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The Outcome of Reamed Intramedullary Interlocking Nail in Fracture Shaft Tibia

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Abstract

Introduction: Intramedually nails, such as Lottes and Ender nails, used without reaming, have been employed successfully in the treatment of open tibial fractures and have been associated with low rates of post-operative infection. They are, however contraindicated for communited fractures, as there tends to be shortening or displacement of such fractures around these small nails. *Methodology:* Patients were operated under spinal / general anaesthesia. Patient is placed in supine position over a radiolucent operating table. The injured leg is positioned freely, with knee flexed 90° over the edge of operating table to relax the gastro soleus muscle and allow traction by gravity. The uninjured leg is placed in abduction, flexion and external rotation to ensure free movements of the image intensifier from A.P. to lateral plane. The table is adjusted to a comfortable operating height. *Results:* 21 cases (70%) had excellent results. 5 cases had good results (16.6%), 2 fair (6.7%) and two case (6.7%) poor result. *Conclusion:* Closed reamed interlocking intramedullary nailing with the help of image intensifier seems feasible in diaphyseal fractures of the tibia.

Keywords: Fracture Shaft Tibia; Intramedullary Interlocking Nail; Clinical Outcome.

Introduction

Three goals must be met for the successful treatment of fractures of tibia. The prevention of infection, the achievement of bony union and the restoration offunction. These goals are interdependent and usually are achieved in the chronologic order given. For example failure to prevent infection promotes delayed union or non-union and delays functional recovery of the limb. Immobilization in a plaster cast has been used most commonly in the past but it does not always maintain the length of the tibia and it leaves the wound relatively inaccessible [1].

Open reduction and internal fixation with plates and screws has yielded unacceptably high rates of infection [2,3,4]. This method may be selected with more severe or local injuries, associated displaced intra articular fractures of knee and ankle.

External fixation, considered the treatment of choice for the open & comminuted fractures by many truamatologists, has the disadvantages of the bulky frames and frequent pin track infections, nonunion, and malunions [2,5].

Charnley [6] in his text closed treatment of common fractures, said that he believed the eventual solution to the tibial fractured would be reamed intramedullary nail.

The Reamed intramedullary nailing locked or unlocked has become an attractive option since image intensifier has made closed intramedullary nailing possible. Nail is a load sharing device and is stiff to both axial and torsional forces. Closed nailing involves least disturbance of soft tissue, fracture hematoma and natural process of bone healing as compared to other forms of internal fixation.

Intramedually nails, such as Lottes and Ender nails, used without reaming, have been employed successfully in the treatment of open tibial fractures and have been associated with low rates of post-operative infection. They are, however contraindicated for communited fractures, as there tends to be shortening or displacement of such fractures around these small nails [5,7].

Among the various modalities of treatment such as conservative gentle manipulation and use of short leg or long leg cast, open reduction and internal fixation with plates and screws, intra medullary fixation (including Ender Pins, intramedullary nails, and interlocking intramedullary nails with remaining (or) without Reaming), and External fixation techniques, surgeon should be capable of using all these techniques and must weigh advantages and disadvantages of each one and adapt the best possible treatment [8]. The best treatment should be determined by a thoughtful analysis of morphology of the fracture, the amount of energy imparted to the extremity, the mechanical characteristics of the bone, the age and general conditions of the patent, and most importantly the status of the soft tissues (the skin, muscle associated neurologic and vascular structure of the leg).

The locking of intramedullary nails to the major proximal and distal fragments decreases the prevalence of malunion of communited fractures. Intramedullary (IM) fracture fixation serves to stabilize fracture fragments and maintains alignment, while permitting motion at the fracture site during functional activities. Acting as an internal splint, the implant serves as a load-sharing device and fracture healing progresses with the formation of peripheral callus. By allowing motion of adjacent joints, rehabilitation is concurrent with treatment, and stress-shielding is thought to be minimal using these techniques. Recently, IM nails have been introduced to widen indications for their use based on variations in the cross-sectional geometry, length and shape of nails, interlocking designs, and surgical techniques. Although the most important mechanical factors in the design of IM nails are strength, stiffness, and rigidity, anatomic constraints and surgical technique limit nail variations. Closed nailing is preferred to open procedures to preserve periosteal blood supply and minimize surgical trauma adjacent to the fracture. Blood flow to the fractured bone is elevated in nailing experiments. However, the end result in terms of healing was similar to that of plate fixation as observed by a study done by Tar et al [9,10].

With introduction of reamed intramedually interlocking nail for tibial shaft fractures has overcome some of these complications by using a bigger diameter nail and encourages the patient for early mobilization. As fracture hematoma is not disturbed, healing of fracture is good. Due to minimal exposure and minimal soft tissue handling the rate of infection is reduced.

