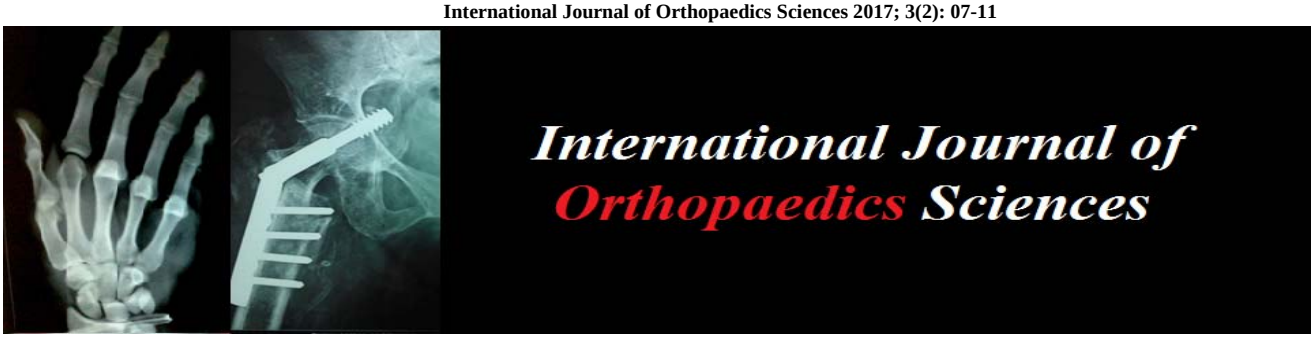

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Result of intramedullary interlock nailing in fracture proximal third tibia in rural hospital

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Abstract
Aim: Tibia is one of the most commonly fractured bone. Proximal third tibial fracture account for 5% to 11% of tibial shaft fracture. Treatment of proximal third fracture tibia is complex and problematic. Techniques include plate fixation, external fixation and intramedullary nailing. Purpose of this paper is to review and compare IM Interlock nailing technique in treatment of fracture proximal third tibia with other available techniques.
Materials and Methods: Study involved 33 patients (24 male and 9 females) operated between year 2012 and 2016 in SRTR Medical College and rural hospital, Ambajogai. An age between 18-70 year was selected for the study. Male to female ratio was 3:1. There were 27 simple fractures and six had open injury (4 with gustillo1 and 2 with gustillo 2). Fractures were classified on basis of fracture pattern as simple undisplaced, displaced, comminuted, and segmental. Fractures extending into articular surface were excluded from our study. Patient was in supine position with knee in figure of four posture. A 4 cm vertical midline incision was taken on patellar tendon. Patellar tendon was retracted medially. Entry made just in front of inter meniscus ligament with curved awl, after removal of piece of infrapatellar pad. Entry point was much higher than techniques described in other interlocking nailing. Tibia IM interlock nail of suitable size was inserted with manual rotation and proximal and distal locking done with locking screw. Polar screw and reaming was not used in our cases. In the case of nonunion, broken implants were removed and nail used, bone graft was done. In the case of hypertrophic nonunion IM nail was used and 1cm fibula excision. Post operatively patients were ambulated with crutches NWB and later PWB to FWB as per the pain threshold of the patient. Follow-up of patients were done at regular intervals and final angulations in four planes were studied. Reduction greater than 5 degree in any plane was considered as mal reduction
Results: The average hospital stay was 3-7 days. There was only one postoperative superficial infection, which healed with antibiotics and dressing. No patient had deep infection, neurovascular injury, implant failure or screw loosening. Union time was average 16 weeks with union rate of 94%. Majority of the patient with fractures (88%) shows painless wt bearing and radiological evidence of healing between 12-16 weeks. About 91% pt. showed more than 120-degree knee range of motion at final follow up. The nonunion cases took 16-20 wks for union. Postoperative angulations were within five degree in all planes, and no secondary procedure was required to achieve union or correct malunion.
Conclusion: Tibia IM intramedullary nailing is a safe and effective technique of fixation with good outcome. Alignment can be well maintained despite short proximal segment because the interlock IM nail, triple diameter screw that provides better stiffness and stability in axial and rotatory plane.

