of alignment, rotation and length, preservation of blood supply to aid union, prevention of infection and early rehabilitation of the patient.
Methods: 30 adult patients of either sex with 30 comminuted fractures of long bones were treated with closed intramedullary interlocking nail. AO type B3 and C in femur and tibia are included. There were 25 males and 5 females, and average age of patients was 36.2 years. Out of 30 cases, 13 cases were of femur fracture while 17 cases were of tibia fracture. There were 21 closed and 9 patients had Grade I open fractures.
Results: Closed intramedullary interlocking nailing was done in 13 cases of femur fracture and 17 cases of tibia fracture. The average duration of partial weight bearing in femur fractures was 4.85 weeks and in tibia fractures was 5.53 weeks. 20 fractures united without additional intervention. The average duration of radiological union in femur fractures was 18.65 weeks and for tibia fractures was 19.29 weeks.
Conclusions: Closed intramedullary interlocking nailing is the treatment of choice of comminuted fractures of long bones in lower limbs which cause minimum damage to the blood supply of the fracture fragments which promotes the chances of bone union.

Keywords: Fracture, Intramedullary, Interlocking, Long bones

INTRODUCTION

Fractures are the most common form of skeletal injuries encountered in orthopaedic practice. Increase in mechanization and high-speed travel are accompanied by increase in the number and severity of the fracture. Fracture femur and tibia can be largely attributed to violent forces leading to undue mortality and morbidity in patients with such injury if not attended to urgently and adequately. The art of lower limb fracture management is a constant balancing act of anatomical alignment, stable fixation and early functional restoration of the limb. Interlocking nailing of femur and tibia has now become the treatment of choice in almost all fractures, located between the lesser trochanter and femoral condyles in case of femur and diaphysial fractures in case of tibia, regardless of the fracture pattern and degree of comminution.[1,2] Our ultimate goal of femur and tibia fracture management is restoration of alignment, rotation and length, preservation of blood supply to aid union, prevention of infection and early rehabilitation of the patient.[3]

Advantages of intramedullary nailing over plating

- IM nail can tolerate bending and torsional loads better than plates

- Locking mechanism provides less tensile and shear than plates
- IM interlocking nail is a load sharing device and is less loaded than plates causing less cortical osteopenia of stress shielding which is a feature of the load bearing plates
- Closed nailing causes no damage to extra periosteal soft tissues and the biological environment round the fracture is least disturbed
- Another important feature of the closed intramedullary interlocking nail is the freedom for early ambulation to the patient which reduces the complications of prolonged recumbency.

Concept of dynamic and static locking

Dynamic locking refers to the placement of transfixing screw only in the shorter fragment which is susceptible to rotational instability and allows intermittent compression at the fracture site during early weight bearing. Dynamic fixation is used typically in fracture of upper or lower-third of the shaft in the absence of comminution.[3]

When the fracture is comminuted or unstable to compressive or rotational forces, interlocking screws must be placed above and the below the fracture i.e. static locking to maintain length of bone. Shortening and malrotation are controlled by transferring the axial and rotational Stresses through nail rather than through the fracture site.

After early immobilization of the fracture site, interlocking screws can be removed from one fragment to allow compressive loading of the fracture site and this procedure has been termed as dynamization. Currently dynamization is carried out if the fracture callus fails to mature by twelve weeks.

METHODS

This prospective study was done in 30 adult patients of either sex with 30 comminuted fractures of long bones admitted in Government Medical College, Patiala and Rajindra Hospital after taking approval from ethical committee and who were treated with closed intramedullary interlocking nail. An informed consent was taken from each and every patient before study.

All patients with comminuted fracture of long bones of lower limbs are included in the present study of AO type B3 and C in femur and tibia. Only closed and grade I open fracture (Gustilo Anderson classification) were considered and open grade II and III fractures were excluded. Also, pathological fractures were not considered. Patients less than 18 years or medically unfit patients were also not taken in the present study. There were 25 males and 5 females, and average age of patients was 36.2 years. High-energy trauma secondary to a motor-vehicle or motorcycle accident or to being struck by an automobile while walking accounted for 86.67 per cent of the fractures. Out of 30 cases, 13 cases were of femur fracture while 17 cases were of tibia fracture. There were 21 closed and 9 patients had grade I open fractures. The average time to nailing after fracture was 2.08 days in femur fracture and 2.18 days in tibia fracture.

Operation was done under spinal or general anesthesia with patient positioned in supine position on operation table.

