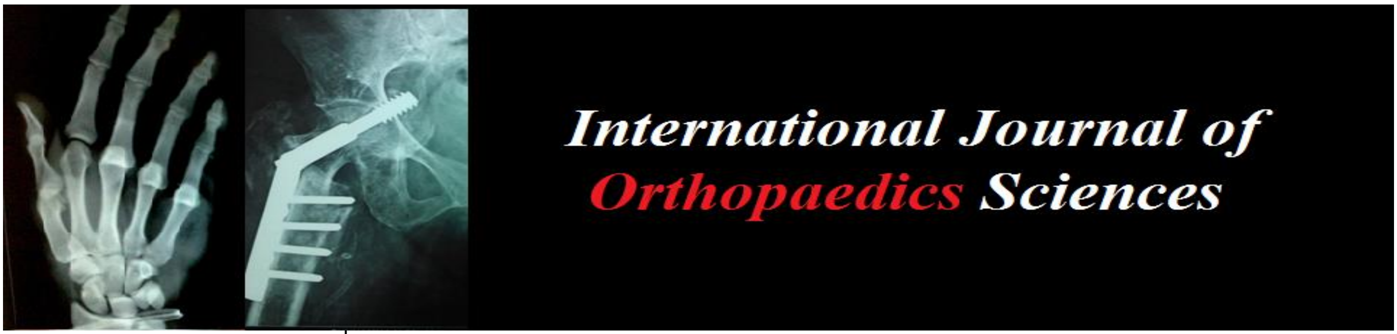


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**Dr. Pawan Kumar**
Associate Professor, Hazaribagh Medical College, Hazaribagh, Jharkhand, India

**Dr. Mritunjay Kumar**
Senior Resident, Department of Orthopaedics, Hazaribagh Medical College, Hazaribagh, Jharkhand, India

**Corresponding Author:**
**Dr. Mritunjay Kumar**
Senior Resident, Department of Orthopaedics, Hazaribagh Medical College, Hazaribagh, Jharkhand, India

# Comparative assessment of the outcome of locking plate fixation and closed intramedullary interlocking nail in the management of extra articular distal tibial fractures

**Dr. Pawan Kumar and Dr. Mritunjay Kumar**

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**Abstract**
**Aim:** To compare the outcome of locking plate fixation and closed intramedullary interlocking nail in the management of extra articular distal tibial fractures.
**Methods:** The prospective clinical study was conducted in the Department of Orthopaedics Hazaribagh Medical College, Hazaribagh, Jharkhand, India for the duration of 1 year. Total 40 Patients aged between 18 and 50 years presence of distal fragment of at least 3 cm in length without articular incongruity duration of injury <2 weeks no involvement of neuro-vascular status were include in the study. Patients with open fractures intra articular extension, pathological fractures were excluded from the study. Poor medical health was excluded from study.
**Results:** The classification of fractures 43 A.1– 10 (50%) ILN, and 10 (50%) plating 43 A.2–6 (30%) ILN, 4 (20%) plating, 43A.3–4 (20%) ILN, 4 (30%) plating. duration of surgery 40–60 min – 14 (70%) ILN, 8 (40%) plating, 61–80 min 6 (30%) ILN, 8(40%) plating, and >80 min 4 (20%) only in plating surgery. duration of total weight bearing after surgery 8–10 weeks 14 (70%) in ILN, 3 (15%) in plating, 11–12 weeks 6 (30%) ILN, 6 (30%) plating, 13–14 weeks 8 (40%) in plating, and >14 weeks 3 (15%) observed only in plating. duration of fracture union (radiological study) – 17.12 (SD ± 1.57) ILN 21.28 (SD ± 1.78) plating *t*-test –6.2 $P < 0.001$ (*P*-value was highly significant). study of post-surgical complications – pain in anterior knee – 5 (25%) in ILN, Superficial infection – 1 (5%) in plating Deep infection, 3 (15%) in plating valgus (angulations) >50 4 (20%) in ILN, 3 (15%) plating stiffness of knee 3 (15%) in ILN, stiffness of ankle 1 (5%) in ILN, 5 (25%) in plating, non-union 1 (5%) in IUN, implant irritation 5 (25%) in plating, and implant failure 5 in ILN.
**Conclusion:** Both closed intermedullary nailing and locking plate fixation equally safe and effective for the management of extra- articular distal tibia fractures.