Keywords: Proximal tibia, interlocking, polar screw

1. Introduction
Proximal third tibia fractures account for 5% to 11% of tibia shaft fractures [1]. It is more prone to injury as proximal third tibia is subcutaneous. Treatment of tibia fracture is always challenging to the orthopedic surgeon due to poor soft tissue coverage and blood supply, [2]. Besides compartment syndrome, neurovascular injury and infection further leads to non-union, delayed union and mal union [1, 2].
The acceptable treatment goals of fracture proximal third tibia are union with maintaining normal length, normal alignment without rotation and deformity, normal joint movement and minimum hospital stay. Valgus angulations, apex anterior displacement is common after IL nailing [2, 3, 4]. Valgus is caused by medially located axis of loading.

Anterior displacement of proximal fragment is encouraged by 3 to 7 degree posterior angulations' of tibial plateau and insertion of patellar ligament on tibial tuberosity [5]. Treatment of proximal third tibial fracture is therefore more challenging than distal fractures [4]. Closed management often leads to varus malunion, especially when the fibula is intact. So conservative treatment is reserved for undisplaced or minimally displaced fractures with little soft-tissue injury [1]. More so, External fixation/Illizarow is used in cases of extensive soft-tissue injury that would preclude use of other surgical techniques. Open reduction and internal fixation with plating of the proximal tibia is also another method of management of these fractures but it is less popular because of the high incidence of infection and fixation failure. Recently MIPPO technique is also becoming popular in the hands of few expert trauma surgeons. Although intramedullary nailing can lead to valgus malunion in some patients, it can be useful for stabilizing fractures with proximal fragments longer than 5 to 6 cm. Alignment after nailing can be improve by placing the entry portal more proximal and lateral, locking in extension, and using specific techniques, such as blocking screws [1, 3]. In the past, tibia shaft fractures were managed by immobilization in a plaster cast, but this leads to joint stiffness, malunion and at times nonunion. In 1960s and 1970s, external fixation was most popular, but external fixation resulted in pin tract infection and sometimes osteomyelitis of bone [6, 7]. In 1974, a semi-rigid triflanged V intramedullary nail was introduced for closed nailing in tibia without reaming, but patient needs to be immobilized in plaster for achieving rigid fixation in this method. Open reduction internal fixation with plating resulted in higher incidence of non-union, infection and fixation failure. Classical Kuntscher nail used previously in nailing of tibial shaft fracture has no control on rotation of fracture fragments, so now it is used in some cases of simple fractures in the middle third tibia only. Due to these problems, a new technique of close tibial interlocking nail was introduced, which minimizes the chances of operative trauma, postoperative infection, promotes early union, and regain early activity. Proximal and distal locking screws which locks the nail firmly into ends of bone fragments provides the ability to control normal length, correction of angulations and rotation and thereby provide good stability. Therefore, locked IM nail has expanded its indications from the diaphyseal fractures to the fixation of metaphyseal fractures, and even to some cases of simple articular fractures of long bones including tibia. Healing rate with close interlocking nail technique is as high as 99% [6, 7, 8]. However, image intensifier is required to achieve interlocking in most cases. Some orthopedic surgeon uses non-reamed IM nail for closed and open fractures associated with severe soft tissues injury as these nails inserted without reaming, extensive damage on the bone circulation followed by bone necrosis, risk of infection is avoided. Purpose of this paper is to review and compare interlock nailing technique in treatment of fracture proximal third tibia with other available techniques.

2. Material and Methods

Study involved 33 patients (24 male and 9 females) operated between year 2012 and 2016 in SRTR Medical college and rural hospital Ambajogai, age group between 18-70 year (mean 45 year) was selected for the study. Male to female ratio was 3:1. There were 27 simple fractures and six had open injury (4 with Gustillo1 and 2 with Gustillo 2). Road traffic accident was leading cause in most (about 81%) cases. Fractures were classified on basis of fracture pattern as simple undisplaced, displaced, comminuted and segmental. Fractures extending into articular surface were excluded from our study. After admission, thorough history, complete physical examination and investigations done. All patients were counseled about their condition. Informed consent was taken from all the patients. Preoperative antibiotic ceftriaxon (2gm) was given to all patients. Patient was kept in supine position with knee in figure of four posture and Esmarch tourniquet was applied to keep the fracture fragments together. A 4 cm vertical midline incision was taken on patellar tendon. Patellar tendon was retracted medially. Entry made just in front of intermeniscus ligament with curved awl. Entry point was much higher than techniques described in other interlocking nailing. Interlock tibia nail of suitable size was inserted with manual rotation and locking done with screw. Polar screw and reaming was not used in our cases. Antibiotics continued for 5 to10 days depending on condition. Pt. mobilized on first postoperative day. Knee and ankle exercises started. Patients allowed partial weight bearing as patient could tolerate, and then gradual full weight bearing. Stitches were removed on tenth postoperative day. Patients were followed up on tenth day for first visit and then every four weeks for subsequent visits for total time of about 36 weeks. In each visit, the progress of healing of fracture site was examined clinically and radiologically. Final angulations in four planes studied. Reduction greater than 5 degree in any plane was considered as malreduction.

