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Aarti Dewan
Associate Professor, Department of Orthopaedics Sri Guru Ram Das Institute of Medical Sciences and Research, Amritsar Punjab India

NK Aggarwal
Ex- Professor, Department of Orthopaedics Dayan and Medical College Ludhiana Punjab India

Correspondence
Aarti Dewan
Associate Professor, Department of Orthopaedics Sri Guru Ram Das Institute of Medical Sciences and Research, Amritsar Punjab India

Outcome assessment of intra medullary nailing in proximal tibial fractures

Aarti Dewan and NK Aggarwal

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Abstract
Purpose: Intra-medullary nailing is now considered as a gold standard in the treatment of diaphyseal fractures of tibia. But scientific literatures do not give consistent results on this. The present study is being undertaken to evaluate the results of intramedullary fixation of fractures of proximal tibia with or without intraarticular extension
Methods: Forty cases of proximal tibia fractures with or without intraarticular extension treated by intra-medullary nail in the department of Orthopaedics. over a period of five years were studied. Only the cases which could be followed up for at least four months or till fracture union were considered for final evaluation.
Results: Average age of our patients was 45 years, most were males (85%). Majority of the fractures were closed (52.5%) having of intra-articular extension (65%). All the closed fractures united at an average of 3.1 months and compound fractures united at an average of 3.9 months. Nonunion was 3.3% and 9.9% infection was seen in open fractures. Average range of motion at knee joint was 111.5°. Two cases had flexion of less than 90°.
Conclusions: In the literature, no studies have been reported with nailing in the metaphyseal fractures of tibia. The results obtained with nailing in the metaphyseal fracture of tibia gives good results with acceptable complication rate and has proved superior to other methods available today.

Keywords: Intramedullary nailing, proximal tibial fractures, outcome assessment

Introduction
Fractures of bones have been capable of healing ever since the evolution of bone as a tissue of reptiles, amphibians, birds and mammals. Humans probably first tried to influence fracture healing by inserting objects into the medullary canal in the sixteenth century. In the nineteenth century, European surgeons recognized the potential advantages of intramedullary fixation.
Apley *et al*. (1956) [1] introduced the technique of closed intra-medullary nailing. Later on, numerous authors [2, 3, 4] reported it as an excellent procedure. Interlocking nail has reduced the incidence of longitudinal and rotatory instability of the fragments [5, 6] encountered in non-interlocked close inramedullary nailing. By this technique, the dangers of open nailing were minimized leading to reduced risk of infection, reduced blood loss, early mobilization, reduced incidence of non-union, minimized soft tissue damage and periosteal blood supply[7]. Intra-medullary nailing is now considered as a gold standard in the treatment of diaphyseal fractures of femur and tibia. The limitations of conventional intra-medullary nailing have been the metaphyseal fractures for which these nails provided poor stability.
As far as the proximal tibial fractures are concerned they have got greater disability. This disability can be avoided by following the objectives of articular surface restoration, stable internal fixation, early knee motion, strengthening exercises and soft tissue repair[7]. Treatment methods proposed for fractures of the proximal tibia includes extensile exposure with arthrotomy and reconstruction of the joint surface with plate and screw fixation, arthroscopy and percutaneous screw fixation or external fixation with pin or wire fixators, close manipulation and casting (cast brace) and traction with early motion. No method can be used routinely for all fractures, and each patient must be individually evaluated. Extensive surgery on a severely comminuted fracture may result in less than optimal internal fixation and a need for postoperative immobilization, often resulting in joint being neither stable nor freely movable. The single most important factor in predicting outcome in a patient with a tibial plateau fracture was the adequacy of reduction.

However, the use of conventional intramedullary interlocking nail for proximal tibial fractures has not yet met with the successful results [8, 9, 10]. Interlocking nail for proximal tibial fractures demands a meticulous operative technique as far as the incision, implantation of the nail and final interlocking is concerned. We have used a special kind of intramedullary device for proximal tibial fractures. The present study is being undertaken to evaluate the results of intramedullary fixation of fractures of proximal tibia with or without intraarticular extension.

Material and Methods

All the patients having fractures of proximal tibia with or without intra-articular extension treated by intramedullary nailing were part of this study. The study spanned over five years. The fractures were classified according to AO/ASIF classification for proximal tibial fractures. Only the cases which could be followed up for at least 4 months or till fracture union were considered for final analysis.

