“STUDY OF SURGICAL MANAGEMENT OF PROXIMAL THIRD TIBIAL FRACTURES USING EXPERT TIBIAL NAIL”

By

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ABSTRACT

INTRODUCTION

Extra articular proximal tibia fractures represent about 7% of all tibia fractures, and usually exhibit complex fracture patterns with moderate to severe soft tissue damage. No fracture arose more controversy regarding the method of treatment than proximal tibia fractures.

Fractures of tibia proximal tibia fractures are particularly difficult to treat with regular intramedullary locking nails. This is because of the discrepancy in the size of the nail and wide metaphysis of proximal tibia. The Herzog's bend which comes at or below the fracture site results in distraction and angulation of the proximal fragment.

Expert Tibial Nail (ETN) is a newer implant that overcomes the problems encountered by the conventional nails. So we have undertaken the study of intramedullary nailing of proximal tibia fracture with ETN.

OBJECTIVES

The aim of the present study is to analyze the results of treatment of proximal tibia fractures with the Expert Tibia Nail with regard to assessment of the union rate, complications associated with the procedure, restoration of range of motion of knee joint.

METHODS

The present study was undertaken at the Department of Orthopaedics, Sri Devaraj Urs Medical College and Research Institute after obtaining ethical clearance. This study involved both male and female patients with proximal tibia fractures, who presented to. R.L.Jalappa hospital, attached to Sri Devaraj Urs Medical College and Research Institute, Tamaka, Kolar.

30 patients who had proximal tibia fractures were treated with expert tibial nailing during the period from December 2011 to October 2013, all were fresh traumatic fractures and patients were followed up for 8 months.

RESULTS

The mean time for radiological union was 29.4 weeks (range 24-36 weeks). , 2 patients (6%) had mild loss of knee motion: 1 (3%) patient had 30° loss of flexion and 1 patient had extension lag of 10°. Also, 1 patient had loss of ankle dorsiflexion due to common peroneal injury sustained during initial injury. 12 patients (40%) had an average anterior angulation of 4°. Valgus angulation of 8° was noted in 1 patient and 5^{o} in 5 patients. 1 patient had infection which subsided with the course of oral antibiotics and aseptic dressings, 2 patients complained of palpable proximal locking screws and one complained of anterior knee pain due to nail projecting from proximal aspect, 2 patients had delayed union and are treated successfully with dynamisation. 5 had excellent result, 14 patients had good and 9 patients had fair results and 2 patients had poor results according to Klemm and Borner functional criteria.

CONCLUSION

Intramedullary nailing of proximal third tibial fractures, using expert tibial nail when meticulously performed can yield excellent clinico-radiological outcomes with minimal complications. But familiarity with the current surgical technique is necessary, otherwise mal-alignment of the fracture is a major problem.

KEY WORDS: Expert tbia nail, proximal tibial fractures

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INTRODUCTION

Tibia is the most commonly fractured of all long bones of the body and occurs at a frequency of 26/1, 00,000 per year[1]. Extra articular proximal tibia fractures represent about 7% of all tibia fractures, and usually exhibit complex fracture patterns with moderate to severe soft tissue damage[2].

No fracture arose more controversy regarding the method of treatment than proximal tibia fractures. Due to their frequency, topography, mode of injury and sometimes type of treatment, they have become a source of temporary or permanent disability.

Proximal Tibia fractures are caused by direct violence to tibia, due to high energy trauma such as occurs in road traffic accidents and low energy trauma such as fall. Tibia fractures commonly affect young males and the complications such as malunion, non-union, infection or arthritis often result in vocational, social and economic problems[3].

In spite of all the advances, proximal fractures of tibia still pose a challenge to the orthopedic surgeons due to the following reasons:

- As tibia is a subcutaneous bone, the fracture is often open.
- In these fractures, there is the tendency of displacement of fracture fragments after swelling subsides due to strong muscular attachments to the proximal fragment.
- If the rotational alignment of the fragment is imperfect, there may be cosmetic and functional disability.
- Being a subcutaneous bone, the rate of post-operative infection is higher than in most other fractures.

- The conventional nails don't provide good stabilization of the short proximal fracture fragment.

Most of these fractures benefit from operative stabilization even if they are not greatly displaced or unstable

There is no universally accepted method of management of proximal tibial fractures till date. Various methods of treatment of these fractures are:

Conservative

- Cast Immobilization
- Traction

Operative

External fixators

Open reduction and internal fixation:

a. Plates and screws
b. Intra-medullary nails

Closed reduction and internal fixation

a. Plates and screws
b. Intramedullary nails

Every technique has its own merits and demerits[4].

Traditional conservative methods by immobilization in plaster cast usually result in a healed and well-aligned fracture, but immobilization for over 16 weeks is not unusual and patient may have significant stiffness and oedema. Shortening, non-union and mal-union are common with this mode of treatment[5, 6].

Traction is mainly used in the management of fractures with intra-articular extension complicated by fracture blisters.

Fixation with plates and screws has high risk of infection and non-union secondary to trauma caused to soft tissues during open technique. The main disadvantage of plating is that it requires soft tissue stripping, which can lead to wound complications and infection. Different operative methods have been described but due to short proximal fragment and the biomechanical problems, plates providing angular stability are preferred. They can be usually be applied with minimal or no exposure of the fracture focus. Early reports on the clinical use of LISS plate and LCP have shown promising results regarding fracture union infection rate and secondary loss of reduction[7, 8].

External fixators provide stable fixation, preserve soft tissues and bone vascularity, leave wounds accessible and cause little blood loss. But pin site infection, malunion, joint stiffness, patient acceptance and delayed union remain the greatest problems. External fixators can be used as temporary method of stabilization followed by secondary stabilization[9].

Intramedullary nailing popularized by Kuntscher (1940) for shaft fractures of the lower extremities has proven its value. Intramedullary fracture fixation serves to stabilize fracture fragments and maintain alignment of fragments along the shaft axis while permitting physiological micro movements at the fracture site during functional activities. Acting as an internal splint, the implant serves as load sharing device, absorbs the rotational and lateral bending forces that occur during motion and weight bearing and fracture healing process progresses with formation of peripheral callus[10].

With closed intramedullary nailing technique the fracture site is not opened at all, this preserves fracture hematoma with reduced risk of infection.

But conventional interlocking nails do not provide the desired stability of the fracture fragments in case the proximal or the distal fractures of tibia. Mal-alignment is a common problem in proximal 3rd fractures treated with locked nails because of large discrepancy in size between the tibia nail and wide tibial metaphysis. Unlike in the diaphysis, the proximal fracture must be reduced before nail insertion. A suboptimal entry point results in axial malalingnment, while secondary misalignment with post-operative tilting of the proximal fragment may be a result of insufficient fixation, sometimes additional implants are needed to secure stability[11].

Lang GJ, Cohen BE, Bosse MJ, et al (1995) treated thirty-two extra articular fractures of the proximal third of the tibia with locked intramedullary nails (84%) had angulation of 5° or greater in the frontal or sagittal plane. Based on their findings, they limited the use of intramedullary nailing for proximal third tibia shaft fractures and considered alternate forms of fixation, plate or external fixation [12].

Henley MB et al (1993) based on their study on the influences of some design parameters on the biomechanics of the unreamed tibia intramedullary nail and found that the oblique proximal locking screws significantly decreased both varus/valgus angulation and medial/lateral translation under load[13].

Laflamme GY et al (2003) based on their study on the mechanical stability of oblique interlocking screws in supplementing intramedullary nail fixation of high proximal tibia fractures concluded that the addition of oblique interlocking screws significantly improved the stability of a nailed proximal tibia fracture and provided comparable stability to a plate osteosynthesis[14].

Freedman and Johnson found out high incidence of malalingnment in proximal tibia when compared to middle and distal fractures with intramedullary nailing[15].

Malunion following intramedullary nailing of proximal tibial fractures is the commonest complication which is due to defective point of entry. The deformities which occur are valgus angulation, flexion of proximal fragment and posterior translation at fracture site.

Valgus deformity occurs due to medial entry point which is not in same line as the medullary canal in proximal third tibia fractures. Once the nail engages the distal fragment valgus angulation occurs because of the mismatch between the so called nail entrance angle and the tibial medullary canal. Additionally the origin of the musculature of anterior compartment act as a tether on the lateral tibial surface proximally which may contribute to valgus angulation.

Flexion deformity is due to quadriceps mechanism extending the proximal fragment, the Herzog bend of the nail hitching against the posterior tibial cortex pushing the proximal fragment forward and nailing done in flexion can also cause anterior angulation. In order to prevent valgus deformity the entry point must be at the edge of the articular surface and laterally to midline in line with medullary canal.

To prevent anterior angulation Tornetta and Collins recommended that a semi extended position with a partial medial knee arthrotomy, which neutralizes the deforming force of the quadriceps on the proximal fragment and allows the patella to be subluxated laterally and the nail must be placed as anteriorly in the proximal fragment as possible to prevent the proximal fragment from flexing.

Another technical contribution for the management of tibia fractures is the concept of blocking screws (poller screws) advocated by Krettek etal and by Cole. This technique involves placement of bicortical screws into the tibia prior to the introduction of the nail, the screws serves to narrow the medullary canal in the tibial metaphysis.

The blocking screw placed in the posterior half of the proximal part of the tibia in the sagittal plane blocks the nail from passing posteriorly and abolishing the flexion and translational forces.

Similarly an anterioposterior screw is placed laterally in the metaphyseal region will substitute for the lateral cortex keeping the nail at midline and preventing valgus deformity.

Tornetta etal reported seventy three proximal tibia fractures for which they have used an algorithm to decide if any special techniques were needed to maintain reduction. Intraoperative a lateral radiograph of tibia is done with knee in flexion, if the fracture goes into anterior angulation they used a semi extended approach if posterior translation occurs a blocking screw is utilized, if both deformities are present both techniques are used.

Other techniques that have been advocated to prevent malreduction of the proximal part of the tibia include provisional reduction and fixation of the fracture with uni cortical plates or distractor and to hold the reduction at all times during the passing of nail until locking is done.

Usage of these techniques with expert tibial nail can give good results.

To overcome the problems encountered by regular nails in 2005 another feature was added to tibial interlocking nails with options of very proximal and very distal locking in multiple planes. Several technical modifications compared to standard tibial nails were incorporated in the design of this nail called Expert Tibail Nail (ETN). The numerous multiplanar locking options at the proximal and the distal end allow for secure stabilization of the metaphyseal fragments and ensure that alignment can be well maintained.

Expert Tibial Nail (ETN) is a newer implant that overcomes the problems encountered by the conventional nails. Certain intraarticular tibial fractures can be addressed by intramedullary nailing in combination with other implants.

It enables the surgeon to further extend the spectrum of fractures eligible for intramedullary nailing. Multidirectional interlocking screws ensure that alignment can be well maintained and stability preserved in short proximal tibial segment. The end cap achieves angular stability between the proximal oblique screw and the nail. These changes in implant design enhance the stability of the bone-nail construct and reduce the risk for secondary malalignment[16].

So we have undertaken the study of intramedullary nailing of proximal tibia fracture with ETN.

Key Features & Benefits

- Numerous multiplanar locking options for expanded proximal and distal indications
- New anatomic bend for facilitated nail insertion and extraction
- Cannulated nails for reamed or unreamed techniques, enabling nail insertion over guide wire
- Solid nails for unreamed technique
- Possibility to block one oblique locking screw with the end cap for absolute angular stability.
- The first oblique locking hole lies at a distance of 14mm from the proximal end of the nail and second one at the distance of 20mm from the proximal end.
-

AIMS AND OBJECTIVES:

The aim of the present study is to analyze the results of treatment of Proximal tibia fractures with the Expert Tibia Nail with regard to:

- Assessment of the union rate
- Complications associated with the procedure
- Restoration of range of motion of knee joint.

REVIEW OF LITERATURE:

The history of fractures of long bones can be traced as far as the history of mankind. The use of bamboo splints to treat fractures has been practiced by the ancient Indians since time immemorial and a variety of resins & lime have also been used.

The fractures of proximal tibia are the most challenging injuries. The surgical treatment of these fractures has evolved a great deal, but we still have a long way to go before the best method of treating a fracture of proximal tibia can be stated with finality.

Historically, the first description of an intramedullary splinting with ivory pegs goes back to the 19^{th} century.

Gerhard Kuntscher (1900-1972) gave the most important contribution to intramedullary fixation who performed a number of animal experiments and perfected not only the nailing technique but also the implant shape and design.

Hey-Groves (1918) used solid metal rods for femur fractures and pointed to the rapid healing, preservation of soft tissues, and periosteum as well as the abolition of prolonged plaster cast immobilization[17].

Blockley(1956) treated 33 cases of tibia fractures with plating and concluded with rigid fixation pain, joint stiffness , edema and osteoporosis are minimal which are seen in fractures treated conservatively. Implant if not rigidly fixed and if periosteum is excessively stripped the rate of union may be slow[18].

Kuntscher (1958) concluded that intramedullary nailing represents the ideal treatment for fracture of shaft of long bones requiring no external splintage or special post-operative care[19].

Ellis (1958) concluded that prolonged immobilization when tibia fractures treated conservatively in cast resulted in joint stiffness. Injury to soft tissues, infection and vascular injury do not play much role in joint stiffness[20].

Veliskakis (1959) in a study concluded that patients should be selected carefully for internal fixation and the soft tissues play an important role in selection of patients. Grade I fractures internal fixation and wound closure can be safely employed. Grade II fractures should be carefully assessed and treated by internal fixation and wound closure only if primary wound healing is expected. Grade III fractures primary wound closure with or without internal fixation should be avoided. In open fractures good wound debridement and antibiotic coverage can give good results[21].

Nicoll (1964) in a survey of 765 tibia fractures summarized

a) The factors most conductive to delayed nonunion are initial displacement, communition, associated soft tissue wound and infection.
b) Continuous traction does not retard union.
c) Internal fixation is better choice of treatment when compared to conservative metods[22].

Slatis (1967) compared closed intramedullary nailing of tibia shaft fractures with conservatively treated fractures and concluded that there is no significant difference between two groups regarding time of full weight bearing, residual joint stiffness in knee and ankle but tarsus movement was better in nailed group. Conservative methods give good results in closed fractures. In fractures with skin wound and multiple trauma closed intramedullary nailing may be better alternative to conservative treatment[23].

Zucman (1969) studied 36 segmental tibia fractures treated with Kuntscher nails and concluded that intramedullary nailing allows walking with full weight bearing in 3-4 months. Also decreases rate of non-union, malunion and infection as fracture site is not exposed. But in open fractures nailing can be complicated by infection, this can be controlled by use of antibiotics and debridement which can give good results[24].

Burwell (1971) treated 181 tibial shaft fractures which included 16 proximal and 17 segmental fractures with plating and concluded that plating gives better functional stability with a shorter period of disability even in open fractures and proved to be valuable treatment in elderly[25].

Solheim (1973) studied 81 fractures of tibia with intramedullary nailing and formulated the results 96% of patients had good union with normal alignment 2% had fair results in terms of union and difficulty in everyday work 1% of patients had poor results mostly nonunion and deformity at fracture site and proposed rigid fixation with nailing made additional immobilization with plaster unnecessary[26].

Langard (1976) treated 54 segmental tibia fractures with nailing and formulated results. Nailing secures realignment and usually yields rigid fixation of both fractures and thereby decreasing time of immobilisation[27].

Edge(1981) in a study on external fixation for complex tibial fractures in 38 patients concluded 95% patients achieved solid union and no refractures occurred after removal of the fixator and this method also permits sufficient movement at fracture site to stimulate callus formation[28].

Merianos (1982) treated 31 tibial shaft fractures with Enders nails and concluded that Enders nails can be used for all diaphyseal fractures of tibia including proximal tibia fractures. The advantages are rapid restoration of bony continuity, minimal postoperative complications and maintenance of normal limb function during period of treatment. Proximal and distal tibial fractures required additional support with plaster as they are prone for angular deformities[29].

Sarmiento (1989) treated 780 tibial fractures with functional braces which include 11% of proximal tibia and segmental fractures which required longer period of immobilization for the fractures to heal and concluded that cast immobilization should only be used in only specific fracture patterns like shaft of tibia[30].

Court-brown (1990 concluded intramedullary nailing of closed and grade I open tibial fractures in 132 cases is a safe method with a high rate of union with low complication and early return to function even in proximal, segmental fractures[31].

Alho (1990) in a study treated 93 tibial shaft fractures with intramedullary interlocking nailing and concluded that intramedullary nailing in addition to early joint motion allows early weight bearing than in plaster fixation[32].

Henley (1993) studied influences of some design parameters on the biomechanics of the unreamed tibial intramedullary nail. These included the effects of the location of the nail bend on the reduction of a high proximal fracture, and the relation of proximal locking screw hole orientation and fracture component cortical contact to the mechanical stiffness of the construct. They found that the oblique proximal locking screws significantly decreased both varus/valgus angulation and medial/lateral translation under load, compared with the parallel screws[33].

Lang (1995) concluded that the fractures of the proximal third of the tibial shaft didn’t appear to respond as favourably to locked intramedullary nailing as do fractures in the distal 2/3. Valgus, apex anterior angulation and residual displacement at the fracture site were common after nailing[12].

Tornetta (1996) reviewed 30 patients with proximal tibial fractures who were treated by nonreamed, statically locked, intramedullary nailing. 25 fractures were nailed using a medial Para patellar incision while the leg was semi extended. This approach allowed the patella to be subluxed laterally availing the trochlear groove for use as a conduit for nail placement. Using only 15^{o} knee flexion eliminated the extension force of the quadriceps on the proximal fragment, which otherwise would have tended to cause anterior angulation at the fracture site. In the first 5 patients, the average anterior angulation was 8^{o}. Of the 25 patients who were treated while in the semi extended position, none had more than 5^{o} anterior angulation. Fractures of 3 of the 25 patients had greater than 5^{o} angulation in the coronal plane; they found that this technique greatly facilitated intramedullary nailing of proximal tibia fractures[34].

Buehler (1997) described a technique for intramedullary nailing of proximal third tibial fractures. Twelve of 14 proximal third tibial shaft fractures were successfully treated with semi extended technique for intramedullary nailing of these fractures. The average anterior displacement was 3.0 mm (range 0-17). The average coronal plane alignment was 2.0 degrees valgus (range 2 degrees varus to 12 degrees valgus). There was one nonunion. They concluded that the technique's success was dependent on neutralizing the primary factors causing malreduction: wide effective diameters of tibial nails, narrow diameter of the medial tibial metaphysis, and a posteriorly directed sagittal plane entrance angle[35].