2.1 Parameters studied

Patients demographics, mechanism of injury, fracture pattern, duration of surgery, postoperative hospital stay and fracture healing indices like non weight bearing time, partial weight bearing time, knee range of motion, serial monthly X-rays and postoperative complications were collected at follow up visit by the surgeon. A fracture considered to be united if there was bridging callus on two cortices of four views of X-rays (AP/Lat/Obliques) and the patients had painless weight bearing.

3. Results

3.1 Patient demographics

Patients age ranged from 18 -80 years (mean 45).
The male to female ratio was 3:1(24 Males; 9 females).

3.2 Mechanism of Injury

Road Traffic Accidents was leading cause of fractures (about 81%) while, percentage of fall, assault were 10% and 3.5% respectively.

3.3 Fracture patterns

Varied from simple undisplaced/displaced transverse fractures to segmental and comminuted Fractures. Simple displaced was the most common type seen in about 37% of case. Whereas, simple undisplaced 21%, comminuted 27%, segmental 6%'spiral 9% cases seen in our study. The average distance of fracture from proximal articular surface was 65 mm. (range 17-100 mm).

3.4 Duration of surgery

The surgical duration ranged from 30-60 min with mean of 45 min.

3.5 Postoperative hospital stay

The duration of post operation stay in hospital ranged from 3–7 days with mean 5 days.

3.6 Partial weight bearing
Majority of patients (76%) could partially bear weight on crutches between 4 and 6
Weeks. While 15% of case PWB was seen in 1 to 3 wks., remaining 9% cases pt. took more than 6 wks.

3.7 Complications
Infection rate was minimal. Only one pt. with compound fracture tibia had superficial infection which was healed with antibiotics and dressing. While no patient shown evidence of deep infection, screw loosing or implant failure.

3.8 Painless weight bearing in weeks
90% of pt. had painless wt. bearing between 12 to 16 weeks. (Minimum-12 weeks, maximum 20 weeks, mean 14 weeks)

3.9 Radiological evidence of healing
Most 88% pt. shows radiological healing between 12-16 weeks

3.10 Healing duration
Mean healing duration was 16 weeks. Range was 12 to 20 weeks. Healing rate was 94%.

3.11 Knee range of motion
About 70% pt. shows knee range of motion between 90 to 120 degrees at time of
Discharge. At final, follow up about 91% pt. shows above 120-degree knee range of motion. Whereas only 6% and 3% of cases shown range of movement up to 90 and 90-120 at knee jt respectively

Fig 1: Preop

Fig 2: Immediate postop

Fig 3: followup at 6 Month

4. Discussion
Intramedullary nailing is one of the good alternative for treatment of proximal third tibial fractures [1]. In past, there were high incidences of valgus and flexion mal alignments in cases treated with Intramedullary nailing in proximal third tibial fractures due to poor understanding of tibial anatomy and the deforming forces acting on proximal segment [2, 3, 4]. But now with use of new techniques like proximal and lateral starting point, use of blocking screws, adjunctive plating it is now possible to obtain and maintain acceptable reduction in these fractures [3, 10].

Interlocking nailing has been increasingly used to treat both acute and chronic injuries to long bones. Kuntscher nail that forms the basis of modern day IM nailing was mostly used in resource poor hospitals, but K nail does not control rotation and not applicable to comminuted fracture. With interlock IM nail also control rotation of fracture fragment. Successful interlocking nailing using this method improves the quality of fracture care.

Ikemi *et al*. [11] have shown that IM nailing can achieved union rates as high as 90% in 18 weeks. Similarly, our study shows 94% union rate in 16 weeks.

Road traffic accidents are the leading cause of injury in our study, which correlates to reports in literature both in developing and developed countries. Several studies have reported the importance of fracture hematoma in fracture healing and hence the advocacy for closed IM nailing [13]. However, sometime there is need to open the fracture site during IM nailing in old fractures or nonunion. The effect of this to healing rate was not clear as the healing rate in our study (94%) was comparable to cases done by closed IM nailing done in other similar study [8, 11, 13].