All patients were evaluated for the limb injuries, local skin condition, distal neurovascular status and open wounds. After preoperative assessment, patients were taken up for debridement and irrigation of the wounds where ever required. Surgery was performed through the medial para-patellar incision with leg hanging and flexed at knee joint. In tibial fractures, the percutaneous lag screw was put to restore the articular surface whenever necessary. Most of the cases were done through closed technique, if necessary open reduction was done in fractures having intra-articular involvement. Whenever fixation with lag screw was done, it was done in such a manner so that it avoids the track for intramedullary nailing.

Post operatively, the patients were managed by daily dressings in open fractures and third day dressings for surgical wounds with I/V antibiotic cover. Active assisted range of motion at knee joint was instituted within the first postoperative week. Secondary procedures for soft tissue coverage like split thickness skin grafting, local rotation flap etc. were done whenever necessary.

Toe touch weight bearing of the affected extremity was allowed as soon as the patient was able to ambulate with either crutches or walker. This was progressed to full weight bearing according to progression in healing of the fractures, within the first three post-operative months. The condition of the wound, the range of motion at knee joint, the progress of union monitored by repeat check x-rays and any complications were noted at follow up.

Secondary procedures like bonegrafting and dynamisation were done wherever required. Final assessment was done on the completion of the treatment depending upon time taken for the fracture to heal, range of motion of the knee joint involved, pain, deformity and complications. Non-union was considered the failure of the treatment. The functional outcome was assessed according to scale developed by Sanders *et al*. (1991) [11].

Results

The total of 40 cases of tibial fracture patients who have completed four weeks of follow up were included in the analysis. The minimum age of the patients was 14 years and maximum was 80 years. The average age was 45 years. Males predominated with incidence of 85% of the tibial fractures. Only six patients (15%) were female patients

Table 1: Detailed description of tibial fractures

Variable	Number & Percentage (%)
1. Side	
Right	25 (62.5%)
Left	15 (37.5%)
2. Mode of Injury	
RSA	39 (97.5%)
Gun Shot	1 (2.5%)
Fall	-
3. Intra articular extension	
Present	26 (65%)
Absent	14 (35%)
4. Type of wound	
Closed	21 (52.5%)
Comp. G-I	10 (25.0%)
Comp. G-II	6 (15.0%)
Comp. G-IIIA	1 (2.5%)
Comp. G-IIIB	2 (5.0%)
Comp. G-IIIC	0
5. Associated injuries	20 (50.0%)
6. Associated medical conditions	12 (30.0%)
7. Time interval between injury and surgery	
Upto 12 hours	26 (65.0%)
13-24 hrs	3 (7.5%)
2-5 days	6 (15.0%)
6- 9 days	1 (2.5%)
> 10 days	4 (10.0%)
8. Type of surgery	
Open Reduction	9 (22.5%)
Close Reduction	31 (77.5%)

Detailed description of fracture tibia cases was given in table 1. The involvement of right extremity was more in tibia fractures. Road traffic accidents were the most common mode of injury in tibia (97.5%) fractures. Gunshot injuries were accountable for 2.5% of the cases having proximal tibial fractures. Majority of tibial fractures were associated with intraarticular extension. The number of compound fractures were found to be same the number of closed fractures for tibia. The distribution of cases was done according to Gustilo and Anderson classification. High incidence of associated injuries were seen (50.0%) tibial fractures. Associated injuries included fractures (shaft of femur, patella, I/T, S/T, metacarpal, metatarsal, both bone leg, talus,), soft tissue injuries, head injury, blunt trauma chest, blunt trauma abdomen etc. Associated medical conditions were seen in tibial (30.0%) fractures. Associated medical conditions included diabetes mellitus, hypertension, dermatitis, ankylosing spondylitis etc. Most of the cases were operated within 12 hours of injury in proximal tibial fractures. Cases in which the surgery was delayed, either had associated life threatening injuries or medical problems or reported late in the hospital. In case of tibial fractures, majority of the thirty one cases (77.5%) were performed through closed technique and nine cases (22.5%) were performed through open technique.

