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A clinical study on surgical management of diaphyseal fractures of tibia by intramedullary interlocking nail

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Abstract
Tibia is the most common fracture in the lower limb (1). Tibia is the subcutenously placed bone and has a precarious blood supply. Hence special care and expertise is necessary while treating this fracture. Biological principles should be followed during fixation of tibial shaft fractures. Intramedullary interlocking nail is a excellent device which provide good fracture stabilization.
Objectives: In this study we evaluated the fracture union time and functional outcome following intra medullary nailing in tibial shaft fracture.
Materials and Method: 30 patient meeting the inclusion criteria were included in the study.
Surgical management was done by the same surgeon. Post operatively patient were followed at intervals of 15 days for the first month followed by monthly visit for next 6 months.
Results: the most common age group was between 25-35, and the most common location was at middle third, 70% of the fracture were united wetween 12 to 16 weeks,
Conclusion: Closed internal fixation with intramedullary interlocking tibial nail is a standard surgical procedure for management of tibial diaphyseal fractures. The advantage of rapid rehabilitation and relatively few complications serve to recommend it for wider use.

Keywords: Closed nailing, intramedullary, interlocking, diaphyseal fractures of tibia

Introduction
Tibia is the commonest bone to be fractured and seen commonly in orthopaedic practice. Open fractures are more common, because one third of its surface is subcutaneous throughout most of its length. Furthermore, the blood supply to the tibia is more precarious than that of bones enclosed by heavy muscles.
Delayed union, non-union and infection are relatively frequent complications especially after open fractures of the shaft of tibia. Due to its frequency, topography and mode of injury it has become a major source of temporary disability and morbidity. Hence special care and expertise is necessary when treating such fractures. The major goal in the treatment of fracture tibia is achieving functionally useful and stable extremity. Now-a-days the well laid principle of biological osteosynthesis is rightly applied in long bone fracture healing and hence the selection of closed intramedullary interlocking nailing in this study. The following study highlights the role of closed interlocking nailing used for treating the fractures of the shaft of tibia [2].

Aims and objectives
The tibial diaphyseal fracture is the commonest fracture encountered, and the locked intramedullary interlocking nailing has revolutionized the management of tibial diaphyseal fractures.
The use of interlocking nails means that virtually all tibial diaphyseal fractures can be stabilized with an intramedullary nail, and the well laid principle of biological osteosynthesis is rightly followed here.

The objectives of the study are
1. To assess and study diaphyseal fractures of tibia with special reference to fracture anatomy, pattern and status of stability.
2. To study fracture healing and the union rates with intramedullary interlocking nail.

3. To study the functional outcome with regard to knee, ankle and subtalar joint movements.

Methodology

Adult patients with diaphyseal fractures of tibia presenting to orthopaedic department in Al-Ameen Medical College & Hospital, Bijapur from July 2012 to June 2014 meeting the inclusion criteria were included in the study.

The inclusion criteria

1. Transverse and short oblique fractures.
2. Segmental fractures of shaft of the tibia.
3. Communited fractures of the shaft of the tibia.
4. Grade I [Gustillo Anderson] compound fractures.

The exclusion criteria

1. Fractures in children.
2. Grade II and III [Gustillo Anderson] compound fractures.
3. Fractures with intraarticular extensions.
4. Burns/Wounds over the entry portal.
5. Patients not fit and not willing for surgery.
6. Polytrauma with other limb fracture.

Surgical procedure: Routine investigations including ECG, CRX-PA view were done according to the physician's advice. Surgery was planned after getting fitness from medicine and anaesthesia point of view.

Positioning of the patient

Patient is operated on an ordinary fracture table with his leg hanging by the side/ edge of the table. A bolster is used to support the distal femur at a sufficient distance from the popliteal artery and vein. The injured leg is scrubbed, painted with betadine, spirit and draped.