Use of proximal and distal interlocking nails has broadened the indications for the use of the technique for the fractures that may be too difficult to maintain the alignment in plaster cast or functional brace.

This lead us to design a trial, to study the results of reamed interlocking intramedullary nails in the treatment of closed fractures of the tibial shaft and assess the functional outcome and quality of life using Johner & Wruh's Criteria in the patients [11].

Methodology

Inclusion Criteria

1. Participant giving consent to enroll in the study.
2. Age > 18 yrswith fracture shaft tibia
3. Patient with closed fracture shaft tibia
4. AO classification used to classify the fractures.
5. Johner & Wruh's Criteria
6. Both males and females

Exclusion Criteria

1. Participant not willing to enroll in the study.
2. Age <18 yrs
3. Fracture extending into tibial condyle
4. Fractures extending into ankle
5. Duration of the fracture > 3 weeks
6. Pathological fractures
7. Compound fractures of the tibia with extensive soft tissue damage.
8. Old fractures with complications like infection, delayed union, nonunion and mal union

Pre operative Preparation of Patients

- Patients were kept NBM for 8 – 10 hours before surgery.
- IV Fluids are per the need were given.
- Adequate amount of compatable blood if needed was arranged.

- Preparation of whole extremity, private parts and back was done.
- Written and informed conscent was taken.
- Soap water enema in night
- Tranquilizers HS
- IV antibiotics half an hour before surgery.

Surgical Technique

Patients were operated under spinal / general anaesthesia. Patient is placed in supine position over a radiolucent operating table. The injured leg is positioned freely, with knee flexed 90° over the edge of operating table to relax the gastro soleus muscle and allow traction by gravity. The uninjured leg is placed in abduction, flexion and external rotation to ensure free movements of the image intensifier from A.P. to lateral plane. The table is adjusted to a comfortable operating height.

AO pneumotic tourniquet/Esmarch rubber tourniquest was used in all patients. The affected limb is thoroughly scrubbed from mid – thigh to foot with Betadine scrub and savlon. Then limb is painted with 10% betadine solution from mid thigh to foot. Rest of the body and other limb is properly draped with sterile drapes. Sterile gloves are applied to the foot and sterile – drape over the leg from knee joint to ankle.

Post Operative Care

Immediate

- NBM 4-6 hours post operatively
- IV fluids / blood transfusions
- IV antibiotics
- IM analgesics
- Tranquilizers HS
- Limb elevation over pillows
- Watch for active bleeding
- Active toe movements
- TPR / BP chart every hourly
- Input / output chart
- Check X-ray of the operated tibia (full length) including knee and ankle joints in both AP and lateral view.

Postoperatively elastocreepe bandage applied and the limbs elevation over pillows. I.V antibiotics is given for 5 days postoperatively. Culture from the wound if necessary sent. Switch over the oral antibiotics is done on the 5th postoperative day. Analgesics if required given. Active knee, ankle and toe mobilization started after over come from anaesthesia. Patient was allowed non – weight bearing crutch walking/walker on next post operative day if associated injuries permits, general condition and tolerance of patient. Skin sutures were removed on 10th– 12th postoperative day. Depending upon the culture report and wound condition antibiotics are stopped / continued. Partial weight bearing crutch walking / walker commenced depending upon the type of fracture, rigidity of the fixation and associated injuries.

Further follow up is done at 6 weekly intervals i.e,. at 12 and 24 weeks and each patient is individually assessed clinically and radiographically according to the proforma.

Results

The present study includes 30 closed fractures of the tibial shaft surgically treated with closed interlocking intramedullary. The patient has followed up for at least 8-10 month. All these patients were available for follow up.

The end results of all 30 cases have been summarized here. All the cases had a follow up between 8 to 10 months.

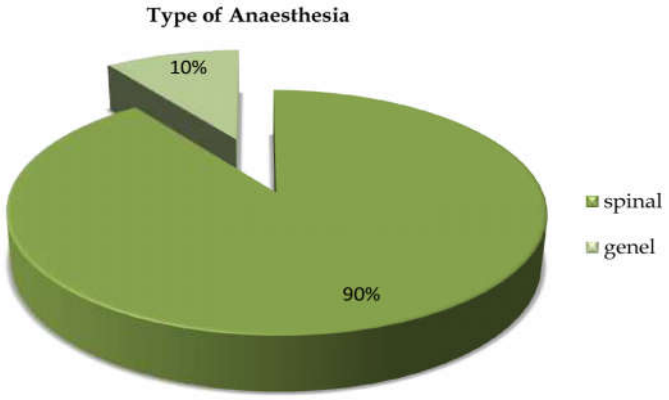
Results were evaluated at every 6, 12 and 24th weeks from the date of discharge.