Krettek (1999) studied prospectively, 21 tibial fractures, 10 in the proximal third and 11 in the distal third of tibia using poller screws along with intramedullary nailing, all fractures had united. There were no complications related to the poller screw. The clinical outcome, according to the Karström-Olerud score, was not influenced by previous or concomitant injuries in 18 patients and was judged as excellent in three (17%), good in seven (39%), satisfactory in six (33%), fair in one (6%), and poor in one (6%) [36].

Krettek (1999) evaluated the mechanical effects of medial and lateral blocking screws in supplementing intramedullary nail fixation of high proximal and low distal tibial fractures treated with small diameter intramedullary nails. They concluded from their study that medial and lateral blocking screws can increase the primary stability of distal and proximal metaphyseal fractures after nailing and could be an effective tool for selected cases that exhibit mal-alignment or instability[37].

Lembeke (2001) found that a nail insertion point medial of the ligamentum patellae caused a valgus deformity, combined with a shift of the distal fragment to the medial side. A lateral point of entry resulted in a varus deformity, together with a lateral shift of the distal fragment. His results showed that the insertion point of the nail was important for the alignment of the axis. Choosing a different point for the insertion of the nail can be useful in operative correction of malalignment of the tibia[38].

Ricci (2001) used intramedullary nailing with blocking screws for fractures of the proximal third of the tibial shaft in twelve patients. Postoperatively, all patients had less than 5 degrees of angular deformity in the planes in which blocking screws were used to control alignment. They concluded from their study that the blocking screws were effective to help obtain and maintain alignment of fractures of the proximal third of the tibial shaft treated with intramedullary nails[39].

Althausen (2002) concluded that the ideal entry point for tibial nailing is just medial to the tibial spine at the anterior margin of the articular surface, a preoperative fluoroscopic measurement before incision can guide the surgeon as to whether a medial parapatellar, transpatellar, or lateral parapatellar approach provides the most direct access to this entry site. The routine use of a single approach for all tibial nails may no longer be justified[40].

Laflamme (2003) evaluated the mechanical stability of oblique interlocking screws in supplementing intramedullary nail fixation of high proximal tibial fractures and concluded they significantly improved the stability of a nailed proximal tibia fracture and provided comparable stability to a plate osteosynthesis[41].

Minimal invasive techniques like intramedullary nailing and external fixators are gaining popularity due to less soft tissue injury, but these methods of fixation are also with side effects[42].

The introduction of interlocking tibia nails has extended the indications for nailing of proximal and distal fractures. About 12% to 37 % of patients have malunion mostly due to malreduction of fracture. Valgus deformity due to mismatch between the axis of nail insertion in the proximal segment and the anatomic axis of the distal segments that contains isthmus of the medullary canal and partly by the shape of the proximal tibia. Flexion deformity due to shape of the nail, eccentric starting point and entrance angle of the nail . so accurate reduction of fracture and meticulous surgical technique needed for nailing of proximal tibia fractures[43].

Mueller compared stability of the various implants using uniaxial testing device the intramedullary nail construct in proximal tibia fractures appeared to be more stable than other implants[44].

Nork (2006) emphasized that proximal quarter fractures of tibia required multiple techniques to obtain and maintain reduction prior to nailing and included attention to the proper starting point, the use of unicortical plates, and the use of a femoral distractor applied to the tibia. Simple articular fractures and extensions were not a contraindication to intramedullary fixation. The proximal tibial fracture healed despite open manipulations. Short plate fixations to maintain this difficult reduction, either temporary or permanent, were effective. They had acceptable alignment in 91.9 of 37 fractures treated[45].

Vidyadhara (2007) carried out a prospective study of the clinico-radiological outcome of interlocked nailing in proximal third tibial shaft fractures in 45 patients. The average time to knee mobilization and partial weight-bearing walking was 3.2 days. The fractures united at an average of 4.3 months. The average lower extremity functional score was 96%. They recommended a nail similar to a Sirus nail, but with a more proximal bend of the nail and no dynamic interlocking screw hole[46].

Douglas (2007) suggested following to avoid potential complications in nailing of proximal tibia fractures

1. Use an appropriate nail
2. Use an appropriate starting point
3. Reduction of fracture before reaming
4. Prevent the deformity from happening by extending the knee, plating the cortex, use blocking screws.
5. Locking the proximal aspect of the nail
6. Fix any deformity before the patient leaves the OT[47].

The expert tibia nail proved to be a very useful implant in treating proximal, midshaft and distal tibia fractures. Still it is challenging to treat proximal tibia fractures. ETN due to improved locking options and higher stability of the nail can reduce the risk of secondary malalignment[48]

Jones (2007) performed an anatomical study of the placement of proximal oblique locking screws in intramedullary tibial nailing in ten paired cadavers. Anatomical dissection was undertaken to determine the relationship of the common peroneal nerve to the cross-screw. The common peroneal nerve was contact directly in four tibiae and the cross-screw was a mean of 2.6 mm (1.0 to 10.7) away from the nerve in the remaining 16. They concluded that iatrogenic injury to the common peroneal nerve by medial-to-lateral proximal oblique locking screws was a significant risk during tibial nailing[49].

Hansen (2007) carried out a biomechanical comparison of intramedullary and extramedullary Implants including a new Proximal Tibia Nail. They concluded that Proximal Tibial Nail would theoretically provide the same mechanical stability as the double-plate osteosynthesis in axial loading. Higher stability in axial loading may be present when compared to the Less Invasive Stabilization System or the External Fixator[50].

Kuhn (2008) using expert tibial nail demonstrated favourable results and extended indications, compared to standard tibial nails[16].

Hansen (2009) concluded that triple proximal interlocking provided more stability in nailed proximal tibial fractures than double proximal interlocking[51].

Singh (2009) studied unreamed intramedullary nailing with oblique proximal and biplanar distal interlocking screws for proximal third tibial fractures. 15 men and 3 women aged 25 to 58 (mean 37) years underwent unreamed intramedullary nailing with oblique proximal and biplanar distal interlocking screws for proximal third metaphyseal tibial fractures. The entry point was kept proximal to the tibial tuberosity and slightly lateral to midline. Proximal locking was at 45º to the coronal and sagittal planes. Biplanar distal locking was in the coronal and sagittal planes. 16 patients had bone union within 20 weeks; 2 underwent dynamisation for delayed union. Three patients had valgus angulation of <5º; 2 had a loss of terminal knee flexion; 3 had a loss of ankle dorsiflexion; and 3 had shortening of >0.5 cm. Functional outcomes were excellent in 13, good in 4, and fair in one patient. They concluded that unreamed intramedullary nailing with oblique proximal and biplanar distal interlocking screws for proximal third tibial fractures was effective in preventing malalignment[52].

Weninger (2009) in a study for entry point for nailing of proximal tibia fractures concluded that lateral or middle third enrty point can correct upto more than 20^o of primary valgus malalignment. ETN system with angular stable locking allows controlled proximal and distal locking. Semiextended position, poller screws, temporary unicortical plates might be an option to improve nailing of proximal tibia fractures[53].

Attal R, Muller M, Hansen M, et al (2009) evaluated the Expert Tibial Nail in their series in a prospective, multicenter setting. 190 patients were treated in 10 participating centers using the Expert Tibia Nail. 127 patients suffered polytrauma, 58 presented as open fractures. Within the framework of the study 5 cases were proximal tibia fractures, 108 shaft fractures, 56 distal fractures, and 21 segmental fractures. These were followed-up postoperatively, after 3 months and one year and evaluated radiologically and clinically with regard to malalignment, union rate and complications. Nonunion occurred in 9 cases after one year of follow up (n=150). 20 patients showed delayed union. The rate of open and complex fractures was high in this group. Dynamisation was performed in 10 cases. Valgus/varus and recurvatum/ antecurvatum malalignment of more than 5 degrees occurred in 13 cases. Stable reduction was achieved in 144 cases. In 4 complex fractures, initial reduction went into malalignment. 2 patients developed a deep infection after 3rd degree open fractures. 34 patients suffered from pain in the operated area. 6 screws broke during the follow-up. The Expert Tibia Nail proved to be an excellent tool to treat tibial fractures. Not only shaft fractures but also complex fractures in the proximal and distal metaphyseal area could be successfully stabilized due to advanced locking options and design of the nail. The rate of malalignment, non-union and complications was low[54].

Trlica J, Dedek T, Smejkal K presented technical experience with the use of the Expert Tibial Nail (ETN) technique and its clinical results. The ETN technique was used in 41 patients to treat 41 diaphyseal tibial fractures. All patients were followed-up prospectively. Of the 41 fractures, 31 were closed and 10 were open injuries. The injury-to-surgery interval ranged from 1h and 50 min to 25 h and 12 min (median, 8 h and 52 min). The operative time ranged from 50 to 170 min (average, 87 min). Three cases of insufficient primary reduction underwent repeat surgery during the first stay in hospital. Full weight-bearing with no pain was reported in the range of 10 to 24 weeks (average, 18 weeks) after surgery. The ETN provided sufficient stability of diaphyseal tibial fractures including those involving the metaphysis. However, in some instances, poller screws were still indispensable. Sufficient reduction was necessary before nail insertion[55].

Erik in a study concluded that semi extended position can be used for simplified imaging of proximal tibia for determination of entry point and easier maintenance of fracture reduction and accurate placement of blocking screws[56].

Proximal third tibial shaft fractures have always produced suboptimal results with intramedullary nails research and development led to new techniques and pearls in achieving stable and well aligned reconstruction in proximal tibia fractures[57].

Rommens studied 22 proximal tibia fractures treated with expert tibial nail and seventeen patients were followed up clinically and radiologically after one year, explained nonunion was observed in one fracture, an angular deformity of 5^0 was observed in 3 patients and also described technique of nailing of proximal tibia fracture with expert nail[58].

Jakma described surgical technique of insertion of ETN for proximal tibia fractures through supra patellar pouch and formulated results. The suprapatellar nail insertion certainly has its benefits as far as the reduction of the fracture is concerned. There was no need to hyperflex the knee to introduce the nail which causes opening out of the fracture. There is no risk of damage to the patellar tendon and no anterior knee pain but there is risk of damaging intraarticular structures if not done properly[59].

Valgus/varus malalignment has been one of the major problems during intramedullary nailing of proximal tibia fractures. Proposals for overcoming the problem include use of additional implants and changing the position of the leg. So this study indicated the location of entry point based on the fracture pattern and proper nail entry trajectory without the need of additional tools[60].

Rene in study concluded that ETN demonstrated important benefits in treating proximal and distal tibia fractures by reducing the risk of secondary malalignment. The modified locking options are able to provide more planes for screw fixation at both ends of the implant thus increasing the stability between the implant and bone fragments[61].

Shon in a study on segmental tibia fractures using expert tibia nail and other methods produced satisfactory results[62].

Proximal third tibia fractures have always produced suboptimal results with intramedullary nails. Research and development led to introduction of several techniques and pearl resulting in achieving stable well aligned reconstruction[63]

ANATOMY

The tibia is the medial and much stronger bone of the two bones of the leg. It is prismoid in section in its shaft and has expanded extremities. Its lower end is smaller than the upper end and in its medial side has stout process, termed medial malleolus which projects downwards beyond the rest of the bone.

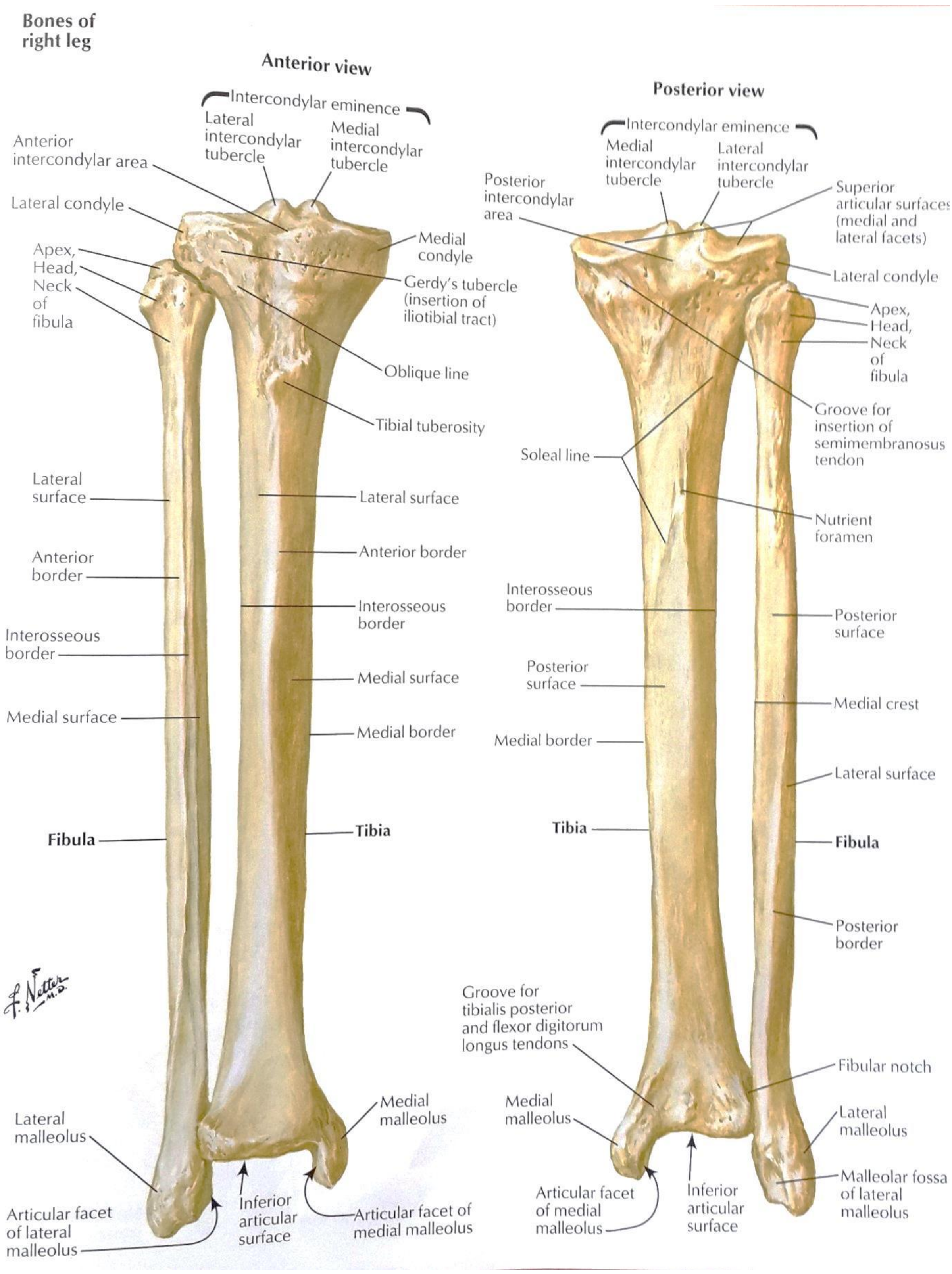
The upper end of tibia is markedly expanded from side to side, to form two large condyles which overhang the posterior surface of the shaft. The upper end includes: a medial condyle, a lateral condyle, an intercondylar area and a tuberosity. The tuberosity is divided into an upper smooth area and a lower rough area. The epiphyseal line for the upper end of the tibia passes through the junction of these two parts.

The shaft has three borders and three surfaces. The anterior border is sharp and S shaped being convex medially in the upper part and convex laterally in the lower part. It extends from tibial tuberosity above to the anterior border of the medial malleolus below. It is subcutaneous and forms the shin.

The medial border is rounded and the lateral or interosseous border has interosseous membrane attached with it, which in turn is attached to fibula.

The lower end of the tibia is slightly expanded and has five surfaces. The anterior surface has a smooth upper part and grooved lower part. The medial surface is subcutaneous and is continuous with medial surface of medial malleolus. The lateral aspect of the lower end presents a triangular fibular notch to which lower end of fibula is attached. The inferior surface is articular, it articulates with talus and thus forms the ankle joint.

BONES OF RIGHT LEG



ATTACHMENTS OF UPPER END OF TIBIA

Attachment to the medial condyle

a) Semimembranosus is inserted into the groove on the posterior surface.
b) The capsular ligament of the knee joint is attached to the upper border which also gives attachment to the deep fibers of tibial collateral ligament.
c) The medial patellar retinaculum attached to the anterior surface.

Attachments to lateral condyle

a) Illiotibial band is attached to the flattened impression on the anterior surface.
b) The groove on the posterior surface of the lateral condyle is occupied by the tendon of popliteus with bursa intervening.

Attachments to the tibial tuberosity

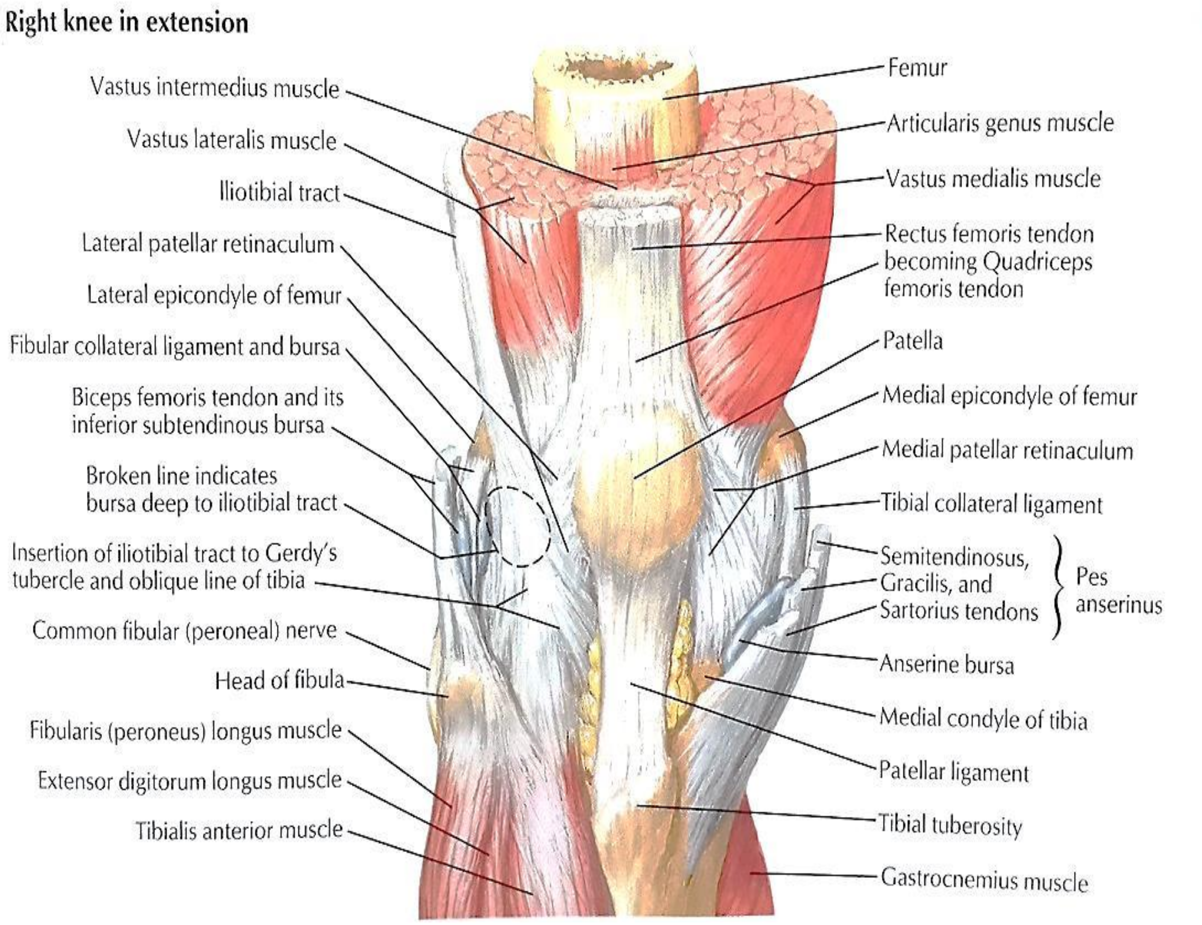
a) The ligamentum patella is attached to the upper smooth part of tibial tuberosity. The lower rough area of the tuberosity is subcutaneous and is separated from the skin by infrapatellar bursa.