Surgical procedure of femur interlocking nailing

An incision was made proximal to the greater trochanter in line with the femoral canal. An entry point was established using either a large cannulated drill over a terminally threaded pin or an entry awl. A guidewire was placed through the entry portal and down the femoral canal. Reduction of fracture was done using traction. Reaming was done while reduction was maintained. Nail mounted on proximal jig was introduced. The fracture reduction and nail position was confirmed by C arm image to be satisfactory. Then guide wire was removed. Interlocking done proximally and distally, wound closed in layers after removal of proximal jig and ASD was done.

Surgical procedure of tibia interlocking nailing

Patient was placed in supine position and adequate flexion given at the knee joint so that inferior pole of patella did not come in the operative field. A midline longitudinal was made over the patellar tendon which extended from the lower pole of patella to just 1 cm distal to tibial tuberosity. The patellar tendon was split longitudinally one third to expose tibial tuberosity.

Entry hole was created with a sharp fine awl. Guide wire was inserted. Reaming was done. Nail of chosen diameter and length was mounted. The fracture reduction and nail position was confirmed by C arm image to be satisfactory. Distal and proximal locking was done. Patellar tendon was sutured and wound closed in layers. ASD was done.

All patients were encouraged to do static quadriceps exercises within 12 hours and isotonic within 48 hours as tolerated by the patients. In unstable fractures (comminution >50%) partial weight bearing was delayed till radiographically visible callus was seen or around 6-week time. Fracture union was assessed radiologically at 1 month, 2 months, 3 months and 6 months.

By the end of 10-12 weeks, if radiological evidence of fracture callus was seen, full weight bearing was advised. We considered a fracture to be united, if there was no pain on palpation or attempted motion at fracture site, no increase in warmth at the fracture site, no discomfort to full weight bearing and serial radiograph demonstrated bone trabeculae across the fracture site.

RESULTS

Closed intramedullary interlocking nailing was done in 13 cases of femur fracture and 17 cases of tibia fracture. The mean age was 36.2 years with more involvement of males (83.33%) than females. RSA was the most common mode of injury in 86.67% patients with more involvement of the right side (66.67%). The average duration of time interval between admission and surgery was 2.08 days and 2.18 days for femur and tibia respectively. The operating time, excluding positioning of the patient on the fracture-table, averaged 85 minutes for femur fractures and 73 minutes for tibia fractures. The average duration of hospital stay was 8.4 days for femur fractures and 8.8 days for tibia fractures. The average duration of partial weight bearing was 4.85 weeks and 5.53 weeks for femur and tibia respectively. Femur fractures were united at an average of 18.65 weeks and tibia fractures at 19.29 weeks respectively. 69.23% of femur fractures and 76.47% of tibia fractures united without any complication. 20 fractures united without additional intervention. However, few complications were encountered in both patients of femur as well as tibia fractures like superficial infection, delayed union (1 case each) and rotational deformity (1 case in femur fracture patients and 2 cases in tibia fracture patients). There was 1 case of non-union in femur fracture which was subsequently treated with exchange nailing. Dynamization was done in 8 cases and bone grafting in 1 case. Deep infection managed with two weeks of IV antibiotics followed by four weeks of oral antibiotics. No patient developed fat embolism in this series. Results were evaluated as per modified Klaus and Klemm Criteria (Table 1).[4]

Table 1: Evaluation criteria.

	Femur Klaus and Klemm[3]	Percentage	Tibia Johner and Wruh's	Percentage	Total	Percentage
Excellent	9	69.23	11	64.71	20	66.67
Good	2	15.38	4	23.53	6	20
Fair	1	7.69	2	11.76	3	10
Poor	1	7.69	0	0	1	3.33
Total	13	100	17	100	30	100

Results were excellent in 9 fractures (69.23%), good in 2 fractures (15.38%), fair in 1 fracture (7.69%) and poor in 1 fracture (7.69%) in case of femur fracture and according to Johner and Wruh's criteria (Table 1).[5]

The results were excellent in 11 fractures (64.71%), good in 4 fractures (23.53%), fair in 2 fractures (11.76%) in case of tibia fractures.

Figure 1: Clinical picture.

Figure 2: Post Op X-ray

DISCUSSION

The mean age in the present study was found out to be 36.2 years. Similar observations were found in the study by Giannoudis PV et al, in which the mean age was 38.9 years for tibia fractures and Chauhan N et al, in which the mean age was 36.2 years for tibia fractures.[5,6] Males were involved more commonly than females both in femur fractures (76.92%) as well as in tibia fractures (88.24%). Similar results were found in other studies as mentioned above. This was due to the fact that males are more involved in outdoor activities in this part of the world because of social and cultural considerations. Road side accidents was found to be the most common mode of injury in occurring in 92.31% patients of femur fractures and 82.35% patients of tibia fracture. Similar results were found in the study conducted in femur fractures by Nellaiyappan B et al, in which 85% cases were due to RSA, in study conducted in tibia fractures by Sahu RL, in which 79.41% cases were due to RSA, Chauhan N et al, in which 86% cases of tibia fractures are due to RSA.[5,7,8]

Overcrowding, increased vehicles, bad condition of roads and traffic rule violation are main reasons for more RSA. In the present study, right side was found out to be more commonly involved both in femur fractures (66.67%) as well as tibia fractures (76.92%).