One of the essential aspect of closed reduction and internal fixation with interlocking intramedullary nailing is the ability to mobilize the patient early. 27 of the patients were mobilized by active knee, bending and quadriceps exercises were initiated after over come from anaesthesia. 3 patients associated with other injuries mobilization was delayed

Union was defined as the presence of bridging callus on two radiographic views and the ability of the patients to bear full weight on the injured extremity, if other injuries allowed. 28 of the thirty

Table 1: Type of anaesthesia

Anaesthesia	No. of cases	Percentage
Spinal	27	90
General	3	10



Graph 1: Type of anaesthesia

Table 2: Difficulties during operation

Difficulties	No. of cases	Percentage
Drill bit breakage	3	10
Locking bolt outside of holes (distal)	3	10

Table 3: Secondary procedure

Procedure	No. of cases	Percentage
Dynamization	4	13

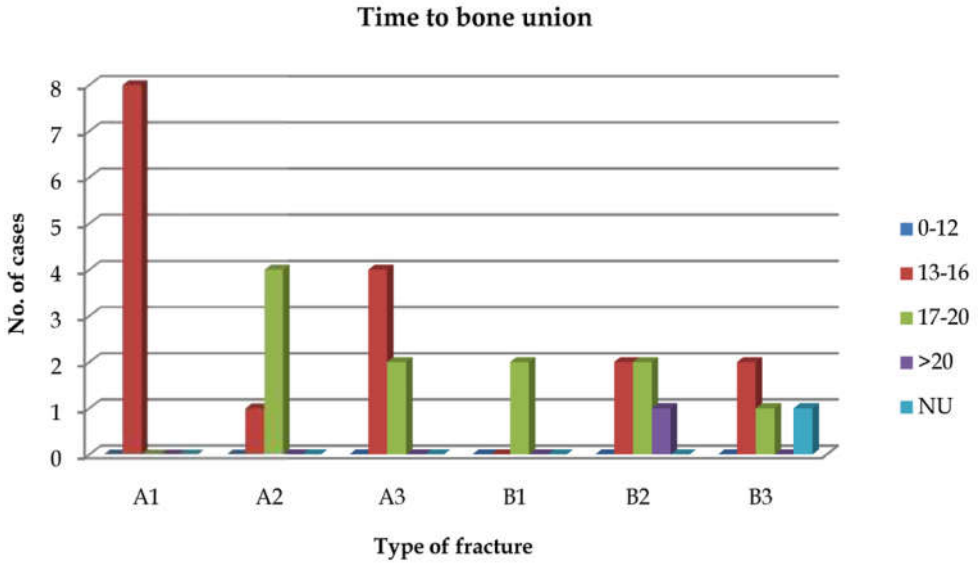
In 4 cases dynamization was done between 16-20 weeks.

Table 4: Union in relation to type of fracture

Duration in weeks	A1	A2	A3	B1	B2	B3	Total
0-12	0	0	0	0	0	0	0
13-16	8	1	4	0	2	2	17
17-20	0	4	2	2	2	1	11
>20	0	0	0	0	1	0	1
NU	0	0	0	0	0	1	1

fractures united. The time to union ranged from three to eight months, with an average of 4 months. 28 fractures healed before 20 weeks, and 1 fractures healed between 21 weeks to 31 weeks. And there was 1 case of non union.

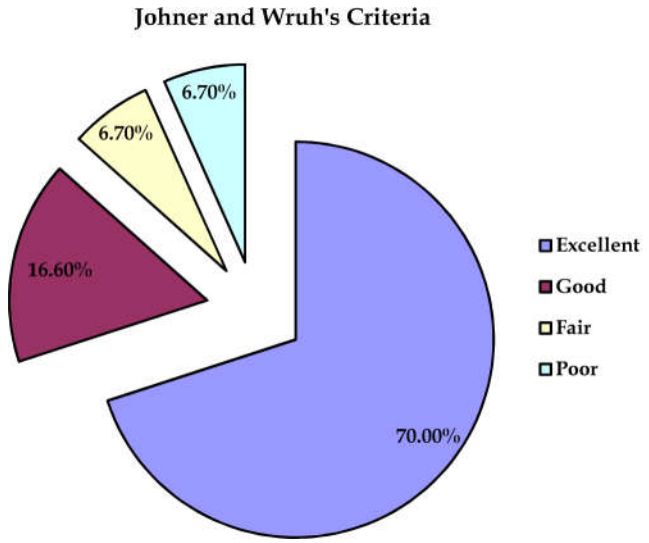
Detailed analysis of function of the patient was done on the basis of the following criteria by Johner and Wruh [28].