Attachments on the shaft

a) The upper medial surface receives insertions of the Sartorius, gracilis and semitendinosus (pes anserinus) from before backwards. Still further posteriorly this surface gives attachment to tibial collateral ligament along the medial border.
b) Popliteus tendon is inserted into post surface in a triangular area below soleal line.

Attachment of patellar tendon pull the proximal fragment into apex anterior angulation, whereas the attachment of pes anserinus commonly causes valgus stress on the proximal fragment in upper third tibial fractures.

RIGHT KNEE IN EXTENSION



The musculature around tibia is divided into three compartments.

1. The anterior compartment of the leg contains the following muscles

(i) Tibialis anterior

(ii) Extensor digitorum

(iii) Extensor hallucis

(iv) Peroneus tertius.

This compartment contains Anterior Tibial Artery and Deep Peroneal Nerve. Near the ankle, the tendon of tibialis anterior, extensor hallucis longus and extensor digitorum longus lie close to the tibia.

Due to the unyielding walls of the anterior compartment, increased tissue pressure may give rise to ischemic process called anterior tibial compartment syndrome.

2. The Lateral compartment of the leg contains

(i) Peroneus longus

(ii) Peroneus brevis muscle.

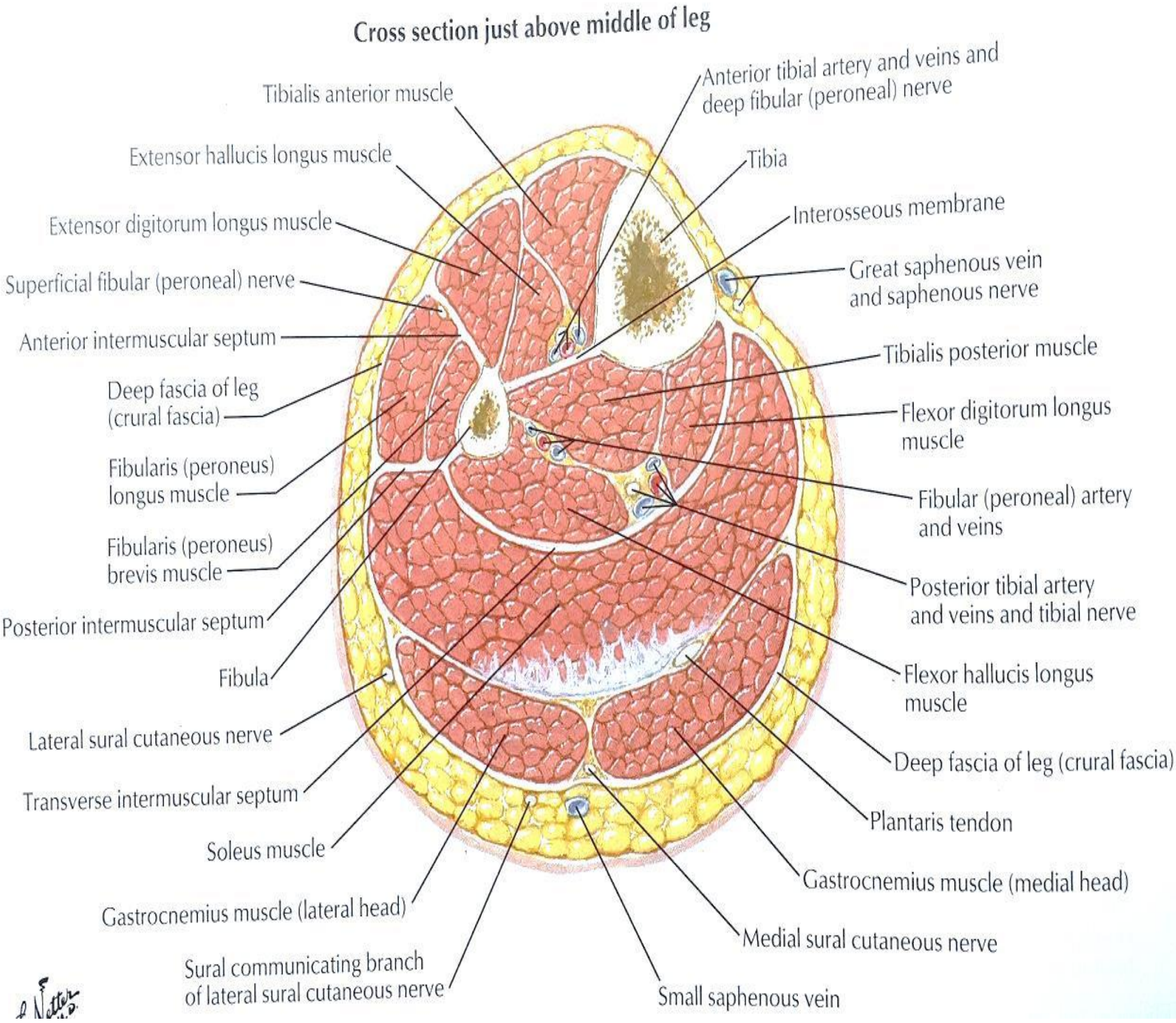
The superficial peroneal nerve which lies in this compartment becomes subcutaneous about three inches above the ankle.

3. The muscles of the posterior compartment are

(i) Soleus (ii) Gastrocnemius (iii) Tibialis posterior (iv) Flexor hallucis longus and (v) Flexor digitorum longus.

The posterior tibial artery and peroneal nerve also run in this compartment.

CROSS SECTION JUST ABOVE MIDDLE OF LEG



THE BLOOD SUPPLY:

The anterior and posterior tibial and peroneal arteries are the main blood vessels of the leg.

The anterior tibial artery is one of the terminal branches of the popliteal artery and passes forward through the opening in the interosseous membrane to reach the anterior compartment, where it passes downwards on the interosseous membrane to terminate in the dorsalis pedis artery.

The posterior tibial is the direct continuation of the popliteal artery. It passes downwards in the space between the deep flexor muscles and the calf muscle to terminate in the plantar arteries. The peroneal artery passes downward in close relation to the posterior surface of the tibia.

Blood supply of the tibia as all other long bones is periosteal and endosteal .The periosteal blood supplies the outer third of the cortex , while the endosteal blood supplies the inner 2/3 of the cortex. Periosteal blood supply comes from the surrounding musculature, while endosteal comes from nutrient artery which is a branch of the posterior tibial artery at the soleal line.

Usually the blood flow is centrifugal ,however in case of a fracture when the endosteal blood supply is damaged ,the flow is reversed and it changes from centrifugal to centripetal .When intramedullary nailing is done, the endosteal blood supply is interrupted .

The nutrient artery divides into three ascending branches which supply the proximal two-third of the tibia, and gives a smaller descending branch which supplies the distal one-third of tibia. Hence, the proximal tibia has good endosteal blood supply, while the distal tibia has poor supply.

MECHANISM OF INJURY

There are five principal causes of tibial diaphysis fractures:

a) falls

b) sports injuries

c) direct blows or assaults

d) motor vehicle accidents

e) gunshot injuries

For the tibial shaft fracture, a significant amount of energy must be applied in one of three modes.

(a) Torsional injuries are more common with low energy trauma where the foot becomes fixed and the body rotates about this fixed point.

(b) Three and four point bending forces produce short oblique transverse fractures as the points of bending are spread further apart and as the amount of energy implied increases, communition increases and even segmental fractures develop.

(c) Direct violence or high energy trauma as a result of motor vehicle and other road traffic accidents .Crushing injuries can be seen in RTA and industrial injuries where high concentration of energy is applied over a small area with resulting increased damage to bone and soft tissues

CLASSIFICATION

Descriptive Classification

1. Open versus closed
2. Anatomic location:
    a) proximal
    b) middle
    c) distal third
3. Fragment number and position
    a) Comminution
    b) butterfly
4. Configuration: transverse, spiral, oblique
5. Angulation: varus/valgus, anterior/posterior
6. Shortening
7. Displacement: percentage of cortical contact
8. Rotation
9. Associated injuries

AO CLASSIFICATION OF TIBIAL FRACTURES:

Proximal fractures:

41-A: Extraarticular fracture

41-A1 avulsion

41-A2 metaphyseal simple

41-A3 metaphyseal multifragmentary

41-B: Partial articular fracture

41-B1 pure split

41-B2 pure depression

41-B3 split-depression

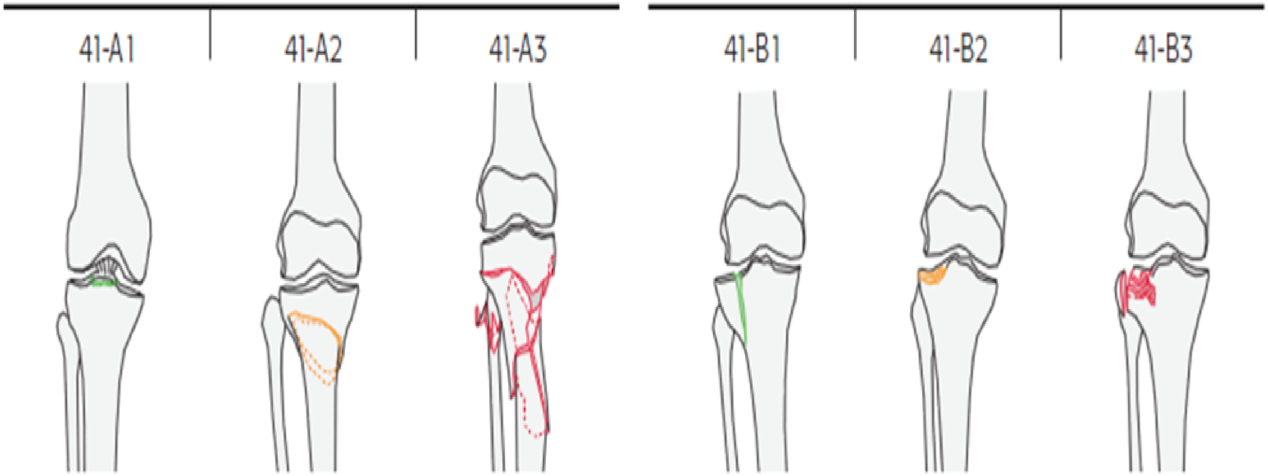
41-C: Complete articular fracture

41-C1 articular simple, metaphyseal simple

41-C2 articular simple, metaphyseal multifragmentary

41-C3 articular multifragmentary

41 proximal



41-A extraarticular fracture

41-A1 avulsion

41-A2 metaphyseal simple

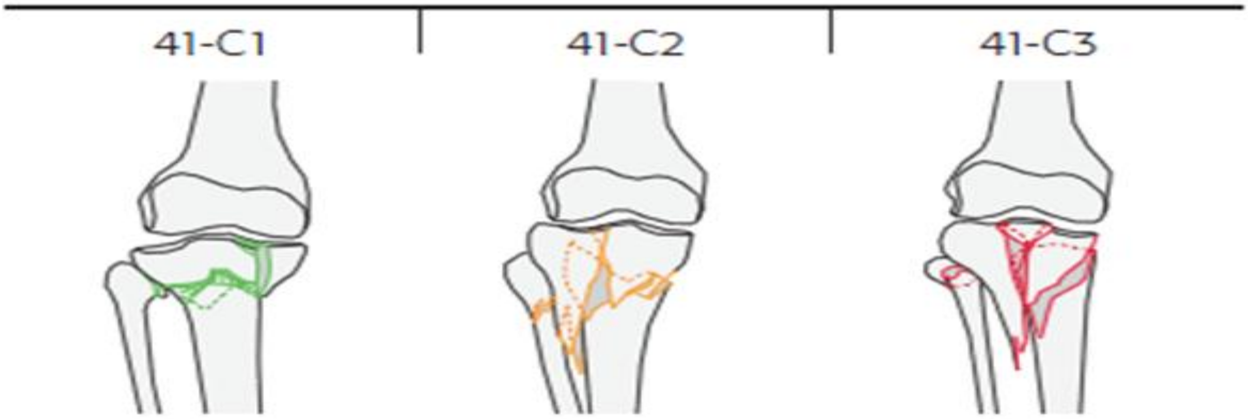
41-A3 metaphyseal multifragmentary

41-B partial articular fracture

41-B1 pure split

41-B2 pure depression

41-B3 split-depression



41-C complete articular fracture

41-C1 articular simple, metaphyseal simple

41-C2 articular simple, metaphyseal multifragmentary

41-C3 articular multifragmentary

DIAPHYSEAL FRACTURES

42-A: Simple fracture

42-A1 spiral

42-A2 oblique (≥30°)

42-A3 transverse (< 30°)

42-B: Wedge fracture

42-B1 spiral wedge

42-B2 bending wedge

42-B3 fragmented wedge

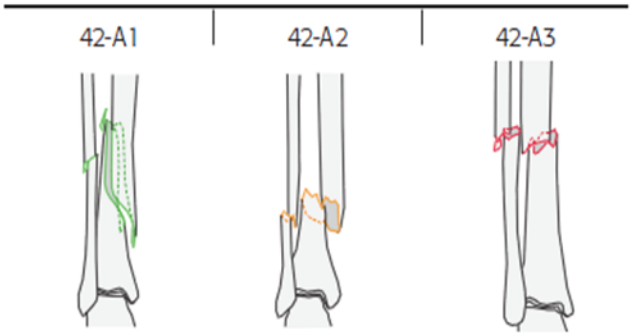
42-C: Complex fracture

42-C1 spiral

42-C2 segmental

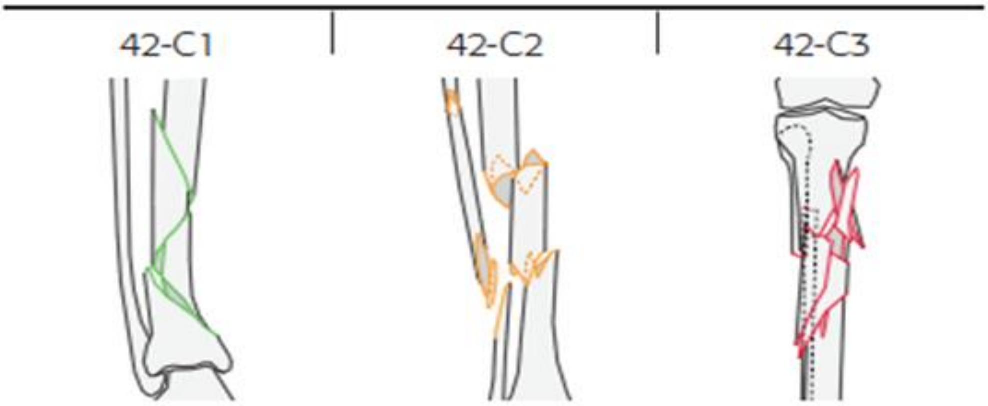
42-C3 irregular

42 diaphyseal



42-A simple fracture
42-A1 spiral
42-A2 oblique (≥ 30°)
42-A3 transverse (< 30°)

42-B wedge fracture
42-B1 spiral wedge
42-B2 bending wedge
42-B3 fragmented wedge



42-C complex fracture
42-C1 spiral
42-C2 segmental
42-C3 irregular

CLASSIFICATION OF OPEN FRACTURES:-

Gustilo et al classified fractures on the basis of compounding as follows:

Type I:		Wound less than 1 cm.
		No contamination,
		Minimal soft tissue injury,
		Low energy trauma.
TypeII:		Wound more than 1 cm,
		Moderate contamination,
		Moderate soft tissue injury,
		Moderate communition of bone.
		Moderate velocity trauma.
Type III:	**A)**	More than 10cm wound,
		Highly contaminated,
		Severe soft tissue injury or crushing,
		Communition at fracture,
		No periosteal stripping,
		Usually soft tissue coverage possible.

Type III: **B)** More than 10cm wound,

Highly contaminated,

Very severe soft tissue injury with loss of coverage, periosteal stripping,

Bony coverage poor, often require soft tissue reconstructive surgery.

Type III: **C)** Any open fracture with vascular injury which needs repair.