Operative time (Range 30-60 minutes) compares to the operation time as reported in other centers using fluoroscopy. The Impact of tibia IM interlock nailing intervention was evident through early discharge from hospital, early weight bearing, early healing and early return to pre-morbid status. Hospital stay for patients done IM locked nail (3-7 days; mean 5 days) was remarkably reduced compared to the patients treated by traditional methods of traction (42-84 days; mean 62 days) [14]. Majority (76%) of patients could partially bear weight between three and six weeks and full painless weight after 10 to 16 weeks. O. O. Soren *et al* [14] study about interlock nailing in long bone fractures shows surgical duration 60-180 min and postop. Hospital stay 1-3 weeks. Therefore, our study shows that patient treated with tibia interlock nail can able to get back their socio-economic activities earlier than traditional methods of treatments.

In our study, there was only one case with superficial infection as post-operative complication which was treated with antibiotics. No patient shown deep infection, screw

loosening and peri-implant fracture, malunion. Study of Bhandari *et al*. [15] in operative treatment of proximal tibia fracture shows infection rate of 3% in pt. treated with IL nailing and 12% in pt. treated with plating. Same study shows nonunion in 3% cases treated with IM nailing and 1% with plating while, mal union in 18% cases treated with nailing and 10% with plating; compartment syndrome 7% with nailing and 1% with plating; implant failure 6% with nailing and 0% in plating. Larsen *et al*. [16] studied 45 patients with reamed interlock nail in tibia shaft fracture had two malunion while in our study no malunion was seen. Bonnevialle *et al*. [17, 18] studied intramedullary nailing with reaming in 32 patients in whom only one case (3.12%) developed deep infection. Steinberg (19 and his colleagues studied 54 cases with diaphyseal fracture. They pointed out 11 (20.4%) complications related to the nailing. 3 (5.55%) deep infection, 2 (3.7%) superficial infection, 2 bone shortening of 1 centimeter secondary to nail protrusion in the knee, 1 compartment syndrome, 1 fracture propagation, 1 distal malalignment and 1 delayed union. In our study, no such complications were observed. Court-Brown *et al*. [20, 21] studied 25 patients of tibial shaft fracture with average union time of 15.4 weeks with no infection, malunion, non-union or delayed union. Overall, infection rate for orthopedic surgery ranges from 1% to 12.5%. (22, 23).Thus, in our study infection rate in patients treated with tibia interlock nail seems to be minimal to negligible.

In our study, healing rate is 94% and mean duration of union is 16 weeks. This results are encouraging when compares to study of Ricci *et al*. [22] which reported mean duration of healing 13 weeks, study of Ikemi *et al*. [11] which reported mean duration of healing 19 weeks of fracture and the study done in Turkey [24] mean time of union was five months. Vidyadharn *et al*. [25] studied the clinic radiological outcome of interlock nail in tibia in which he found that the average time of fracture healing was 20.1 weeks more as compare to our study. Larsen *et al*. (16) studied 45 patients with reamed interlock nail in tibia shaft fracture whom average time to fracture healing was 16.7 weeks. He also pointed out that meticulous intramedullary nailing for tibial fracture has excellent clinico-radiological out come and is relatively safe.

Sean E. Nork *et al*. [2] studied 35 pt. with proximal tibia fracture treated with Intramedullary nailing and found 97.3% pt. have final angulations within five degree and concluded that Intramedullary nail offer an attractive alternative for proximal tibial fractures. Simillarly in all cases in our study shows final angulations in acceptable range.

As most of the cases done closely, interlock I.M. interlocking technique prevent excess soft tissue dissection unlike in plate fixation. As interlock IM nail is load bearing device, it provides more stiffness and implant stability and that helps in early mobilization, early weight bearing, early healing of fracture and less chances of implant failure [9] evident from the above facts that IM intramedullary nailing is a safe and quite effective for treatment of proximal third tibia fracture

5. Conclusion

Close tibia intramedullary interlock nailing is a safe and effective technique of fixation and can achieve good outcome and comparable results in fracture upper third tibia. Alignment can well maintained despite short proximal segment because the intramedullary nail provides better stiffness and stability in axial and rotatory plane.

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