Graph 2: Time to bone union

Table 5: Functional results (Johner and Wruh's criteria)

	Excellent	Good	Fair	Poor
Non union, Ostetitis, amputation	None	None	None	Yes
Neuro-vascular disturbances	None	Minimal	Moderate	Severe
Deformity				
Varus / Valgus	None	2°-5°	6°-10°	>10°
Anteversion / recurvation	0°-5°	6°-10°	11°-20°	>20°
Rotation	0°-5°	6°-10°	11°-20°	>20°
Shortening	0-5mm	6-10 mm	11-20mm	>20mm
Mobility				
Knee	Normal	>80%	>75%	<75%
Ankle	Normal	>75%	>50%	<50%
Subtalar joint	>75%	>50%	<50%	
Pain	None	occasional	moderate	Severe
Gait	Normal	Normal	Insignificant limp	Significant limp
sternous activities	Possible	Limited	Severly limited	Impossible
No. Of cases	21	5	2	2



Graph 3: Functional results (Johner and Wruh's criteria)

Table 6: Complications

Complications	No. of cases	Percentage
Infection	1	3
Non-union	1	3.3
Knee Pain	6	20

The results of this grouped under the above categories are as follows. 21 cases (70%) had excellent results. 5 cases had good results (16.6%), 2 fair (6.7%) and two case (6.7%) poor result.

Discussion

The optimal management of tibial shaft fractures continues to be a problem with several unanswered questions. Those fractures, usually caused by high energy trauma, have numerous problems resulting from the poor soft tissue coverage and limited vascular supply of the tibia, cause malunion, non-union, infection and some times resulting in amputation.

There are two major factors related to the lesion that alter the final out come in tibial shaft fractures. The first is the severity of the fracture, characterized

according to Nicoll [12] by the degree of initial displacement, comminution and soft tissue injury. Accordingly, the more severe the fracture, the higher the rate of complications, and the longer the periods of healing will be, whatever the method of fixation used.

Unstable and open fractures can be treated with plaster casts in corporating transfixion pins.This method has been valuable for distal tibial fractures, including those with joint extension, especially the rotation type Pilon fractures. The method has an advantage of maintaining the length, prevention of rotation and allows the mobilization of knee. This has the disadvantage of severe pin tract infection and pivoting of the bone and angulation of the fracture site.

Plate osteosynthesis provides rigid fixation of an unstable fracture, and that reduces the problems of non union. The stripping of soft tissue required for application of plate, however, has lead to an unacceptable rate of infection in patients who have an open tibial fractures.

In current series 30 cases of closed fracture of shaft of the tibia were treated by closed reamed interlocking intramedullary nailing over a period of two years.

They were followed up for an average of 10 months. The purpose of this study was to evaluate the end results of treatment in these patients.

In our series 29 (97%) fractures united within 4 months of injury, is comparable with the other series as well.The delay in union was noticed in 1 patient which was infected. And there was one case of non union.

The physiological and stable fixation with reamed interlocking intramedullary nailing should lower the rates of infection and mal union and expand the use of intramedullary locked nails to the tibial fractures with any degree of comminution and soft tissue injury.

A malunion was defined as angulation in a coronal plane (varus–valgus) > 5^{o}, sagital plane (anterior – posterior) angulation of > 10^{o} or 10 > mm of shortening. In our series, 4 cases of malunion occurred (15%).

These results comparable with the early results of reamed interlocked intramedullary nailing of closed tibial fractures from other centers.

In our series no implant failure was observed.

On the basis of this study, we are now recommend dynamization of most statically locked nails at 8-12 weeks if callus is not evident to promote fracture union and to avoid fatigue fracture of the inter locking screws.

In our series, 21 patients (70%) full range of knee motion, in 21 patients (70%) full range of ankle motion at 12 weeks of injury

Table 7: The results of reamed intramedullary nailing in the treatment of closed tibial fractures

Authors	No. of patients	Union (weeks)	Infection (%)	Non-union (%)	Mal-union(%)
Court-Brown et. al.,[16]	25	15.4	0	0	0
Blachur et. al.,[1]	73	18	2	4	4
Bone et. al.,[3]	47	18	0	2	2
Present study	30	16.89	3.3	3.3	4

In our study 6 patients (20%) noticed pain at the knee joint. Similar results were found by Keating et, al., Court and Brown et, al. and Toivanen et, al [13-15]. Patzakiset. al., (1996) recommends removal of nail after fracture healed to avoid the risk for reactive of infection.

Conclusion

1. Early mobilization of the patient which helps in healing of the fracture and prevent joint stiffness.
2. Strict adherence to technical principles during nailing might have prevented some of the complications that developed in this series.
3. Acceptable complications rate as compared to other modalities of treatment.

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