IMPLANT

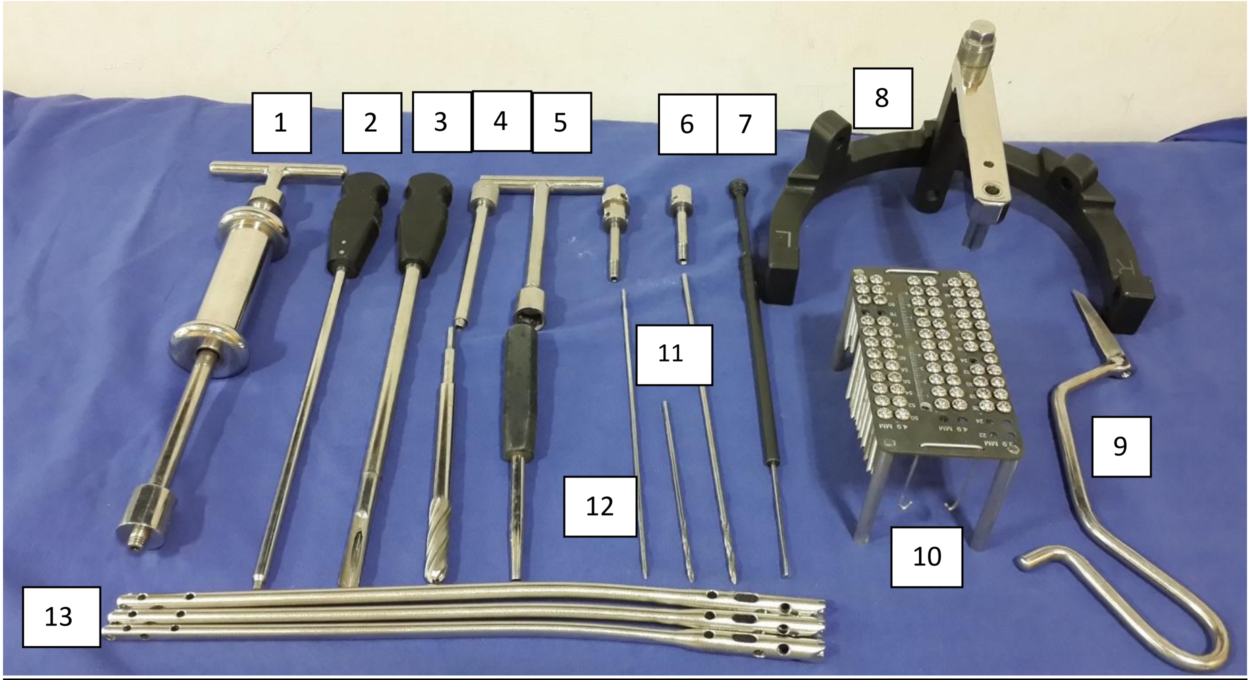
The nail used in the present study is an Indian made counterpart of the Synthes expert tibial nail which could not be used in the present study due to the cost factor. The nail used has the following features:

1. Four proximal locking holes: two medio-lateral and two 45° oblique.
2. The first oblique locking hole lies at a distance of 14mm from the proximal end and second one at the distance of 20mm.
3. Four distal locking holes: two medio-lateral, one antero-posterior and one oblique hole.
4. The distal most locking hole lies within 5mm from the distal tip.
5. End caps to block proximal most oblique locking screw.
6. Steel nails were used in the study.
7. Available in diameter of 8mm, 9mm and 10mm

Locking screws: Self tapping screws of diameter 3.9mm and 4.9mm are used for locking. 3.9mm for distal locking in 8mm and 9mm diameter nails; and 4.9mm for proximal locking in all diameter nails and distal locking in 10mm diameter nails. The important dimensions of the screws can be summarized as below:

Dimension	**3.9mm screw**	**4.9mm screw**
Core diameter	3.4mm	4.3mm
Thread diameter	3.9mm	4.9mm
Head diameter	8mm	8mm
Hexagonal socket width	3.5mm	3.5mm
Drill bit for thread hole	3.2mm	4mm

INSTRUMENTS AND IMPLANTS USED



1. Hammer with connecting rod
2. Star drive screw driver
3. Cannulated medullary canal cutter
4. Reamer for proximal canal
5. T-spanner
6. Conical bolt
7. Depth gauge
8. Radiolucent jig
9. Bone awl
10. 4.9mm and 3.9mm locking bolts
11. 3.5 mm and 4.5 mm drill bits
12. Guide wire for cannulated medullary canal cutter
13. 8mm, 9mm, 10mm expert tibia nails

MATERIAL AND METHODS

The present study was undertaken at the Department of Orthopaedics, Sri Devaraj Urs Medical College and Research Institute after obtaining ethical clearance. This study involved both male and female patients with proximal tibia fractures, who presented to. R.L.Jalappa hospital, attached to Sri Devaraj Urs Medical College and Research Institute, Tamaka, Kolar. 30 patients who had proximal tibia fractures were treated with expert tibial nailing during the period from December 2011 to October 2013, all the patients were fresh fractures and were traumatic in nature.

INCLUSION CRITERIA:

1) Age above 18 years
2) open/closed proximal one third tibia fracture (AO 41-A2 and A3)
3) Segmental fractures of tibia with proximal extension (AO 42-C2 and C3)

EXCLUSION CRITERIA:

1) GustiloAnderson type III B, III C.

2) Tibial plateau fractures (AO 41-C2 and C3)

3) Pathological fractures

All the 30 cases were initially assessed in the causality of R.L.Jalappa hospital. They were provided first aid in the form of analgesia, splintage and other resuscitation measures.

Detailed history was elicited from the patient and/or patient attenders to reveal the nature of injury, site of injury and previous medical history. Then patients were assessed clinically to evaluate their general condition and the local injury.

General conditions of the patient, vital signs were recorded. Comprehensive examination, not only of the injured limb, but also of all the limbs, to avoid missing the other associated injuries was done.

The injured limb was examined for all signs of fracture (swelling, deformity, tenderness, crepitus, abnormal mobility, loss of transmitted movements) and open wound were classified according to Gustilo Anderson classification. Vascular and neurological status of the limb was assessed, any signs of compartment syndrome and skin condition.

Medical consultation was sought for geriatric patients and general surgery consultation for polytrauma patients.

Radiographic evaluation included anteroposterior and lateral radiographs of the proximal tibia with knee and ankle joints.

Afterwards following baseline investigations were done so as to assess the fitness for anaesthesia

- Hb, BT, CT
- Blood sugar
- Serum Urea, Creatinine, Electrolytes
- Blood Grouping
- Urine routine examination
- ECG
- X ray of chest PA view
- X ray of the local part including the knee and ankle joint AP and lateral views
- HIV and HBSAg, HBCAg

In case of open fractures thorough debridement and dressing was done and broad spectrum antibiotics started.

PROCEDURE:

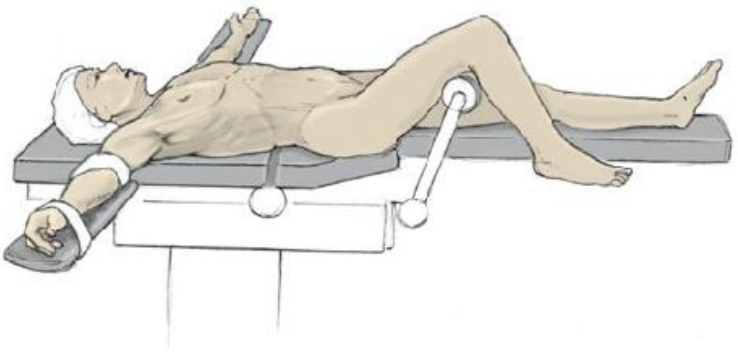
Pre anaesthetic check-up was done in all patients and once deemed fit for surgery; was posted for surgery.

- Appropriate length of the nail was assessed clinically and radiologically.
- Preparation of the part was done.
- Pre-operative prophylactic dose of antibiotic was given half hour before surgery.

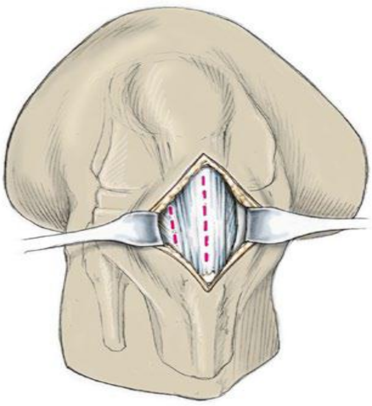
OPERATIVE PROCEDURE:

- *Type of anaesthesia:* Spinal, Epidural or General Anaesthesia
- *Position:* Supine with leg in semi extended position on radiolucent table.
- Tourniquet was applied around the thigh over adequate padding.
- *Reduction*: Closed reduction of the fractured fragments was done by axial traction under image intensifier. Open reduction was done when closed technique failed. Reduction was maintained using reduction forceps or k-wires or with uni cortical plating
- *Incision*: Anterior midline vertical skin incision from the inferior pole of the patella to the tibial tuberosity. The patellar tendon was split centrally to gain access to the tibial plateau, or there is a medial or lateral parapatellar access selected. Same incision was used in most of the cases except in cases where there are abrasions over the incision site where an incision bypassing the wound was taken.
- The Hoffa's fat pad is mobilized with a blunt periosteal elevator and displaced posteriorly. This protects the underlying joint capsule and prevents accidental opening while the joint nailing
- *Entry portal*: The correct entry point was identified which lies in line with the axis of the intramedullary canal and with the lateral tubercle of the intercondylar eminence. In lateral view the entry point is at the

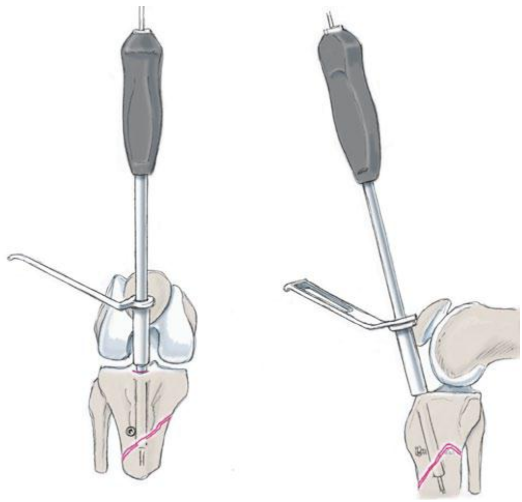
ventral edge of the tibial plateau. If there is valgus angulation present at fracture site lateral entry was taken.



POSITION OF PATIENT ON FRACTURE TABLE



MID PATELLAR OR PARAPATELLAR INCISION



OPENING THE MEDULLARY CANAL WITH CANNULATED CANAL CUTTER

- The guide wire for the medullary canal cutter is inserted as far as possible in a sagittal angle of only 10 ° to tibial shaft with rotating movements in the metaphyseal cancellous bone. This angle corresponds roughly to the curvature of the proximal medullary nail. After placing the wire under fluoroscopic its location is considered in two levels .The wire is introduced at least 10 cm deep into the tibia to provide a sufficiently stable guidance of the opening cannulated instruments. With a cannulated medullary canal cutter the meduulary canal is opened and guide wire is passed.
- Reaming was done over the guide wire as per need.
- Nail size required was calculated intraoperatively by comparing two equal length guide wires and confirmed by C-arm image intensifier.
- The nail was inserted over a guide wire using C-arm image intensifier.
- Distal locking, proximal locking including proximal oblique locking was done.
- Tourniquet was released
- Haemostasis was achieved
- Wound closed
- Sterile dressing applied

POST-OPERATIVELY

- Limb was kept elevated, monitoring of peripheral blood circulation, motor and sensory function was done.
- Antibiotics were given for 72 hours intravenously in closed fractures post-operative and in open fractures they were continued longer as required.
- Analgesics for 48 hours.
- Check X-rays were taken

- Gentle active exercises of the knee and ankle were encouraged as soon as the pain allowed.
- Stitches were removed at two weeks post-operatively
- The patients were discharged with the advice to attend for follow-up to OPD.
- Weight bearing was restricted until early callus occured (4 to 6 weeks) and then progressed as tolerated and according to radiological and clinical assessment.

Follow up:

Follow-up was done at 4, 6, 12 weeks and 6 months post-operatively and later as required.

At the follow-up, patients were assessed clinically and radiologically as follows:

1) **CLINICAL**
    a) Swelling
    b) Tenderness
    c) Any mobility at the fracture site
    d) Range of motion at knee and ankle joints
    e) Muscle wasting- Thigh and calf
    f) Any other complication

2) **RADIOLOGICAL**

X-rays of leg, both AP and lateral views were taken to note any

a) Angulation
b) Bending of nail
c) Breakage of screws/nail
d) Displacement of fracture fragments
e) Signs of union i.e. callus formation.
f) Malunion – varus/valgus, anterior angulation $>5^0$

EVALUATION OF RESULTS:

Final evaluation of results were done after 32 weeks according to radiological alignment and functional criteria laid by **Klemm & Borner**

Excellent

I. Full knee and ankle motion
II. No muscle atrophy
III. Normal radiographic alignment

Good

I. Slight loss of knee or ankle motion (<25%)
II. Less than 2cm of muscle atrophy
III. Angular deformity less than 5°

Fair

I. Moderate loss of knee or ankle motion (≥25%)
II. muscle atrophy of ≥2 cm
III. Angular deformity 5°-10°

Poor

I. Marked loss of knee or ankle motion
II. Marked muscle atrophy
III. Angular deformities greater than 10°

OBSERVATIONS:

In the present study 30 patients of proximal tibial fractures were treated with the intra medullary Expert Tibial Nail. The procedure was carried out at the earliest when the patients were fit for anaesthesia and surgery. The following observations were made during the course of this study in the proximal tibial fractures.

TABLE 1: AGE DISTRIBUTION

Age (in years)	No. of patients	Percentage
18-30	11	36.6
31-40	6	20
41-50	8	26.6
51-80	5	16.8

In this study the average age was 40.5 years (19-80) with about 83% of patients are below the age of 50 years.

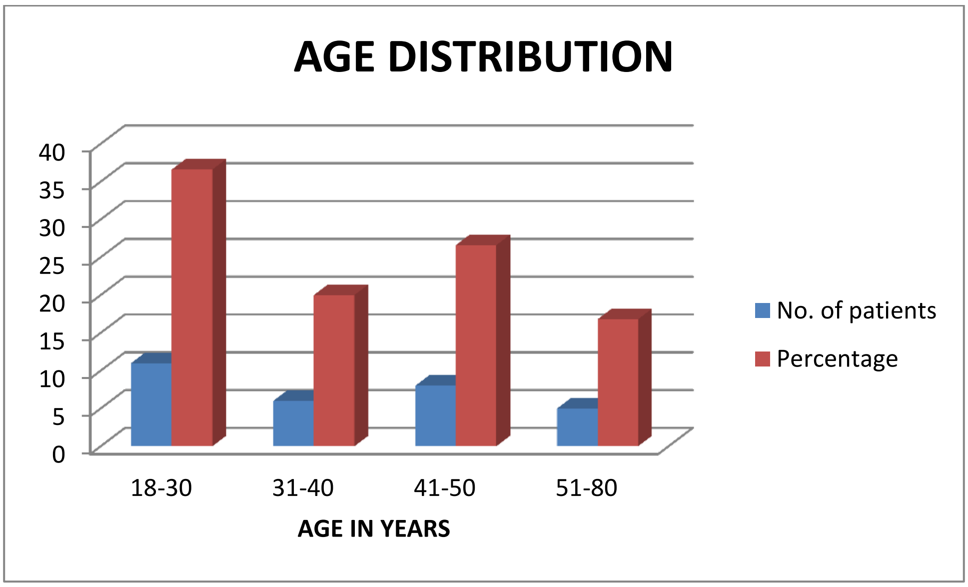


TABLE 2: SEX INCIDENCE

Sex	No. of patients	Percentage
Male	26	87%
Female	4	13%
Total	30	100%

90% of the patients in the present study were males and only 10% were females.

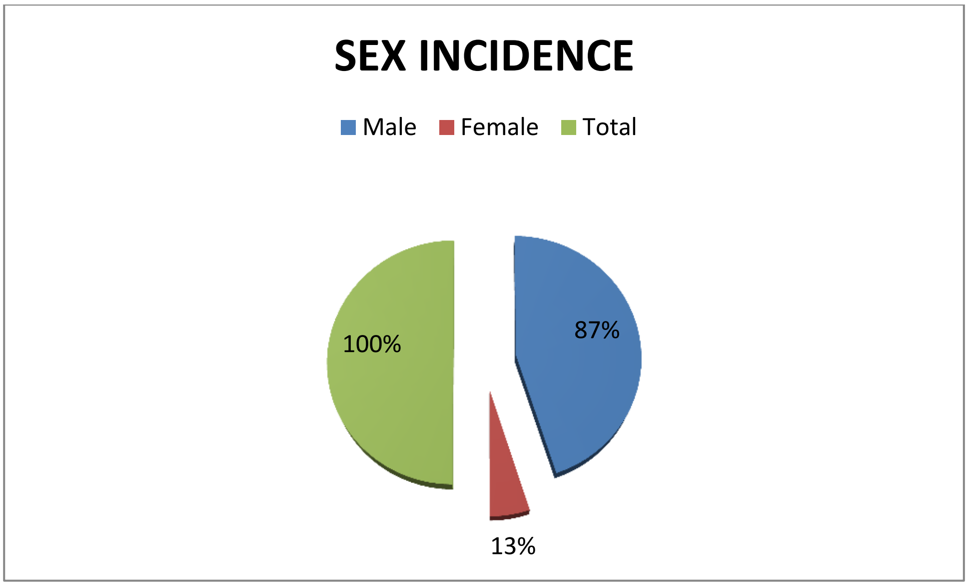


TABLE 3: MODE OF INJURY

Mode of trauma	**No. of patients**	**Percentage**
Road traffic accidents	25	83.4%
Falls	4	13.3%
Assault	1	3.3%

Most of the patients (25) sustained fractures due to RTA. 4 patients sustained fractures due to falls. 1 patient sustained fracture due to assault.

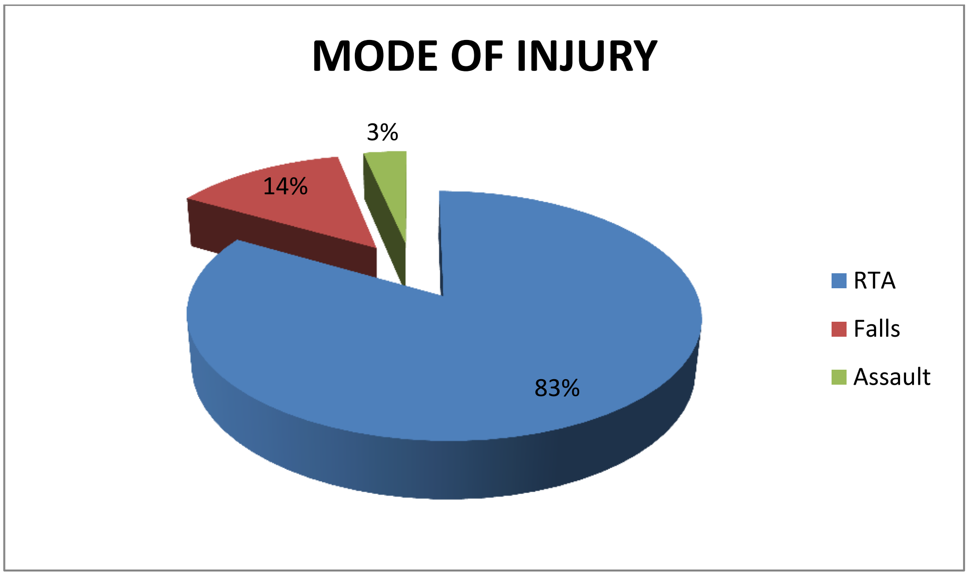


TABLE 4: SIDE INVOLVED

Side	No. of patients	Percentage
Right	18	60%
Left	12	40%
Total	30	100%

In this study, Right side (60%) was more involved than the left side (40%).