Division of Fractures According To Ao/Asif

Fractures were classified according to AO/ASIF classification where type a fractures are extraarticular, type B fractures are partially articular and type Care intraarticular. Fracture types are numbered 1, 2 or 3 based on the degree of communition A1 being a simple, 2-part fracture of the metaphysis, A2 having metaphyseal wedge and A3 having severe communition. Partially articular condylar fractures are classified; B1 fracture of the lateral condyle, B2 fracture of

the medial condyle and B3 fractures seen in the frontal plane involving the condyles. Intraarticular fractures are similarly classified; C1 fractures are a simple T or Y split of the femoral condyles. C2 fractures have metaphyseal communition, and C3 having communition of the articular surface. Majority of the cases were type C i.e. intraarticular in tibial fractures. The distribution of the division of fractures according to AO/ASIF is shown in table2.

Table 2: Type of tibial fractures

Type of #	Tibia		
	A	B	C
1	4 (10.0%)	2 (5.0%)	12 (30.0%)
2	1 (2.5%)	10 (25.0%)	8 (20.0%)
3	3 (7.5%)	-	-
Total	8 (20.0%)	12 (30.0%)	20 (50.0%)

Wound Infection In Relation To Type of Wound

In tibia, post-operatively one case had a discharge from the wound after fifteen days and it did not heal till last follow up. Deep infection was seen in another case in which the discharge from the wound was there after three months and it did not heal till last follow up. The distribution of the wound infection is seen in table 3.

Table 3

Wound infection	Closed reduction cases	Open reduction cases
Superficial infection	-	
Deep infection	-	2

Progression/ Improvements of patients at 4 weeks follow up

A total of thirty patients were followed up till 4 weeks postoperatively. In the proximal tibial fractures, two patiens had flexion less than 90° (one had 60° and one had 70°). The case having flexion of 60° was due to the fact that patient was not cooperative. The case having flexion of 70° had an associated injury (fracture patella). There were three cases of floating knee injuries in the study. All had good range of motion at knee joint (100-110°). The distribution of the flexion at the knee joint is shown in table 4.

Table 4. Progression/Improvements at 4 weeks follow up

Variable	Number & Percentage (%)
Range of Movements	
5°-90°	2 (6.6%)
90°-100°	3 (10.0%)
100°-124°	19 (63.3%)
124°-130°	3 (10.0%)
* 100°-110°	3 (10.0%)
Extensor lag	
0°	25
<5°	2 (8.0%)
6-10°	-
>10°	3 (10.0%)
Deformity	
Varus	
0°	-
<10°	1 (3.3%)
Valgus	
0°	-
<10°	2 (6.6%)
FFD	
10°	-
10-20°	-
Shortening (cm)	
0	-
<1.5	1 (3.3%)
1.5-2.5	-
>2.5	-
Pain	
Mild	3 (10.0%)
Moderate	3 (10.0%)
Severe	0

*Floating Knee injuries

Cases with residual extensor lag were either non-compliant to physiotherapy or were bed ridden for some other reasons. In proximal tibial fractures, three patients had extensor lag > 10° (one had 12°, two had 15°). Varus and valgus deformity was seen in tibial fractures but there was no fixed flexion deformity. Shortening was seen in one case having proximal tibial fractures. Majority of the cases had no pain at knee joint at last follow up. Only three patients had moderate pain and three had mild pain.

Fracture Union

The criteria for estimating the fracture union was based on clinical and radiological findings. Clinically fracture was considered united when there was no abnormal mobility, tenderness at the fracture site and unprotected weight bearing was there. Radiologically, fracture was considered united when bridging callus was seen in three cortices out of four in AP and lateral views. Nonunion was considered when two x-rays taken at a interval of six weeks showed no further progression to union and the surgeons felt that the fracture cannot unite without further operative intervention. Delayed union was considered when the union has not occurred at four months in closed fractures and six months in open fractures. Of the eighteen closed tibial fractures all united within four months. There were two open fractures, one case was still under treatment and was uniting and one went into nonunion. The distribution of fracture union is shown in table 5

Table 5: Fracture union according to the type of wound

Fracture Union	Tibia	
	Open	Closed
United	10	18
Nonunion	-	-
Delayed union	1	-
Union in progress at last follow up	1	

Complications

Following complications were noted among tibial fracture cases (table 6). Deep infection occurred in two patients. Shortening of limb more than 2 cm happened in one patient (table 6).