Similar results were found out in the study conducted by Akhtar A et al, in which right side was involved in 72.41% patients of tibia fracture.[9] Another study conducted by Kamruzzaman et al, showed that right side was involved in 56.67% of tibia shaft fractures.[10] 76.92% cases of femur fractures were closed injuries while in tibia 64.71% cases of tibia fractures were closed injuries. Similar results were found out in study conducted by Borel JC et al, in which 75% cases of femur fractures were closed injuries, Mohammad AK et al, in which 60% cases of femur fractures were closed injuries.[11,12] Similar results were found for studies in tibia fractures by Melis GC et al, in which 57.89% cases were closed injuries. The average time interval between admission and surgery was found out to be 2.08 days for femur fractures and 2.18 days for femur fractures. The average duration of hospital stay was found out to be 8.38 days for femur fractures and 8.76 days for tibia fractures.

The average duration of partial weight bearing in femur fractures was 4.85 weeks and in tibia fractures was 5.53 weeks. Similar results were found in study conducted by Sahu RL et al, in which the average duration of PWB was 6 weeks and study by Raghavendra B et al, in which average time for PWB was 4 weeks.[8,14] The average duration of full weight bearing in femur fractures was 10.15 weeks and in tibia fractures was 12.65 weeks. Similar results were were found in study conducted by Al-Algawy-Alla AH, in which average duration of FWB was found out to be 13.2 weeks and study by Raghavendra B et al in which average time for FWB was 10.81 weeks.[14,15] The average duration of radiological union in femur fracture was 18.65 weeks and in tibia fracture was 19.29 weeks. Similar results were found out in studies conducted by Anastopoulos G et al, and Webb LX et al, in which average duration of radiological union was found out to be 18 weeks in cases of femur fracture.[16,17] Similar results were found in studies conducted in tibia fractures by Siebenrock KA et al, in which average duration of bone union was 21.5 weeks, Chauhan N et al in which average duration of radiological union was 20.13 weeks.[5,18]

In the present study, anteversion/recurvation deformity was found out to in 1 (7.69%) out of 13 cases of femur fracture and 1 (5.88%) out of 17 cases of tibia fracture. Similar study conducted by Borel JC et al, found out anteversion/recurvation deformity in 2.5% of cases of femur fracture.[11] Similar study conducted by Chauhan N et al found out anteversion/recurvation deformity in 10% of cases of tibia fracture.[5] Varus/valgus deformity of 6-100 was found out in 1 (7.69%) out of 13 cases of femur fracture and 1 (5.88%) out of 17 cases of tibia fracture. Similar results were found out in study conducted by Borel JC et al, which had varus/valgus deformity in 8 (11.76%) out of 68 cases.[11] Rotational deformity of 11-200 was found out to in 1 (7.69%) out of 13 cases of femur fracture and 2 (11.76%) out of 17 cases of tibia fracture. Similar results were found out in study conducted by Wiss DA et al, in which rotational deformity was found out in 7% of cases, Mohammad AK et al, in which rotational deformity was found out in 5% of cases.[2,12]

Excellent or good results were found out in 84.61% cases of femur fracture and 88.24% cases of tibia fracture. Similar results were found out in study conducted by Klemm KW et al, in which 97% of cases of femur fracture and 94.3% cases of tibia fracture had excellent or good results, Youssef S et al, in which 92.85% cases of femur fracture had excellent or good results.[1,19] Similar results were found in study conducted by Chauhan N et al, in which 90% of cases of tibia fracture had excellent or good results.[5]

CONCLUSION

We recommend closed intramedullary interlocking nailing for the treatment of comminuted fractures of long bones in lower limbs because of the predictability of fixation in terms of maintenance of length, alignment and rotation of the site of the fracture until union and because of the minimum risk of late refractures. There is minimum damage to the blood supply of the fracture fragments in comminuted fractures which further promotes the chances of bone union. The interlocking nail system combines the best of both i.e. not only does it offer axial and rotational stability in comminuted and unstable fractures, but also involves minimal interference with soft tissue around the bone especially when introduced in a closed manner.

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