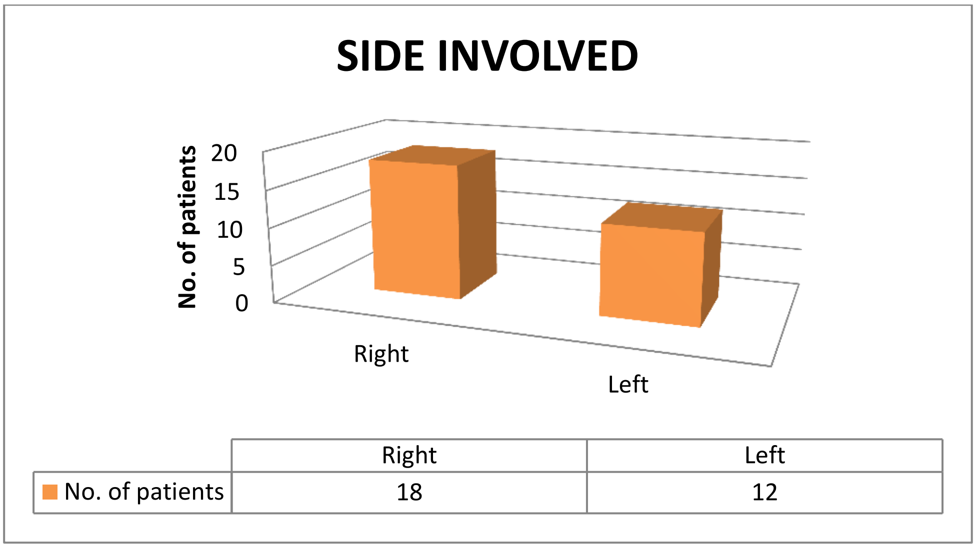


TABLE 5: CLINICAL TYPE

Clinical type	No. of cases	Percentage
Closed	15	50%
Open type I	7	23.3%
Open type II	7	23.3%
Open type III	1	3.4%
Total	30	100%

In this study 50% of the cases were closed and 23.3% cases were open (Type I), 23.3% cases were open type II and only one case of open type III A

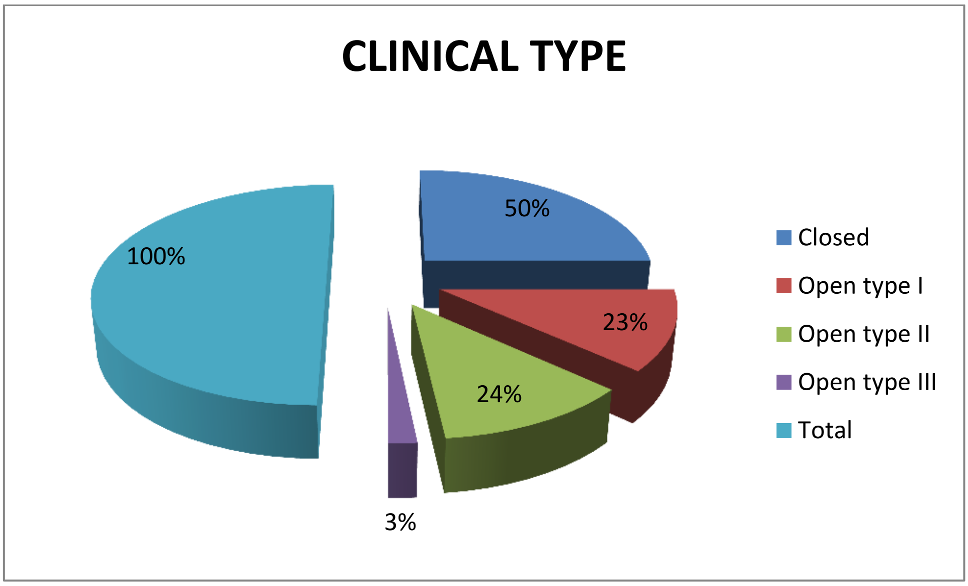


TABLE 6: AO TYPE

AO type	No. of cases	Percentage
41A2	16	53.3%
41A3	9	30%
42C2	3	10%
42C3	2	6.7%
Total	30	100%

There were 16 cases of AO type 41A2, 9 cases of AO type 41A3, 3 cases of AO type 42C2 and 2 cases of 42C3.

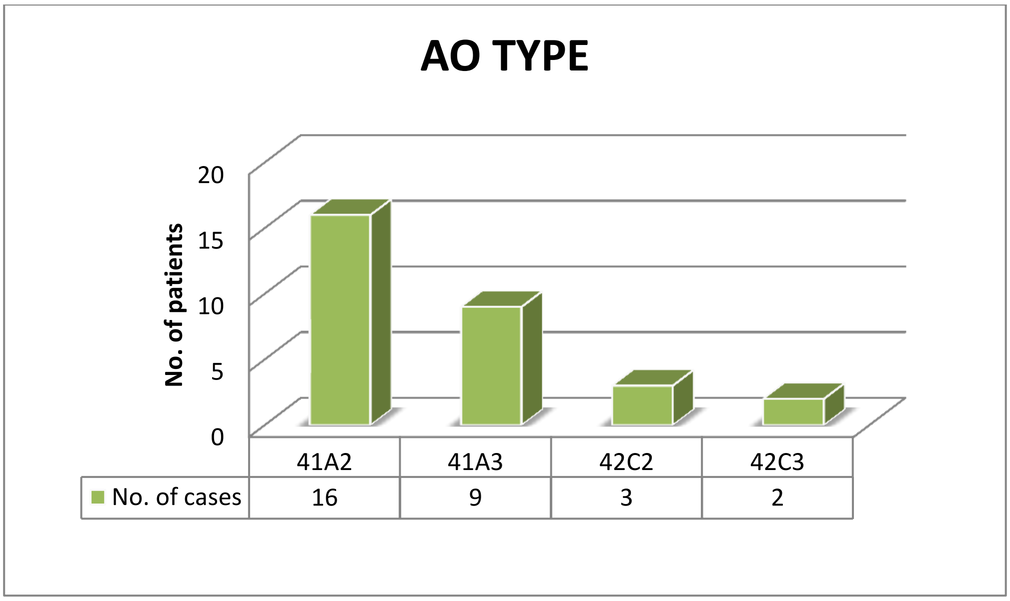


TABLE 7: ASSOCIATED INJURIES

Associated injury	No. of cases
Fracture shaft of femur ipsilateral	2
Contralateral tibia	2
Head injury	3
Neck of femur	1
Calcaneal fracture	1
Patella fracture	1

In this study 2 cases had ipsilateral shaft of femur, 2 patients had contralateral tibia, 3 patients had head injury, 1 patient had ipsilateral fracture neck of femur, 1 patient had calcaneal fracture and 1 patient had patella fracture.

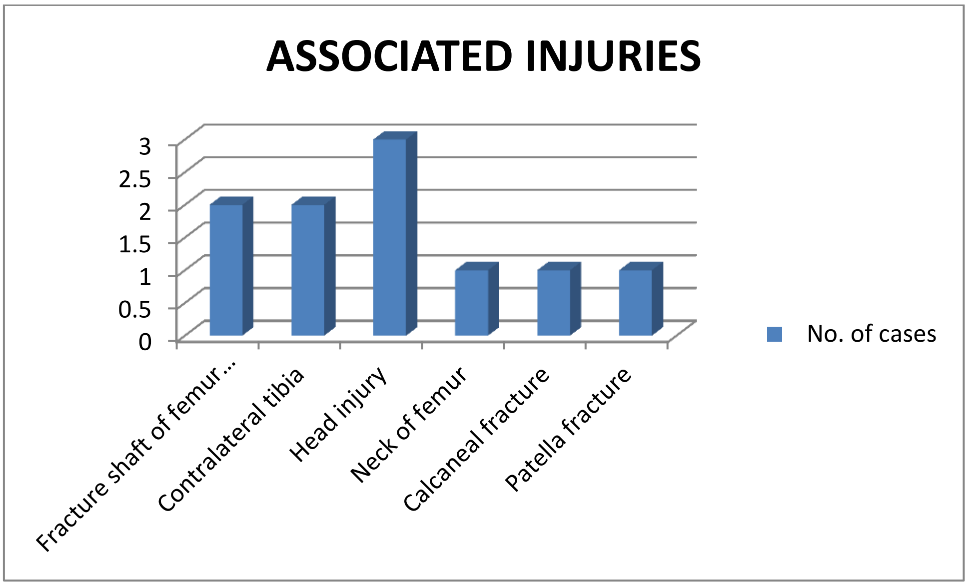


TABLE 8: DAYS FROM INJURY TO SURGERY

Time interval (in days)	No. of patients	Percentage
0-1	14	46.7%
1-2	11	36.7%
3-4	5	16.6%
Total	30	100%

Mean time interval from injury to surgery in the present study was 1.7 days (range 1-4days).

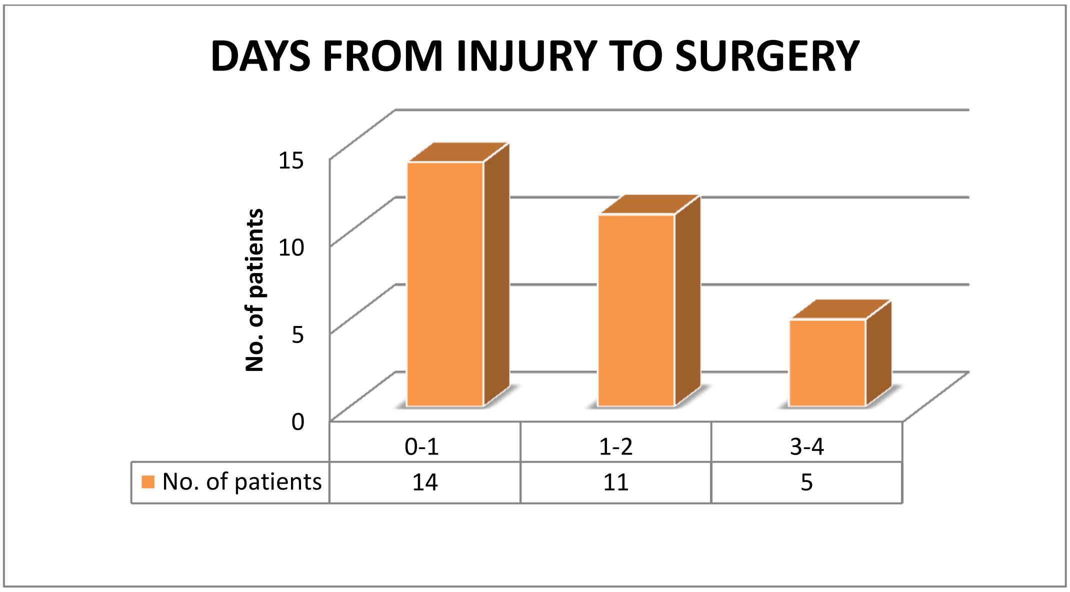


TABLE 9: DURATION OF HOSPITAL STAY:

DURATION (in days)	No. of patients	Percentage
0-10	1	3.3%
11-20	15	50%
21-30	10	33.4%
>30	4	13.3%
Total	30	100%

The mean time of hospital stay in the present study was 23.6 days (range 8-60 days).

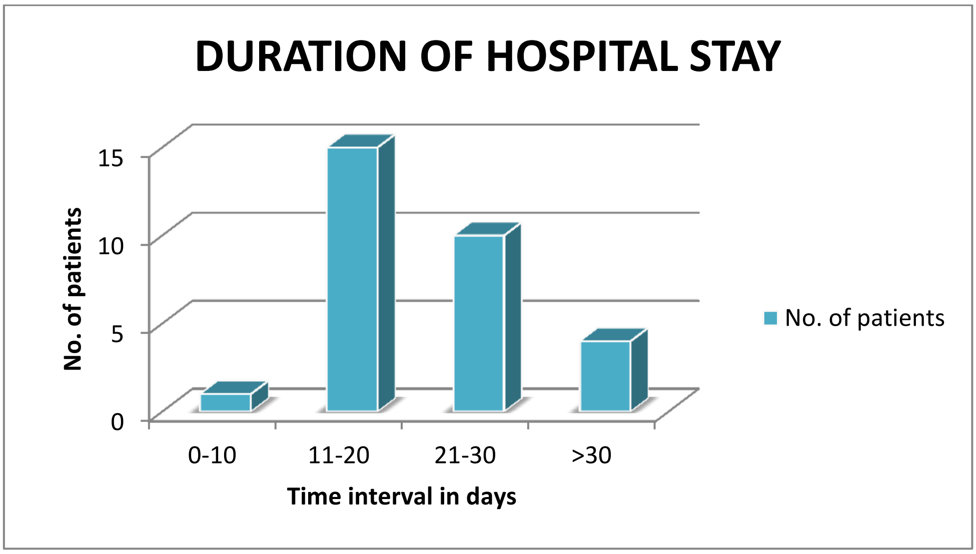


TABLE 10: COMMENCEMENT OF PARTIAL WEIGHT BEARING

Partial weight bearing(PWB)	**Number of patients**	**Percentage**
6 weeks	13	43.30%
8weeks	12	40%
>10 weeks	5	17.70%
Total	30	100%

In this study the average time of partial weight bearing was 7.9 weeks (range 6-18 weeks).

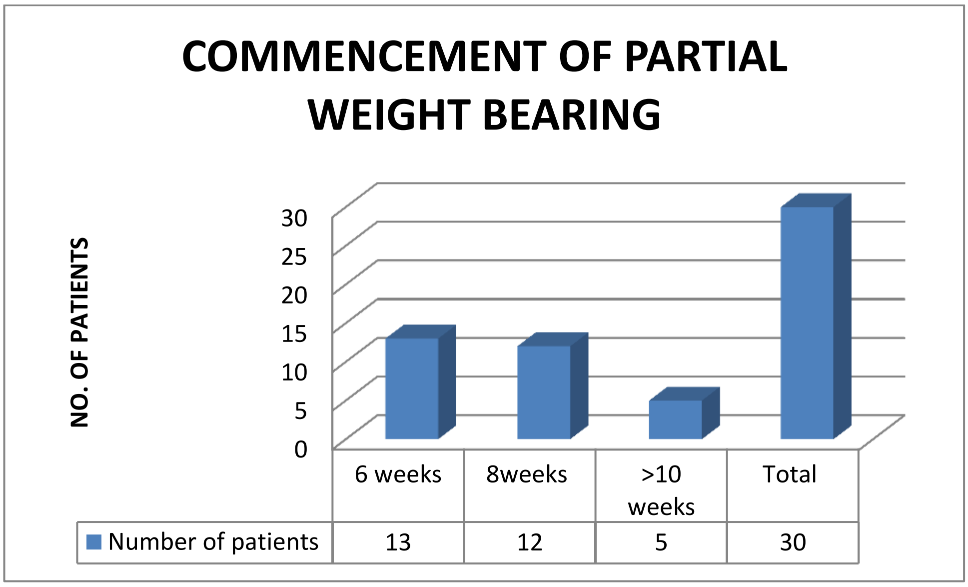


TABLE 11: COMMENCEMENT OF FULL WEIGHT BEARING (FWB)

Full weight bearing (FWB)	Number of patients	Percentage
10-12 weeks	21	70%
13-16weeks	5	16.7%
17-24 weeks	4	13.3%
Total	30	100%

Average time of full weight bearing in the present study was 13 weeks (range 10-24 weeks).

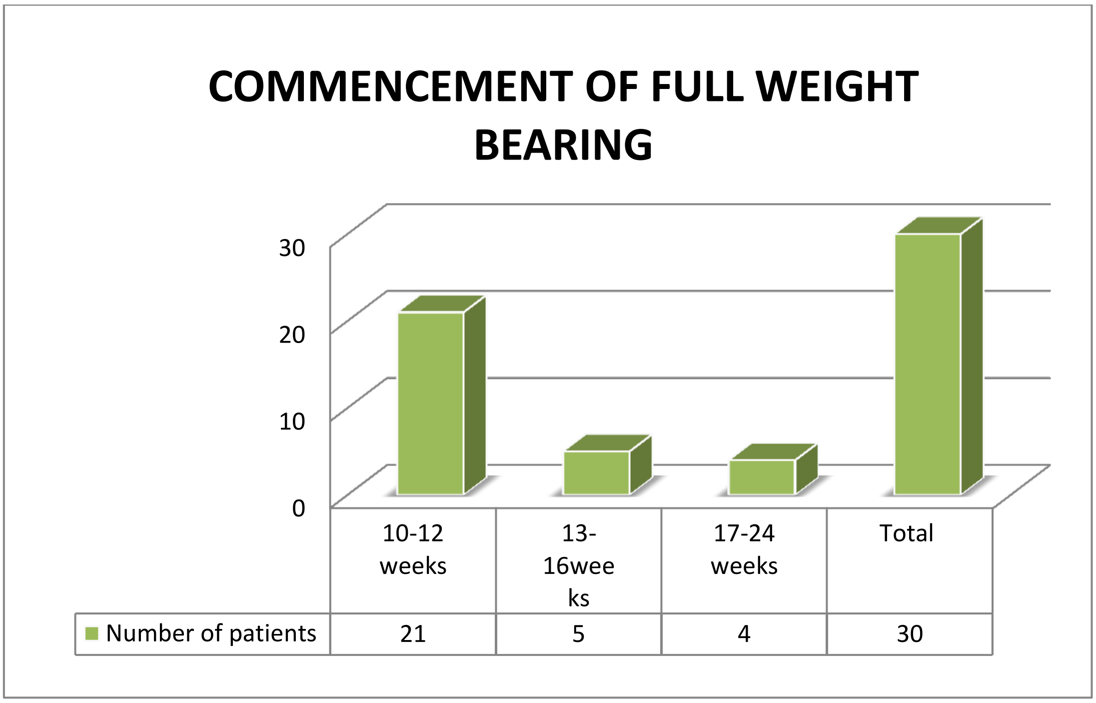


TABLE 12: RADIOLOGICAL UNION

Time interval	No. of cases	Percentage
24 weeks	7	23.3%
28 weeks	6	20%
30 weeks	5	16.7%
32 weeks	9	30%
36 weeks	3	10%
Total	30	100%

The mean time for radiological union was 29.4 weeks (range 24-36 weeks) in this study.