**Keywords:** Intermedullary nailing, plating, distal tibia fractures, infection

## Introduction
These fractures may be quite disabling to patients if they aren't treated appropriately, since soft tissue damage is widespread. Falls, direct blows, and sports injuries are the next most prevalent causes, followed by high-energy motor vehicle trauma [1].
Distal tibia fractures are uncommon, occurring in just 0.6 percent of cases, yet they account for 10%–13% of total tibial fractures [2].
Using the largest region of the tibial plafond as a reference point, the distal tibial metaphysis may be conceptualised as a square [3]. As a result of the wound's placement under the surface of the skin, as well as its low blood supply and reduced anterior muscle cover, problems such as delayed or non-union, infection, and wound dehiscence are common.
Historically, both the minimally invasive plate osteosynthesis (MIPO) and the intramedullary interlocking nail (IMLN) have been linked to problems.
After IMLN, malalignment and knee discomfort are often observed; nevertheless, in certain studies, tibial plating has been related with wound problems and implant prominence [4-6]. In addition, the intramedullary treatment of distal tibia metaphyseal fractures is associated with its own set of problems, including malalignment and hardware failure [7]. Instead than depending on frictional force between the plate and bone to maintain the periosteal blood flow around the fracture site, locked plate designs work as fixed-angle devices.

The axial and angular stability at the screw-plate interface provides the stability [8, 9]. Locked plates can be used to treat distal tibia metaphy seal fractures because they are appropriate for fracture management in osteoporotic bone and fracture patterns that are close to the articular surface.

**Material and methods**

The prospective clinical study was conducted in the Department of Orthopaedics Hazaribagh Medical College, Hazaribagh, Jharkhand, India for the duration of 1 year, after taking the approval of the protocol review committee and institutional ethics committee.

**Inclusion criteria**

Patients aged between 18 and 50 years presence of distal fragment of at least 3 cm in length without articular incongruity duration of injury <2 weeks no involvement of neuro-vascular status were include in the study.

**Exclusion criteria**

Patients with open fractures intra articular extension, pathological fractures were excluded from the study. Poor medical health was excluded from study.

**Methodology**

Total 40 with distal tibia extra articular fractures Ao type 43A out of 40 patients 20 were operated with inter locking nailing and 13 with locking plate. Radiographic examination was done antero-posterior (AP) view and lateral view of the defected limb. Patients were operated under spinal anesthesia. Antibiotic of third generation cephalosporin was given intravenously 15 min before surgery. Pneumatic tourniquet / Esmarch rubber tourniquet was used in all patients. The affected limb was thoroughly scrubbed from mid-thigh to foot with Betadine scrub and savlon. The limb was painted with Betadine solution from mid-thigh to foot. Rest of the body and other limb was properly draped with sterile drapes. Cases in which fibula was fixed in addition nailing or plating of tibia, were done either with a one-third semi tubular plate, a reconstruction plate or a rush nail. In cases fixed with plating incision were taken just posterior to fibula soft tissues were dissected and the reduction of the fracture fragments was achieved after cleaning the fracture site. The fracture was fixed with six or seven hole plate with screws. In cases of rush nail fixation it was passed percutaneous over a stab incision at the tip of lateral malleolus after reduction of fracture manually. The passage and location of the nail were checked under image intensifier.

**Surgical Technique for Intermedullary Nailing**

A vertical patellar tendon splitting incision over skin extending from center of the inferior pole of patella to the tibial tuberosity was made about 3 cm long. The patellar tendon was split vertically, in its middle and retracted to reach the proximal part of tibial tuberosity. Next step was to determine the point of insertion. Essential for the success of procedure is the correct choice of insertion point. After selecting the point of insertion curved bone awl used to breach in the proximal tibial cortex. In the metaphyseal malleolus bone on entry portal was created, making sure it was in line with center of medullar canal. After widening the medullary canal with a curved awl, a guide wire of size 3 mm diameter × 950 mm length was passed into the medullary canal of the proximal fragment.

Accurate closed reduction of fracture was verified under image intensifier before insertion of the guide wire in the distal tibial metaphysis. After reduction, the tip of the guide wire was passed till it enters the sub-chondral bone of distal tibia. Exact length of nail was measured from length of the guide wire remaining inside the medullary canal from the entry point.

Size of the nail was assessed as 1 mm less than the diameter of the last reamer and passed into medullary canal over the guide wire. Screw positions were confirmed under C-arm image intensifier. After this Zig was removed and stability was checked by performing flexion and extension at knee and ankle joint all incisions were closed in layers. Sterile dressing was applied over the wound. Surgical technique for locking plate fixation - The concept of this approach was to preserve the soft tissues and blood supply in the metaphyseal fractures area. A straight or slightly curved skin incision was performed on the medial aspect of the distal tibia. The length of the incision varied from 3 cm to 5 cm depending on the type of the planned plate.

The incision was ended distally at the tip of medial malleolus. The incision was carried out straight across the sub cutaneous fat preserving great saphenous vein and saphenous nerve. They were held anteriorly with a blunt retractor. The dissection advanced down on to the periosteum, which was completely preserved. In this anatomical space, the tunneling toward the diaphysis was achieved with blunt tip of the plate. For the insertion of the proximal screws in the diaphysis separate stab, incisions were made. The plate was inserted after proximal tunneling with the plate itself. It is important that the plate and the proximal screw be centered on the tibia, particularly if locking head screwed is planned.