Medial parapatellar incision was used in all the cases. Entry portal is made the junction of the articular and anterior surface of the bone. A curved awl is used to open the medullary canal.

3.2 mm guide wire with ball tip is pushed into the canal, past the fracture site into the malleolar region (0.5 to 1 cm proximal to ankle joint) assisted by reduction manually.

Determination of the length of nail is done by subtracting the exposed length of guide wire from its overall length using another guide wire of same size or another nail of same size, which is used with C-arm assistance.

The nail with the proximal insertion handle and jig is passed over the guide wire and is inserted as far as possible. Hammering is done to drive the tip of nail to the distal metaphysis and proximal end should be flush with the surface of cortex at the point of insertion. The nail should be centralized as far as possible. The guide wire is then removed. Distal locking was done by free hand technique. Proximal locking was done using the jig and insertion handle.

The wound is closed and dressing is done, compression crepe bandage is applied to control postoperative swelling. Postoperatively the limb is elevated on a pillow.

Complications with respect to fracture healing, deformity and patients functional limatations were also documented during each followup visit.

Statistical analysis

Descriptive statistical methods and expression of results in terms of mean, chi-square test and others were done using latest SPSS software with significant p value of <0.05.

Results

Twenty six patients with unilateral and two patients with bilateral tibial shaft fractures were included in the study. The male to female ratio was 2.4:1. The most common mode of injury was road traffic accident. (Table 2) The most common age group was between 25-35 years (Mean 28.7) (Table 3). Six fractures were of compound grade 1 type. All the other fractures were closed.

According to the anatomical location 53 % of the fractures were in the middle third shaft. Next most common location was in the lower third, followed by junction of upper and middle third. One segmental fracture was also included in the study (Table 5).

Fracture union time was calculated using serial X-rays done at each follow up visit. 70% of the patients had union between 12-16 weeks. 26% of the patients achieved union by 17 to 20 weeks while, 4% of the patients had delayed union. (Table 4) Dynamization was done in these patients which led to union in 24 weeks. Full weight bearing mobilization was started only after achieving full bony union.

Complications: Two patients had superficial infections. Injectable antibiotics were given in these patients. 4 patients reported of anterior knee pain, which subsided with oral analgesics. Two patients had shortening of less than 2 inches. Shoe raise was provided in these patients. One patient had screw breakage. When evaluated retrospectively it was found that the patient did not abide by the Doctors instructions and was bearing weight on the limb before fracture union. However the fracture united and the broken screw was removed later (Table 7).

The following table shows comparative final results of various series of different modalities of treatment of tibial fractures. Of all the fractures.

Table 1: Results of various studies done in tibia interlocking nailing.

Author	Technique	Excellent-Good	Fair-Poor
Present study	Closed interlocking nailing	94%	6%
Edward series (1965)	Closed interlocking nailing	85%	15%
Olerud &Karlstrom(1972) [11]	Compression plating	91%	9%
Puno *et al.* (1986) [12]	Closed interlocking nailing Vs casting	98.3%	1.7%
Klemn and Broner (1986)	Closed interlocking nailing	94.3%	6.7%
Ekoland *et al.* (1988)	Closed interlocking nailing	94%	6%
Melcher *et al.* (1993)	Closed interlocking nailing	85%	15%

Table 2: Mode of injury

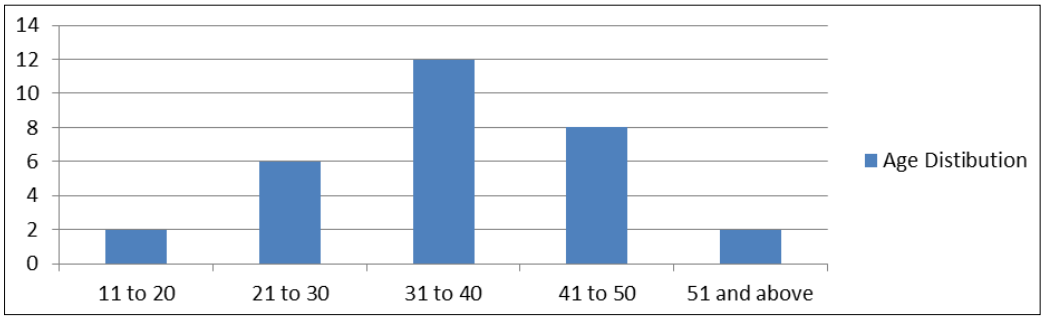
Mode of Injury	No. of patients	Percentage
Road traffic accident	19	63.33
Fall from height	8	26.66
Assault	3	10
Total	30	100