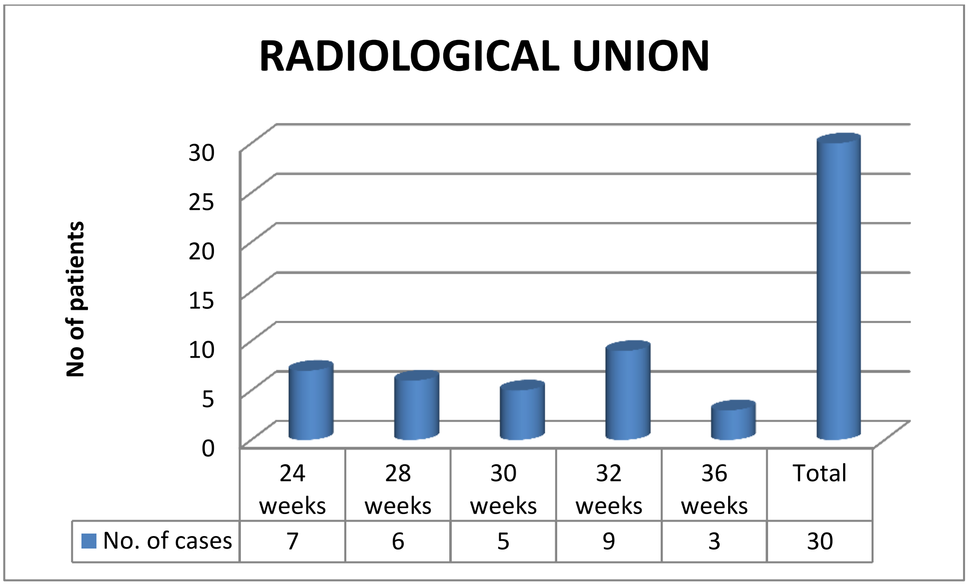


TABLE 13: TIME TAKEN FOR UNION IN CLOSED AND OPEN FRACTURES

Type of fracture	No. of cases	Time in weeks
Closed fractures	15	29
Open type I	8	30
Open type II	6	30
Open type III A	1	36

Time taken for radiological union in open fractures was 30-36 weeks. Time taken for radiological union in closed fractures was 29 weeks. Time taken for open fractures was longer than closed fractures.

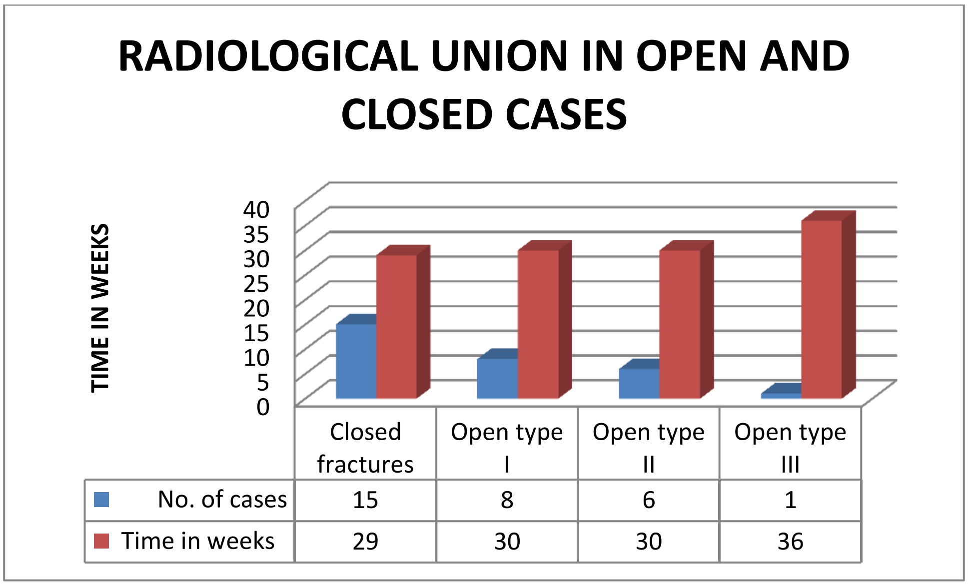
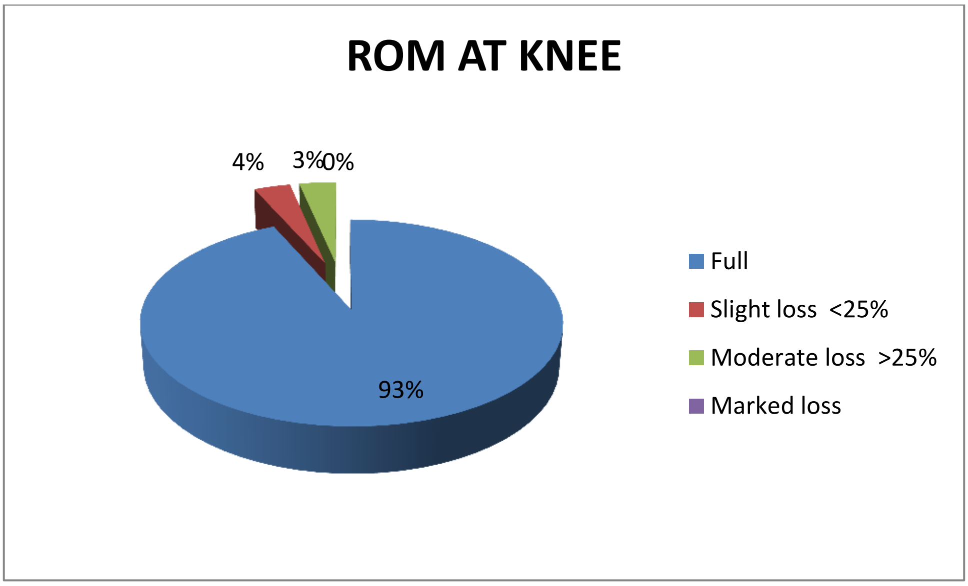


TABLE 14: RANGE OF ANKLE AND KNEE MOTION

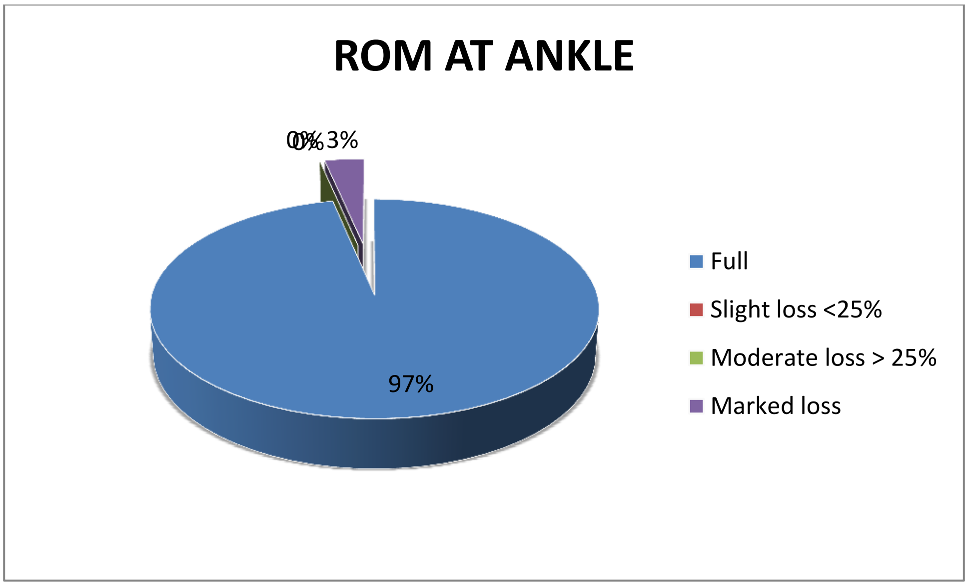
THE KNEE

Range of motion at knee	No. of cases	Percentage
Full	28	93.4%
Slight loss <25%	1	3.3%
Moderate loss >25%	1	3.3%
Marked loss	0	0%



THE ANKLE

Range of motion at ankle	No. of cases	Percentage
Full	29	96.7%
Slight loss <25%	0	0%
Moderate loss > 25%	0	0%
Marked loss	1	3.3%



In the present study, 2 patients (6.6%) had mild loss of knee motion: 1(3.3%) patient had 30° loss of knee flexion and 1 patient had extension lag of 10° at the knee joint. Also, 1 patient (3.3%) had marked loss of ankle motion

TABLE 15: RANGE OF MOTION IN OPEN AND CLOSED FRACTURES

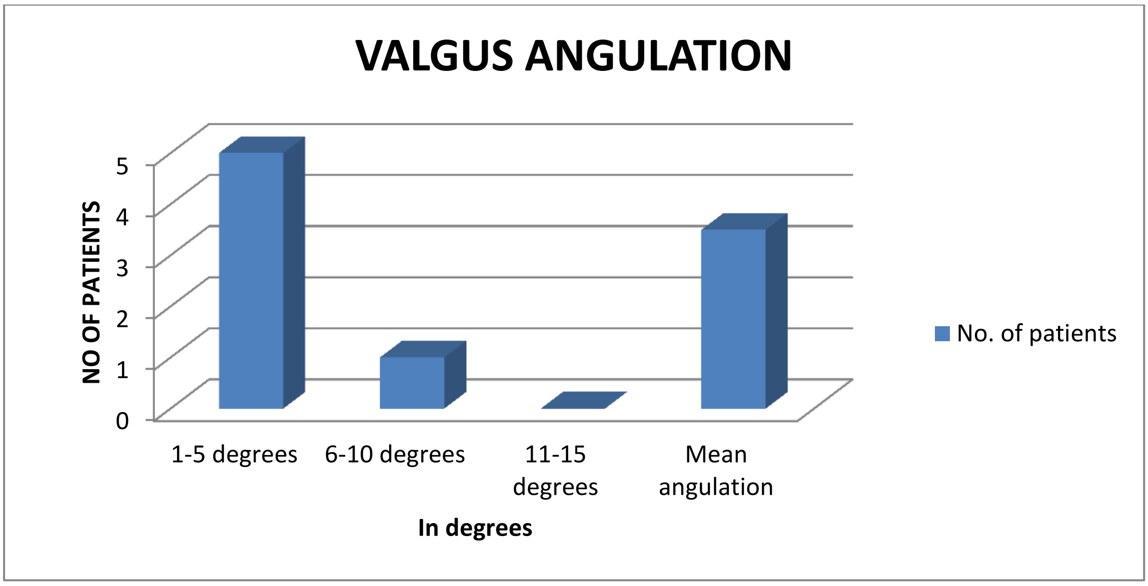
Type of fracture	**No. of cases**	**Range of movements at knee**
Closed fractures	15	Full
Open type I	8	1 patient had 30^{o}flexion loss
Open type II	6	1 patient had $10^{o}$of extensor lag, 20^{o}flexion loss
Open type IIIA	1	Full

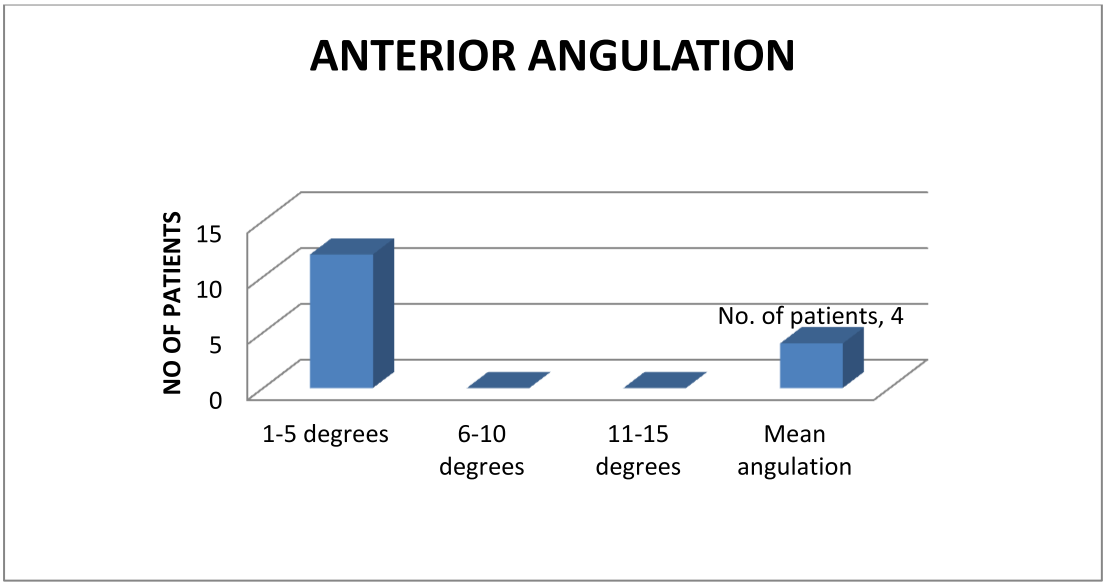
There is no loss of range of motion in closed fractures. In open fractures1 patient had 30^{o}flexion loss, 1 patient had $10^{o}$of extensor lag, 20^{o}flexion loss

TABLE 16: RADIOLOGICAL MALALIGNMENT

Valgus angulation	No. of patients
0-5	5
6-10	1
11-15	0
Mean angulation	3.5

Anterior angulation	No. of patients
0-5	12
6-10	0
11-15	0
Mean angulation	4





12 patients (40%) had a mean anterior angulation of 4^{o} (Range 2-5^{o}). Also, 5 patients had a valgus angulation of 5°and 1 patient had valgus angulation of 8^{o}.

TABLE 17: COMPLICATIONS

Complication	No. of cases(n=30)	Percentage
Delayed union	**3**	**10%**
Palpable screws	**2**	**6%**
Malunion(varus-valgus angulation or recurvatum of > 5° or greater	**1**	**3%**
Anterior knee pain	**1**	**3%**
Infection	**1**	**3%**

Complications among 30 patients who underwent nailing are, In 15 closed fractures 1(3%) patient had infection subsided by antibiotics and daily dressings, and 1(3%) patient delayed union and 1(3%) patient had anterior knee pain.

In open fractures 2(6%) patients had delayed union and 2(6%) patients had palpable screws and 1(3%) patient had malunion.

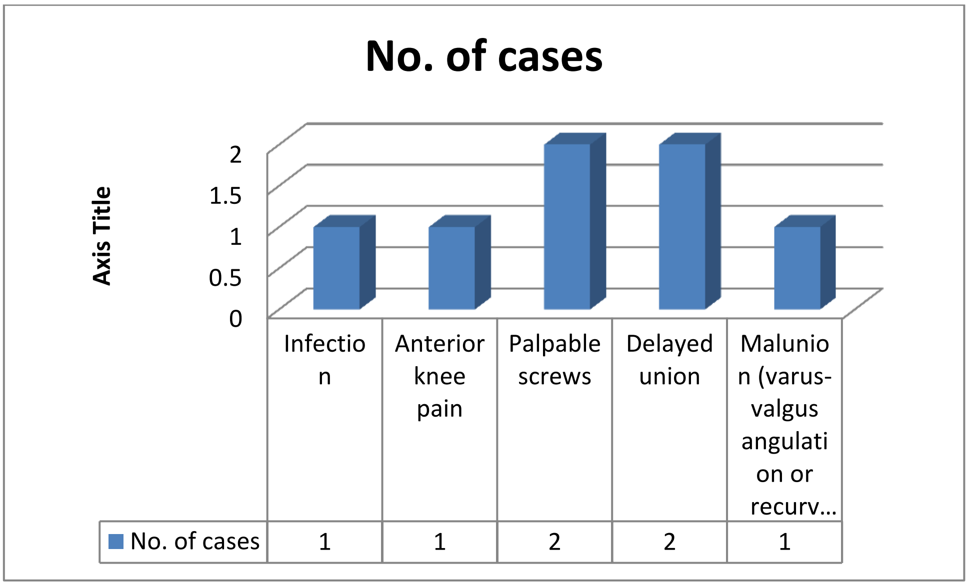
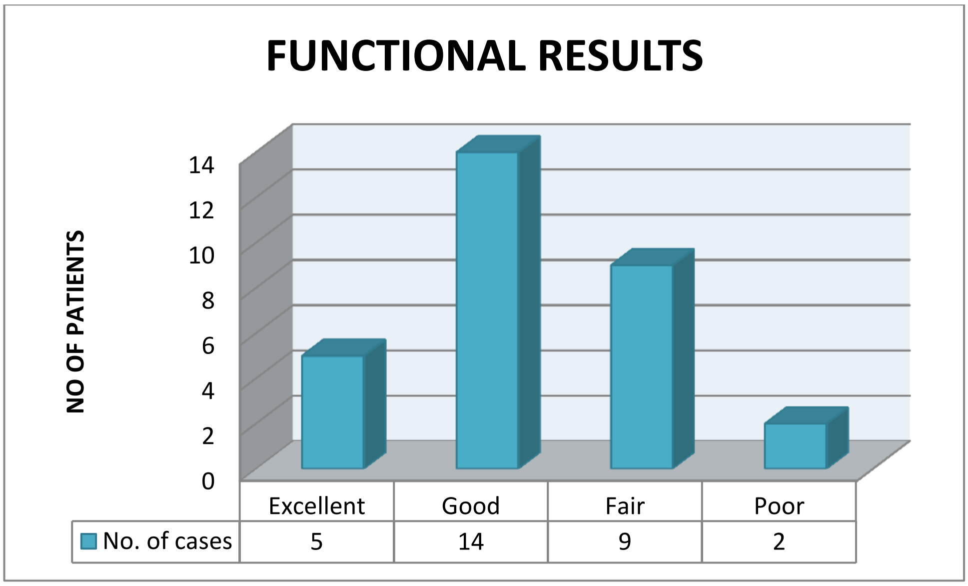


TABLE 18: FUNCTIONAL RESULTS ACCORDING TO KLEMM & BORNER CRITERIA

Grade	No. of cases	Percentage
Excellent	5	16.7%
Good	14	46.7%
Fair	9	30%
Poor	2	6.6%

According to Klemm and Borner criteria, 5 patients showed excellent results, 14 patients showed good and 8 patients showed fair results.