Table 6: Complications among tibial fracture cases

Complications	Number & Percentage (%)
Early	
Screw missing locking hole	2 (6.6%)
Delayed	
Knee instability	0
Distal screw pain	1 (3.3%)
Breakage of distal screw	0
Deep infection	2 (6.6%)
Quadriceps lag >5°	3 (9.9%)
Deformities	
• Valgus >5°	2 (6.6%)
• Varus >5°	1 (3.3%)
Non-union	1 (3.3%)
Delayed union	-
Shortening>2cms	1 (3.3%)

Dynamisation was done in 18 patients and local rotation flap was done in four patients (Table 7).

Table 7: Supplementary procedures done in addition to intramedullary nailing

Supplementary procedures to I/M Nailing	Tibia
Tightening of screw	-
Resciting of screw	1
Dynamisation	18
Bone grafting	1
Bone Marrow Injection	-
Split Thickness Skin Grafting	-
Local rotation flap	4
Gastronemius flap	2

Final outcome

Final outcome of the patients were graded as excellent, good, fair and poor according to the evaluation scale of Sanders *et al*. (1991). Out of thirty cases of proximal tibial fractures, one case was still under treatment and one case had gone into nonunion leaving twenty eight cases for evaluation of the results. In the proximal tibial fractures, there were two excellent, twenty good, four fair and two poor results. (Table 8) Nonunion was considered the failure of treatment.

Table 8: Final outcome of tibial fracture cases

Final Outcome	Tibia
Excellent	2 (6.8%)
Good	20 (68.9%)
Fair	4 (13.7%)
Poor	2 (6.8%)
Failure of treatment	1 (3.4%)

Discussion

The fractures of the proximal tibia present considerable challenge in their management. Regardless of the method of treatment, associated soft tissue damage, comminution, fracture extension into the knee joint and injury to the quadriceps mechanism often leads to unsatisfactory results[12]**.** This is the study of forty proximal tibial fractures treated with intramedullary supracondylar nail in the department of Orthopaedics.

Iannaconne (1991) [13] highlighted the problems of conventional intramedullary nailing in the fractures of the proximal shaft of the tibia and reported high degree of malalignment complications. Pommer *et al*. (1998) [14] observed that the tibial nail provided the same mechanical stability as plate fixation for proximal tibial fracture and had the advantages of soft tissue preservations. Instead of conventional intramedullary nail in the present study, we have used intramedullary supracondylar nail for treating the metaphyseal fractures of the tibia since 1997 in selected cases. There is only a single report [15] in which supracondylar nail for the proximal tibial fracture was used and had a good result.

Most of the surgeries (65%) were done within 12 hours of injury and any delay in surgery was due to associated injuries and associated medical conditions. About half (77.5%) of the surgeries were done through close technique i.e. through medial parapattelar approach with minimal soft tissue dissection and rest (22.5%) were done through open technique in which soft tissue dissection and periosteal stripping was minimal also less. Blokker *et al*. (1983) [16] reported 70% of the open reductions in his study with blade plates. The incidence of open reductions was significantly less with intramedullary nail in the present study as compared to other treatment methods because in open reduction there was less of soft tissue dissection and periosteal stripping.

The average union time for closed fractures in the present study was 3.1 months and the average union time for open fractures was 3.9 months. Overall, union time was 3.3 months. Yang *et al*. (1995) [17] showed union time of 3.8 months with blade plates and external fixator. Average range of motion at knee joint in the present study was 111.8°. The average range of motion reported in the literature was 80°-110° with conservative and other operative methods [18, 19].

Nonunion was seen in 3.3% of the cases in the present study. Guerra JJ et al [20] reported 9% of the cases of non-union with external fixator. No incidence of delayed union was seen in the present study. Rich C [21] reported 7% delayed union with lateral fixation devices. Mal union was seen in three cases in the present study. Out of these one had varus deformity and two had valgus deformity. Incidence of infection was seen in 6.6% of the open fractures in the present study. Infection reported in the literature with operative methods other than conventional intramedullary nail was 5%-20% [22, 23]. The incidence of infection was significantly less with IMSC nail than other methods.

Conclusions

In the literature, no studies have been reported with nailing in the metaphyseal fractures of tibia. The results obtained with nailing in the metaphysical fracture of tibia gives good results with acceptable complication rate and have proved superior to other methods available today.

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