Table 3: Age incidence

Age groups (years)	No. of patients	Percentage
11-20	2	6.66
21-30	6	20
31-40	12	40
41-50	8	26.66
51 and above	2	6.68
Total	30	100

Table 4: Fracture union

Time taken in weeks	No. of patients	Percentage
12 to 16	21	70
17 to 20	8	26.67
21 to 24	1	3.33
Total	30	100



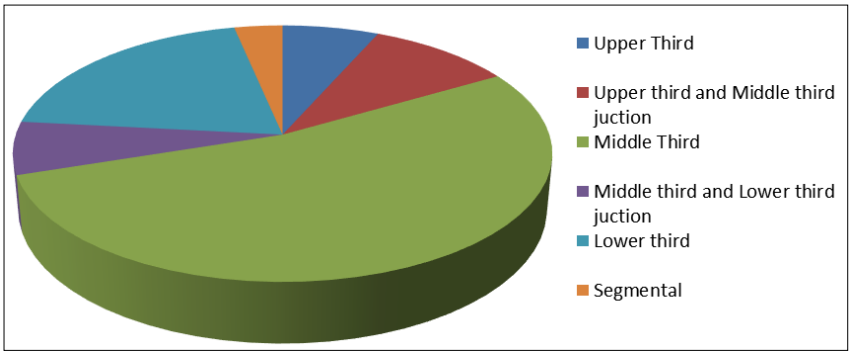
Age distribution

Table 5: Anatomical location of the fracture

Anatomical location of the fracture	No. of patients	Percentage
Upper third	2	6.66
Upper third and middle third junction	3	10
Middle third	16	53.33
Middle third and lower third junction	2	6.68
Lower third	6	20
Upper third and middle third junction and middle and lower third junction (segmental)	1	3.33
Total	30	100

Table 6: Type of fracture

Type of fracture	No. of patients	Percentage
Transverse	11	36.66
Oblique	8	26.66
Wedge(Butterfly)	5	16.68
Spiral	3	10
Segmental	2	6.67
Communited	1	3.33
Total	30	100



Anatomical Location of the fracture

Table 7: Complications

Complications	No. of patients	Percentage
Superficial infection	2	6.66
Proximal screw breakage	0	0
Distal screw breakage	1	3.33
Nonunion and nail breakage	0	0
Anterior knee pain	4	13.33
Mal union	0	0
Shortening	2	6.66

Table 8: Functional outcome

Function outcome	No. of patients	Percentage
Excellent	18	60
Good	8	26.66
Fair	4	13.34
Poor	0	0
Total	30	100

Radiographs- A/P and lateral

Fig 1a: Preoperative x-ray, 1b: immediate post operative x-ray, 1c: 6month post operative x-ray

Clinical photographs of the patient at 6 months showing and movements of knee and ankle

Fig 2a: Squatting, 2b: knee flexion 2c: dorsi flexion 2d: planter flexion.