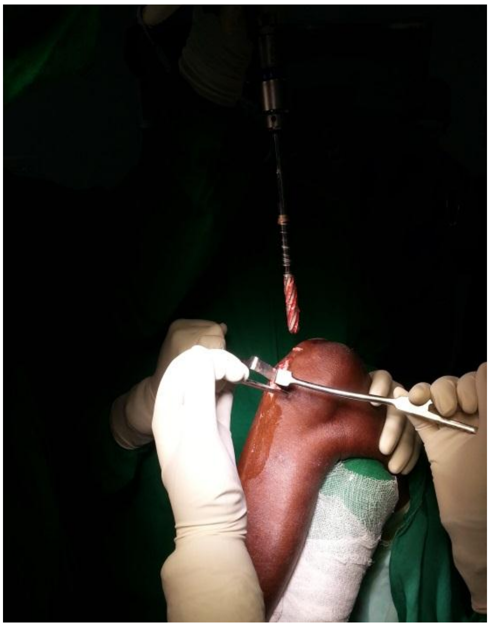


OPERATIVE PHOTOGRAPHS

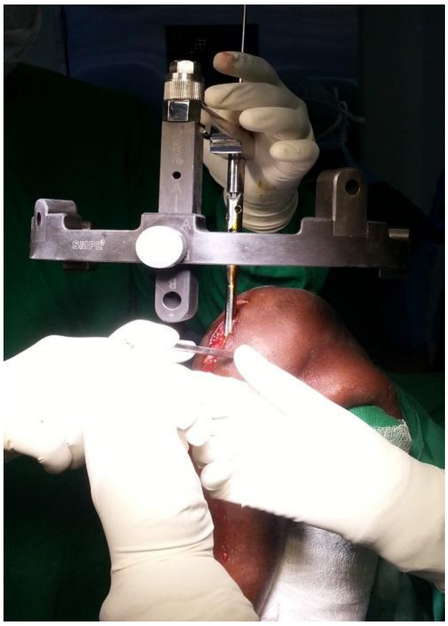
PROCEDURE DONE IN FULL FLEXION

Incision

Insertion of Guide Wire



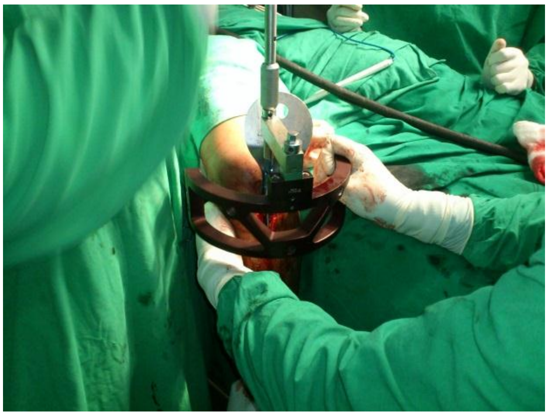
Reaming



Insertion of Nail

PROCEDURE DONE IN 90^{O} OF FLEXION

MID PATELLAR INCISION



SEMI EXTENDED POSITION USED FOR NAILING

CLINICAL PHOTOGRAPHS

CASE 9

PREOPERATIVE X-RAYS **POST OPERATIVE X-RAYS**

RADIOLOGICAL UNION X-RAYS AFTER 28 WEEKS

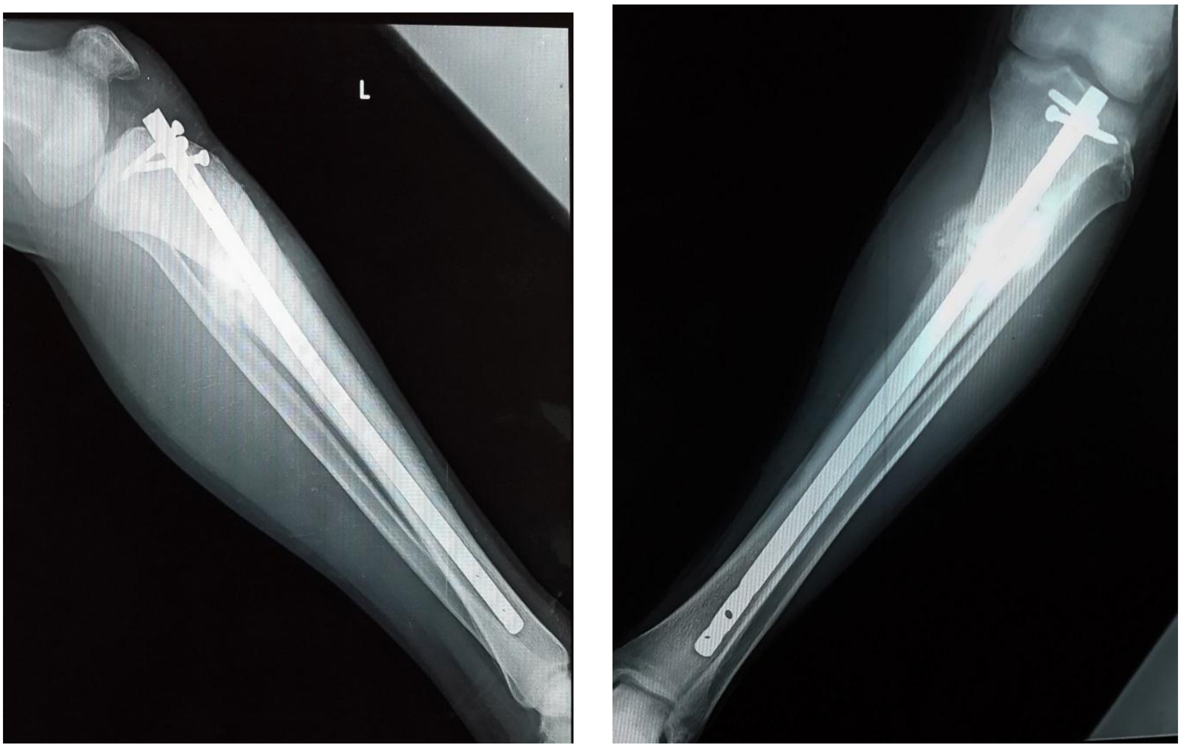
CLINICAL PHOTOGRAPHS

FULL RANGE OF MOTION AT KNEE AND ANKLE AT 12 WEEKS POST OP

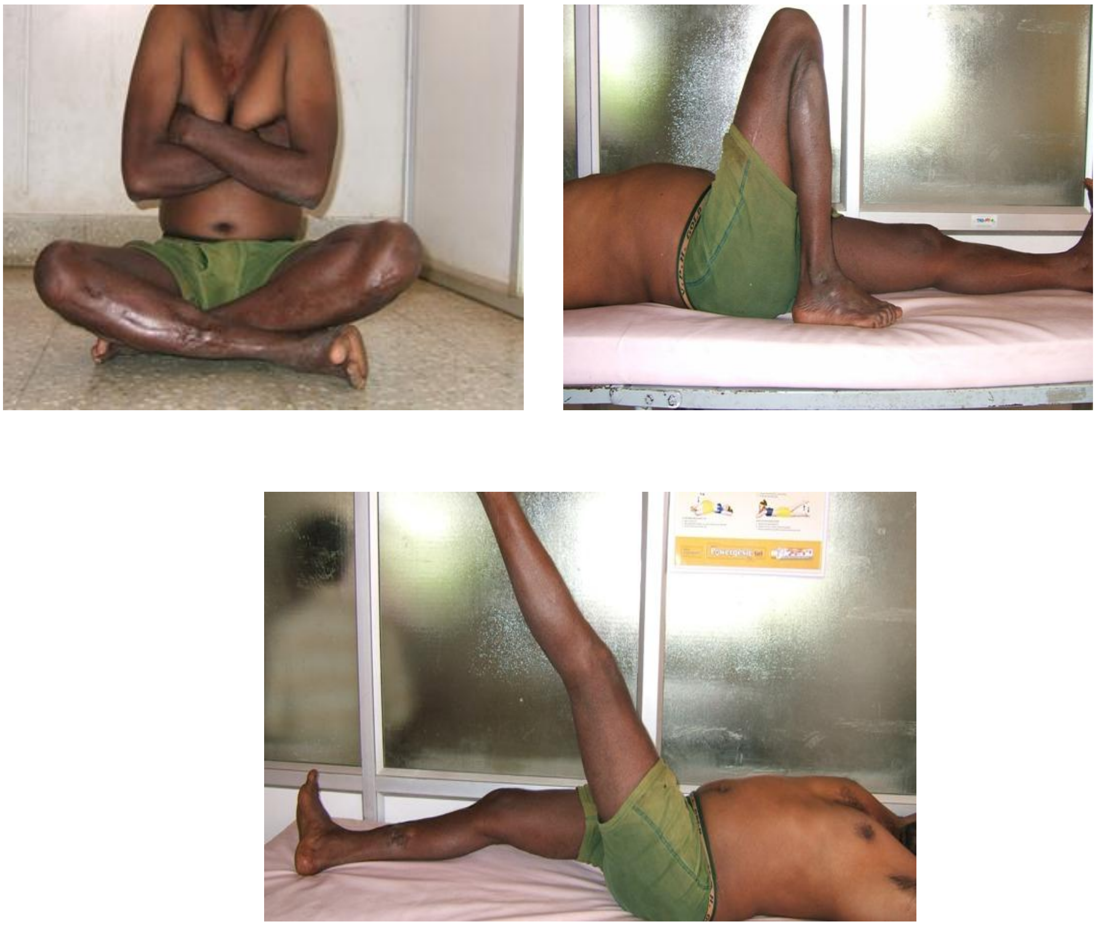
CASE 4

PREOPERATIVE RADIOGRAPHS

2 MONTH POSTOPERATIVE RADIOGRAPHS

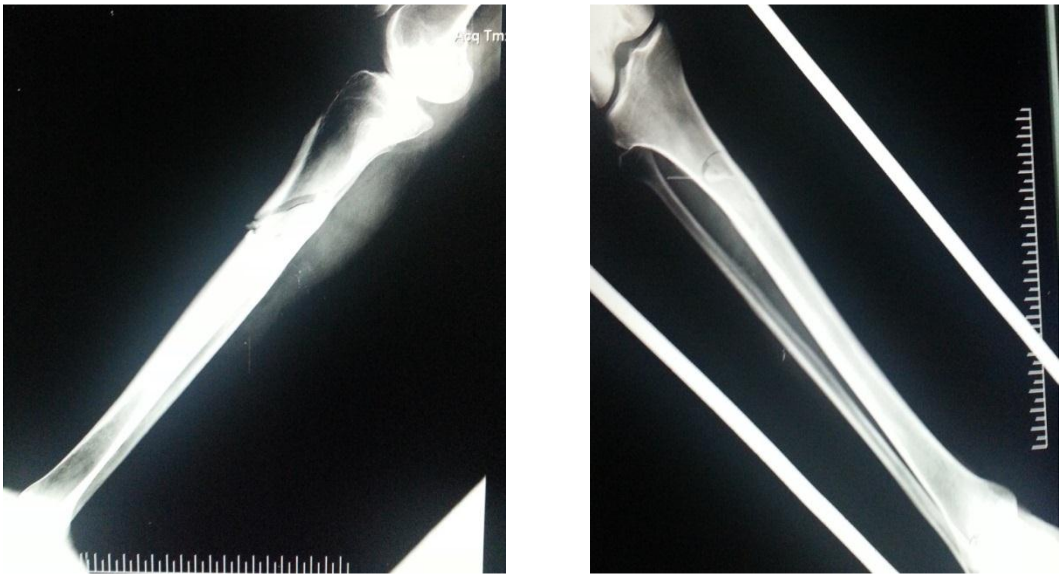


24 WEEKS RADIOGRAPH SHOWING RADIOLOGICAL UNION



FULL RANGE OF MOVEMENTS AT KNEE AND ANKLE

CASE 7



PRE OPERATIVE RADIOGRAPHS

POST OPERATIVE RADIOGRAPHS

24 WEEK RADIOGRAPHS SHOWING RADIOLOGICAL UNION

MILD LOSS OFRANGE OF MOVEMENTS AT KNEE

CASE 8

POSTOPERATIVE XRAYS

XRAYS SHOWING UNION AT 28 WEEKS

CLINICAL PHOTOGRAPHS SHOWING RANGE OF MOTION AT KNEE AND ANKLE


CASE 24

POSTOPERATIVE XRAYS

XRAYS AFTER UNION AT 32 WEEKS

CLINICAL PHOTOGRAPHS SHOWING ROM AT KNEE

CASE 6

PRE OPERATIVE PHOTOGRAPHS

POSTOPERATIVE XRAYS

XRAYS SHOWING UNION AT 24 WEEKS

CLINICAL PHOTOGRAPHS SHOWING ROM AT KNEE

CASE 7

PRE AND POST OPERATIVE XRAYS

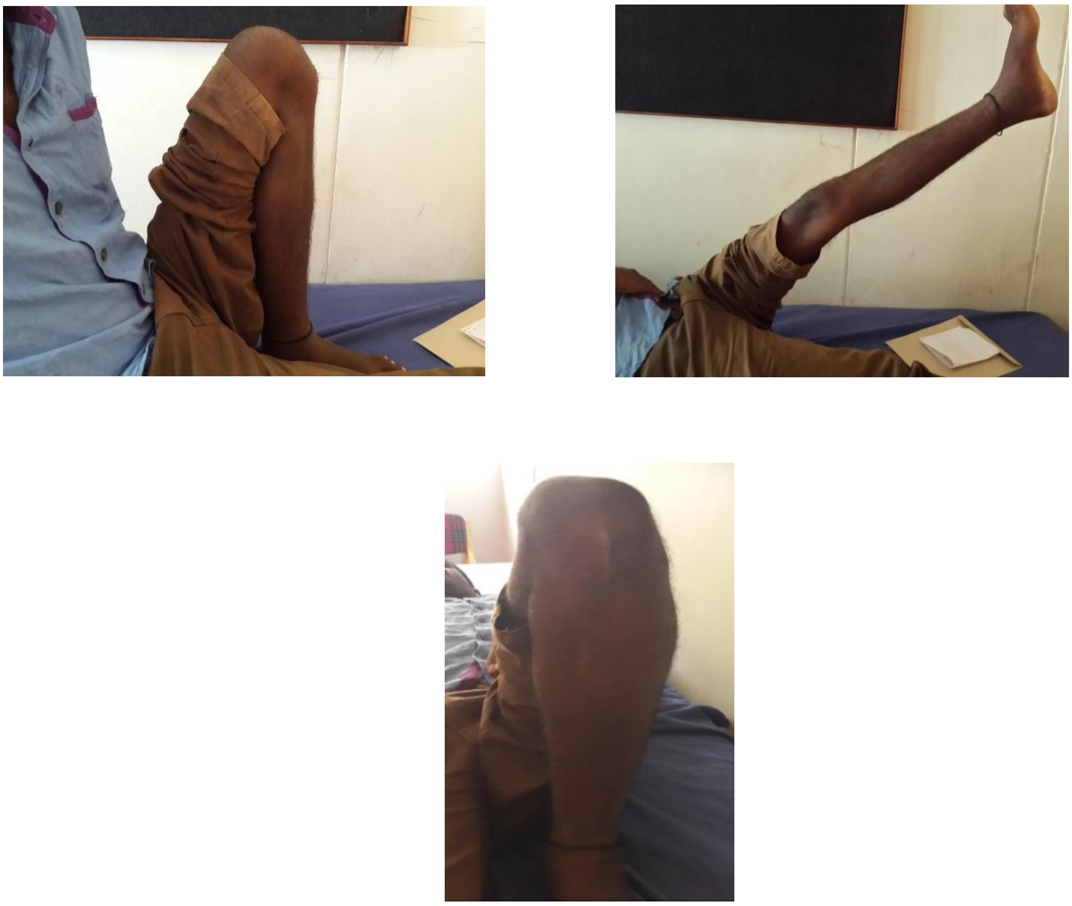
XRAYS SHOWING UNION AT FRACTURE SITE AT 24 WEEKS

CLINICAL PHOTOGRAPHS SHOWING ROM AT KNEE

CASE 18

POST OPERATIVE XRAYS

XRAYS AFTER 28 WEEKS UNION



CLINICAL PHOTOGRAPHS SHOWING ROM AT KNEE

COMPLICATIONS

CASE 1

HEALED FRACTURE AFTER INFECTION AFTER IMPLANT REMOVAL

CASE 3

A CASE OF MALUNITED AO 42 C3 FRACTURE AFTER NAILING

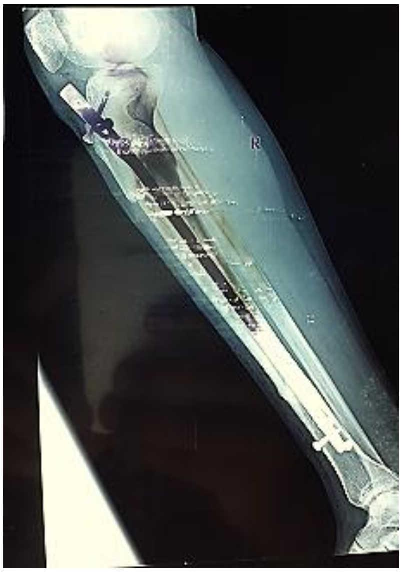
MAL UNION AFTER 30 WEEKS POSTOPERATIVE

CASE 10

XRAYS OF CASE SHOWING UNION AFTER DYNAMISATION

CASE 2

XRAYS OF CASE WITH ANTERIOR KNEE PAIN DUE NAIL PROJECTING FROM PROXIMAL TIBIA



CLINICAL PHOTOGRAPH SHOWING NAIL PROJECTING BELOW THE SKIN

DISCUSSION

Intramedullary nailing is the standard treatment for most patients with fracture of tibial shaft. Fractures of the proximal third of the tibial shaft are difficult to treat with intramedullary nails as the diameter of the nail is smaller compared to the wide metaphyseal proximal fragment which offers little resistance to deforming forces. This makes alignment in both sagittal and coronal planes dependent on the operative reduction and fixation. A small angulation in the proximal fracture can be accentuated by the nail as it is passed.

Valgus mal-alignment is due to the medial nail entry point and the laterally directed nail insertion in the proximal fragment and also due to inadequate reduction before nailing. In addition, the origins of the musculature of the anterior compartment act as a tether on the lateral tibial surface, which may contribute to the valgus angulation.

Varus angulation at the fracture site occurs if the nail entry is lateral, and use of the lateral approach.

Apex anterior angulation is the most common deformity which is due to nail insertion done with knee in flexion and also due to the patellar tendon pulling the proximal fragment anteriorly. The other major contributing factors are the nail insertion angle being directed posteriorly and the bend of the nail. Posterior translation is mainly due to the herzog's bend crossing the fracture site which pushes distal fragment posteriorly.

To prevent valgus angulation, a lateral poller screw was inserted in the anteroposterior direction and placed in the distal portion of the proximal fragment slightly lateral to the longitudinal axis. To reduce the apex angulation, a posterior poller screw was inserted in the mediolateral direction and placed in the distal portion of the proximal fragment slightly posterior to the longitudinal axis.

The locking was carried out with the limb in semi-extension using minimum of two screws in the proximal fragment, oblique locking screws were preferred. Two mediolateral screws are disadvantageous because of poor bone hold when the nail is anterior. Ideally the proximal bend should be in the proximal fragment.

In the present study, reduction methods using of bone reduction clamps, poller screws,k-wires and anterior plating with reconstruction plates were used only to prevent deformity at fracture site during passing of the nail to hold the reduction they were removed after locking was done. Also, the semi-extended position for interlocking was used when there was flexion deformity on lateral radiography.

1. AGE INCIDENCE

The mean age in our study is 40.5 years and in other studies as quoted below

Study	**Vidyadhara S,Sharath K et al**	**Nork et al**	**Singh et al**	**Ricci et al**	**Present study**
Range in years	18-67	19-73	25-58	18-80	19-80
Average in years	43	42	37	47	40.5

2. SEX INCIDENCE:

Majority of the patients in our study were males same as in other studies

Study	Vidyadhara S, Sharath K et al	Nork et al	Singh et al	Present study
No. of patients	45	35	18	30
Male	39	28	15	26
Female	6	7	3	4
Ratio (M:F)	6.5:1	4:1	5:1	6.5:1

3. MODE OF TRAUMA

High energy trauma due to automobile accidents was the most common mode of trauma in most of the series including the present one.

Study	Vidyadhara S, Sharath K	Nork et al	Singhet al	Ricci etal	Present study
Fall	-	2	2	-	4
Automobile accidents	43	33	15	9	25
Sports & miscellaneous	2	-	1	3	1

4. LIMB INVOLVEMENT

In the present study, 60% patients had the involvement of right limb and 40% had the involvement of left limb.

In the study by Singh et al, 14 patients (77.78%) had the involvement of their right limb and 4 (22.22%) patients had the involvement of left limb

5. PWB, FWB AND RADIOLOGICAL UNION:

In the present study active range of motion of the ankle and the foot joints were encouraged at 1^{st} post-operative day. Patients were allowed toe touch weight bearing when comfortable. At 1 week post-operatively, active range of motion of the knee joint was started. Plain radiographs were obtained post operatively and then again at 6-7 weeks. When there was evidence of early osseous healing as determined by blurring of fracture planes, partial weight bearing was started. Patients were followed up on OPD basis and full weight bearing was started depending upon clinical and radiological assessment.

In the present study, mean time of start of partial weight bearing was 7.9 weeks and the mean time of full weight bearing was 13 weeks. In our study PWB and FWB was delayed for >10 weeks in 5 cases (17.7%) due to associated injuries.

In our study the mean time for radiological union was 29.4 weeks.

In closed fractures the mean time taken for union was 29 weeks, in open fractures the time taken for union was 30-36 weeks, to conclude open fractures took more time for union than closed fractures.

In the study by Vidyadhara et al, mean time for radiological union was 4.3 months.

In the study by Singh et al, mean time for radiological union was 17 weeks.

In a study by Shon et al the mean time of radiological union of segmental tibia fractures was 16.3 weeks

Study	**Vidyadhara et al**	**Singh et al**	**Shon et al**	**Present study**
Radiological union in weeks	18 weeks	17 weeks	16.3 weeks	29.4weeks

6. RANGE OF MOTION AT ANKLE AND KNEE

In the present study, 2 patients (6%) had mild loss of knee motion: 2 (6%) patients had 30° loss of knee flexion and 1 patient had extension lag of 10° at the knee joint. Also, 1 patient had loss of ankle dorsiflexion due to common peroneal injury sustained during initial injury. In 15 closed fractures there was no loss of range of motion in any case. In open type I one patient had 30^{o} of loss of flexion. One patient of open type III fracture had full range of motion. 1 patient of type II open fracture had 10^{o} of extensor lag.

In the study by Singh et al, two patients (11.11%) had a loss of terminal knee flexion (10º and 20º); none had extension lag. Three patients (16.67%) had a loss of ankle dorsiflexion (15º in 2 and 5º in one).

7. RADIOLOGICAL MALALIGNMENT

12 patients (40%) had an average anterior angulation of 4° (range 2-5^0). Also, 5 patients had a valgus angulation of 5°. Valgus angulation of 8° was noted in 1 patient.

In a study by of 32 proximal tibial fractures treated with intramedullary nail, Lang GJ et al observed that 27 patients (84%) had angulation >5° in frontal or sagittal plane.

In the study by Vidyadhara et al, four patients had average valgus angulation of 4.5° (range 3—9°) , seven had average apex anterior angulation of 4.5° (range 2—9°), five had average posterior displacement of 4 mm (range 3—5mm), one patient had 3° of varus angulation and one had 4° of internal rotation deformity after nailing.

In the study by Nork et al, 3 patients (8.1%) showed angulation ≥5° (5° varus in 1 patient, 7° varus in other and 5° valgus in 1 patient).

In the study by Singh et al, 3 patients had valgus angulation of <5° (4° valgus in 2 patients and 3° valgus in 1 patient).

In a study by Hansen M et al using the expert tibial nail, they found that the risk for varus, valgus or antecurvation malalignment of more than 5 degrees in any plane on radiologic long leg views was 4.3% for shaft fractures, 1.5% for distal fractures, and 13.6% for proximal fractures.

8. ADDITIONAL SURGERIES:

In this present study 2 patients underwent dynamisation, 1 patient underwent bone grafting.

Study	**Lang et al**	**Vidyadhara et al**	**Nork et al**	**Singh et al**	**Present study**
Dynamisation	-	-	3	2	2
Bone grafting	4	2	2	-	1
Exchange nailing	9	1	3	-	-

Dynamisation was done in 2 cases after 3 months as they showed no signs of consolidation at fracture site. These patients achieved union by 28 weeks after dynamisation.

Bone grafting was done in one patient as there was delayed union at fracture site after 5 months; autologous bone marrow was injected patient achieved union by 8 months.

9. DELAYED UNION AND MALUNION IN CLOSED AND OPEN FRACTURES

In our study 3 patients had delayed union out of which one case of closed fracture had delayed union and was treated with autologous bone marrow injection patient achieved union by 28 weeks. 1 case of open fracture had delayed union and was successfully treated with dynamisation. 1 case of open type III A AO 42-C3 had malunion with 8^o of anterior angulation.

In a study by Vidyadhara four patients had malunion with two valgus and two apex anterior angulations.

In a study by Nork etal 2 patients had malunion with one patient having anterior angulation of 7 degrees.

In the study by Lang et al 84% patients had malunion (defined as angulation of >5° in coronal or sagittal plane)

10. COMPLICATIONS:

Study	Nork et al	Vidyadhara et al	Present study
Infection	4	2	1
Anterior knee pain	-	-	1
Malunion	6	4	1
Compartment syndrome	4	-	-

In the present study, 1 (3%) patient had malunion is a case of open fracture, 3% of patients had infection which subsided with the course of oral antibiotics and aseptic dressings, 5% patients complained of palpable proximal locking screws and one patient complained of anterior knee pain due to nail projecting from proximal aspect, 5% patients had delayed union and are treated successfully with dynamisation.

2 cases of open fractures had delayed union. 2 cases of open fractures had mild loss of range of movements at knee joint

In the study by Lang et al 84% patients had malunion (defined as angulation of >5° in coronal or sagittal plane).

In the study by Nork et al, 4 patients had compartment syndrome, 2 deep infections (in type III fractures) and 2 non-unions.

In the study by Vidyadhara et al, 1 nail broke, two patients developed delayed union and four patients had malunion, with two values and two apex anterior angulations.

11. RESULTS:

Result	Singh et al	Present study
Excellent	13(72.22%)	5
Good	4(22.22%)	14(46.7%)
Fair	1(5.55%)	9(30%)
Poor	0	2(6.6%)

In study by Singh et al, functional outcomes were excellent in 13, Good in 4, and fair in one patient.

In present study, 5 had excellent result, 14 patients had good and 9 patients had fair results and 2 patients had poor results.

SUMMARY OF PROXIMAL TIBIAL FRACTURES:

Fractures of the proximal tibial shaft pose challenge to the treating orthopaedic surgeon despite several methods of treatment available. Expert tibial nail is an effective and successful method of treatment available which has been used in the study.

- Our study comprised of patients in the age group 19-80 years, average being 40.5 years.
- 87% of the patients in the present study were males and only 13% were females.
- Road traffic accidents were the most common mode of trauma in the present study (83.4%).
- In 60% involvement of the right limb and 40% of the left limb.
- Closed and open cases were equal in number.
- There were 16 cases of AO type 41A2, 9 cases of AO type 41A3 and 3 cases of AO type 42C2 and 2 cases of 42C3.
- 2 patient had ipsilateral fracture shaft of femur, 3 patient had head injury, 2 patients had contralateral tibia fracture,1 patient had ipsilateral fracture neck of femur, 1 patient had patella fracture and 1 patient had ipsilateral patella fracture.
- Mean time interval from injury to surgery in the present study was 1.7 days (range 1-4 days).
- The mean time of hospital stay in the present study was 23.6 days (range 18-60 days).
- Average time of partial weight bearing in the present study was 7.9 weeks (range 6-18 weeks). The average time for full weight bearing was 13 weeks (range 10-24 weeks).

- The mean time for radiological union was 29.4 weeks (range 24-36 weeks).
- In the present study, 2 patients (6%) had mild loss of knee motion: 1 (3%) patient had 30° loss of knee flexion and 1 patient had extension lag of 10° at the knee joint. Also, 1 patient had loss of ankle dorsiflexion due to common peroneal injury sustained during initial injury.
- 12 patients (40%) had a mean anterior angulation of 4° (range 2-5^0). Also, 5 patients had a valgus angulation of 5°. Valgus angulation of 8° was noted in 1 patient.
- 1 (3%) patients had malunion, 1 patient had infection which subsided with the course of oral antibiotics and aseptic dressings, 2 patients complained of palpable proximal locking screws and one patient complained of anterior knee pain due to nail projecting from proximal aspect, 2 patients had delayed union and are treated with dynamisation.
- 5 had excellent result, 14 patients had good and 9 patients had fair results and 2 patients had poor results according to Klemm and Borner functional criteria.

CONCLUSION

Fractures of the proximal third of tibia are most often due to high velocity trauma occurring in young individuals. Because of several deforming forces acting they are more prone for malunion when treated with regular intramedullary nails.

Expert tibial nail with its multiplanar locking options and when used with proper reduction technique using reduction clamps, k-wires, poller screws or unicortical plating in semi extended position for nailing is an effective, stable and successful method of treatment for proximal third fractures of tibia.

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PROFORMA FOR EXPERT TBIAL NAILING:

1. Name:
2. Age :
3. Sex :
4. Hosp no:
5. D.O.A:
6. D.O.D:

History:

1. Mode of injury
2. Duration of injury
3. Limb involved- Right/Left

Any relevant:

1. Past history
2. Personal history
3. Family history

Examination:

a. **General Physical Examination**

b. **Systemic Examination**

- CVS
- CNS
- Chest
- Abdomen
- Musculoskeletal system
- Urogenital

c. Local examination:

1. Swelling
2. Tenderness
3. Deformity
4. Crepitus
5. Associated injury
6. Neurovascular status
7. Type of fracture

Investigations:

1. Haematology: Hb BT CT
2. Blood biochemistry: S. Urea S. Creatinine S. Electrolytes B. Sugar
3. Urine routine examination
4. ECG
5. X-ray chest PA view
6. X-ray of the involved leg including knee and ankle joints AP & Lateral views

Operative notes:

1. Date of surgery
2. Tourniquet time
3. Reaming/non-reaming
4. Operation time
5. Locking
6. Blood transfusion, if any

2nd to 8th P.O. Day:

- Condition of wound
- Any complication/remarks

Follow up Visits:

Clinical:

1. Swelling present/absent
2. Tenderness present/absent
3. Range of motion of knee & ankle joints
4. Limb length Shortening- present/absent
5. Abnormal mobility at fracture site present/absent

Radiological:

1. Angulation
2. Bending of nail
3. Breakage of screws
4. Displacement of fracture fragments
5. Signs of union i.e. callus formation

Complications:

Follow up	**1**	**2**	**3**	**4**	**5**	**6**
Date						
Condition						

Final Result: **Excellent**

Good

Fair

Poor

KEY TO MASTER CHART

Sl.No	SERIAL NUMBER
M	MALE
F	FEMALE
RTA	ROAD TRAFFIC ACCIDENT
LT	LEFT
RT	RIGHT
#	FRACTURE
PWB	PARTIAL WEIGHT BEARING IN WEEKS
FWB	FULL WEIGHT BEARING IN WEEKS
RAD U	RADIOLOGICAL UNION IN WEEKS
APEX	ANTERIOR APEX ANGULAATION

Sl. No	AGE	SEX	MODE OF TRAUMA	SIDE	CLINICAL TYPE	AO TYPE	ASSOCIATED INJURY	PWB	FWB	RAD U	KNEE&ANKLE ROM	RADIOLOGICAL ALIGNMENT	RESULT	COMPLICATIONS
Ushavathi	38	F	RTA	RT	CLOSED	41A2	NONE	6	10	28	FULL	NONE	FAIR	INFECTION
Muniraju	30	M	RTA	LT	CLOSED	42C2	NONE	8	12	32	FULL	NONE	GOOD	ANTERIOR KNEE PAIN
Kodanda Ramappa	48	M	FALL	LT	OPEN TYPE I	41A2	NONE	6	12	32	FULL	5 DEG APEX 3 DEG VALGUS ANGULATION	FAIR	NONE
Ramesh	42	M	ASSAULT	LT	OPEN TYPE I	41A2	OPP TIBIA #	8	16	24	FULL	NONE	EXCELLENT	NONE
Madhu Sudana	20	M	FALL	LT	OPEN TYPE II	41A2	NONE	6	10	28	FULL	2 DEGREE APEX ANGULATION	GOOD	NONE
Munishami	45	M	RTA	RT	OPEN TYPE IIIA	42C3	NONE	18	24	36	FULL	8 DEGREE VALGUS 5 DEGREE APEX ANGULATION	POOR	MAL UNION
Dasappa	40	M	FALL	LT	CLOSED	41A3	NONE	6	12	28	FULL	2 DEGREE APEX ANGULATION	GOOD	NONE
Chalapathi	55	M	RTA	LT	CLOSED	42C2	HEAD INJURY	8	12	28	FULL	NONE	EXCELLENT	NONE
Imrankhan	28	M	RTA	RT	OPEN TYPE I	41A2	NONE	6	10	30	FULL	3 DEGREE APEX ANGULATION	GOOD	NONE
Srinivas	28	M	RTA	RT	CLOSED	41A2	NONE	6	12	28	FULL	3 DEG APEX 2 DEG VALGUS ANGULATION	FAIR	NONE
Anil kumar	25	M	RTA	RT	CLOSED	41A2	NONE	8	12	32	FULL	3 DEGREE APEX	GOOD	NONE
Narashimha	19	M	RTA	RT	OPEN TYPE I	42C3	RT PATELLA#,FEMUR#	12	16	36	30 DEGREE FLEXION LOSS	NONE	FAIR	NONE
Ramakka	50	F	RTA	RT	CLOSED	41A3	NONE	8	12	32	FULL	3 DEG APEX 3 DEG VALGUS	FAIR	NONE
Muniyappa	40	M	RTA	RT	CLOSED	42C2	NONE	8	16	32	FULL	NONE	FAIR	NONE
Thimme gowda	80	M	RTA	RT	CLOSED	41A3	# NOF RIGHT SIDE	12	18	30	FULL	NONE	GOOD	NONE
Sandappa	50	M	RTA	RT	CLOSED	41A3	HEAD INJURY	8	16	32	FULL	5 DEGREE APEX 3 DEGREE VALGUS	FAIR	NONE
MJ Rao	74	M	RTA	LT	CLOSED	41A2	PERONEAL N INJURY	8	12	28	DORSIFLEX OF ANKLE LOST	NONE	GOOD	FOOT DROP
Devraj	30	M	RTA	RT	OPEN TYPE II	41A2	NONE	6	12	24	FULL	NONE	GOOD	NONE
Anand	35	M	RTA	RT	OPEN TYPE II	41A3	NONE	8	16	32	FULL	5 DEGREE APEX ANGULATION	GOOD	NONE
Zameer	35	M	RTA	LT	CLOSED	41A3	NONE	10	16	36	FULL	5 DEGREE APEX 5 DEGREE VALGUS	POOR	NONE
Nirmala	22	F	RTA	LT	OPEN TYPE II	41A3	RT LEG #,HEAD IJURY	8	12	24	FULL	NONE	FAIR	PALPABLE SCREWS
Narayanappa	45	M	RTA	RT	OPEN TYPE II	42A2	NONE	6	10	24	FULL	NONE	GOOD	NONE
Suman	26	M	RTA	RT	OPEN TYPE I	41A2	NONE	8	12	30	FULL	NONE	GOOD	NONE
Dodda narashimappa	40	M	RTA	RT	OPEN TYPE II	42A3	RT FEMUR #,RT CALCANEUM OPEN #	12	16	32	10 DEGREE KNEE EXTENSOR LAG	NONE	FAIR	PALPABLE SCREWS
Murali mohan	23	M	RTA	LT	OPEN TYPE I	41A2	NONE	6	12	30	FULL	NONE	GOOD	NONE
Bagawan	46	M	RTA	LT	OPEN TYPE I	41A2	NONE	6	10	32	FULL	NONE	GOOD	NONE
Basheer	26	M	RTA	RT	CLOSED	41A2	NONE	6	8	30	FULL	NONE	GOOD	NONE
Krishnappa	50	M	RTA	RT	CLOSED	42A2	NONE	8	12	24	FULL	NONE	EXCELLENT	NONE
Krishnamma	68	F	FALL	LT	CLOSED	41A2	NONE	6	10	24	FULL	NONE	EXCELLENT	NONE
Subba reddy	58	M	RTA	RT	OPEN TYPE 1	41A2	NONE	6	12	24	FULL	NONE	EXCELLENT	NONE