Discussion

Fracture shaft tibia is one of the most common fractures encountered in everyday orthopaedic practice. In our study all the fractures were managed with intramedullary locked nails. The most common age group in our study was between 31 to 40 years. This was in accordance with the studies conducted by Arne Ekland *et al.* and Court Brown *et al.* [3, 4]. The most common mode of injury was RTA accounting to about 63.3%. Lawrence *et al.* in their study found that RTA was the most common mode of injury accounting for 90% of all the fractures [5]. According to the anatomical location, the most common site of fracture in our study was in the middle third (53.3%) followed by the lower third fractures (20%). This is comparable with the studies done by Lawrence B Bone *et al.* and Hooper *et al.* who reported the incidence of fracture in the middle third to be between 40-50% [5, 6].

The most common fracture type in our study was oblique type followed by transverse type. 55% of the patients had either of these two type of fractures. This is consistent with the findings of Sankarsan *et al.* who reported their incidence to be 59% [7].

Unreamed closed interlocking nailing was done in all the cases. The most common nail diameter used was 9mm, and the most common nail length was 34mm. Schemitsh *et al* (1998) noted no difference in bone formation between reamed and unreamed nailing [8]. The averge OT time was 90 minutes and the average blood loss was 400 ml. Postoperatively in our series, no complications like fat embolism, compartment syndrome, neurological or vascular injury occurred. Superficial infections occurred in two patients at the site of surgical incision over knee and both the superficial infections healed by dressings and injectable antibiotics.

In majority of our patients, active hip, knee, ankle movements and quadriceps exercises were started on the first postoperative day in all the 20 patients.

Majority of the patients were mobilized with the walker from the third postoperative day, without bearing weight on the operated leg. Suture removal was done in all patients on 14th day. Complete relief of pain was seen in majority of patients in two weeks. Follow up was done at 4th, 6th, 10th, 12th, 16th, 20th week and 6th month. At follow-ups, clinical and radiological assessment was done regularly with suitable follow-up advice.

Full weight bearing in our series was started at 10th week in 10 patients (50%) at 12th week in 6 patients (30%) and at 14 week in 4 patients (20%). The appearance of bridging callus was used to assess and allow the patient full weight bearing. The average time of full weight bearing was 9 weeks. Full weight bearing has been delayed in 5 patients as there were communited fractures.

This is comparable to Lawrence B.Bone *et al* (1986), wherein his study weight bearing has been delayed in unstable fractures [5].

Fracture union was considered when patient was full weight bearing without pain, fracture site was not tender on palpation and radiograph showed osseous union. In our series, majority of fractures united within 20 weeks (16 patients). The average time of union 19.1 weeks. This is comparable to the study done by Lawrence B. Bone *et al.* (1986) who reported average union time at 19 weeks [5]. Court Brown *et al.* (1990) reported average union time at 16.7 weeks [4]. Arne Ekeland *et al.* (1988) reported average union time at 16 weeks [3]. In our series, average time of union was 19.1 weeks.

Complications

Lawrence B. Bone *et al.* (1986) noted an infection rate of 6.25%. Arne Ekeland *et al.* (1988) noted infection rate of 4.4% [3].

Blachut PA *et al*. (1997) noted an infection rate of 1% [9]. In our series, which is comparable to the above workers study series, superficial infection rate was 10% and it healed with dressings and antibiotics. Anterior knee pain can be compared to Hernigou P *et al* (2000), who noted improper entry of nail into medullary canal, may cause anterior knee pain [10]. Anterior knee pain was seen in two patients 10%. In these patients the nail was abutting the patellar tendon and tibial tuberosity, causing anterior knee pain and was relieved after removal of the nail. One patient had distal screw breakage. This was because he did not follow the post operative rehabilitation protocol, and started full weight bearing before achieving union at the fracture site. Two patients had delayed union which healed with dynamization.

Conclusions

Fracture tibia is a very common fracture of the lower limbs. It should be adequately to provide good functional outcomes. Locked intramedullary nails are excellent fixthation devices and provide good fixation of the fracture fragments. Complications commonly encountered re superficial infections and anterior knee pain. Good union is achieved in majority of the patients by 6-8 weeks. Locked intramedullary nails when used properly provide an excellent treatment option in these fractures.

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