Temporary fixation was performed with wires through the screw holes to approximate the final plate position before the screw insertion. For spiral and short oblique fracture patterns were anatomically reduced and lag screws were placed to enhance the stability. The screw was placed independent of the plate conventional screw and was inserted in one of the most distal plate holes to approximate the plate close to bone after achieving accurate position of the plate. All the incisions were closed in the layers. Sterile dressing was applied over the wound plaster slab was applied below the knee in all patients.

Postoperatively radiographs were taken. Passive knee and ankle range of motion were started in the 1st post- operative week depending on type of fracture and stability of fixation. Active moments started in the 2nd week once pain had subsided. The weight bearing was planned as per the type of fractures fixation and general condition of patient. Initially partial weight bearing was advised between 4 and 8 weeks and then full weight bearing was advised when there was formation of callus and union of fracture process was observed radiologically.

Clinical follow-up examination was at 4 weeks, 6 weeks, 10 weeks, 3 months, 6 months, and 1 year. Every patient was assessed clinically radiologically to rule out tenderness at fracture site, abnormal mobility, infection, and pain on movement of knee and ankle joint.

**Statistical Analysis**

The results were compared with percentage and duration of union of fracture was compared with t-test. The statistical data were performed in SPSS software 21.0.

**Results**

Table 1 shows the classification of fractures 43 A.1– 10

(50%) ILN, and 10 (50%) plating 43 A.2–6 (30%) ILN, 4 (20%) plating, 43A.3–4 (20%) ILN, 4 (30%) plating.
Table 2 shows duration of surgery 40–60 min – 14 (70%) ILN, 8 (40%) plating, 61–80 min 6 (30%) ILN, 8(40%) plating, and >80 min 4 (20%) only in plating surgery.
Table 3 shows duration of total weight bearing after surgery 8–10 weeks 14 (70%) in ILN, 3 (15%) in plating, 11–12 weeks 6 (30%) ILN, 6 (30%) plating, 13–14 weeks 8 (40%) in plating, and >14 weeks 3 (15%) observed only in plating.
Table 4 shows duration of fracture union (radiological study) – 17.12 (SD ± 1.57) ILN 21.28 (SD ± 1.78) plating *t*-test –6.2 $P < 0.001$ (*P*-value was highly significant).
Table 5 shows study of post-surgical complications – pain in anterior knee – 5 (25%) in ILN, Superficial infection – 1 (5%) in plating Deep infection, 3 (15%) in plating valgus (angulations) >50 4 (20%) in ILN, 3 (15%) plating stiffness of knee 3 (15%) in ILN, stiffness of ankle 1 (5%) in ILN, 5 (25%) in plating, non-union 1 (5%) in IUN, implant irritation 5 (25%) in plating, and implant failure 5 in ILN.

**Table 1:** AO classification of fractures

| Types of AO | Group | | | | | |
|---|---|---|---|---|---|---|
| | ILN (20)% | | Plating (20)% | | Total (40)% | |
| 43A.1 | 10 | 50 | 10 | 50 | 20 | 50 |
| 43A.2 | 6 | 30 | 4 | 20 | 10 | 25 |
| 43A.3 | 4 | 20 | 6 | 30 | 10 | 25 |

**Table 2:** Comparison duration of surgery in both techniques

| Duration (in minutes) | ILN | | Plating | | Total | |
|---|---|---|---|---|---|---|
| | N=20 | % | N=20 | % | N=40 | % |
| 40–60 | 14 | 70 | 8 | 40 | 22 | 55 |
| 61–80 | 6 | 30 | 8 | 40 | 14 | 35 |
| >80 | 00 | - | 4 | 20 | 4 | 10 |

**Table 3:** Comparison duration of total weight bearing after surgery in both techniques

| Duration (in minutes) (weeks) | ILN | | Plating | | Total | |
|---|---|---|---|---|---|---|
| | No=20 | % | No=20 | % | No=40 | % |
| 8–10 | 14 | 70 | 3 | 15 | 17 | 42.5 |
| 11–12 | 6 | 30 | 6 | 30 | 12 | 30 |
| 13–14 | 0 | — | 8 | 40 | 8 | 20 |
| >14 | 0 | — | 3 | 15 | 3 | 7.50 |

**Table 4:** Comparison duration of fracture union (radiological)

| ILN | Plating | *t*-test | *P*-value |
|---|---|---|---|
| 17.12 (SD±1.57) | 21.28 (SD±1.78 | 6.2 | <0.001 |

**Test applied:** Student t-test

**Table 5:** Comparative study of post-surgical complications

| Details | ILN=20 | % | Plating=20 | % |
|---|---|---|---|---|
| Pain in anterior knee | 5 | 25 | 0 | |
| Superficial infection | 0 | – | 1 | 5 |
| Deep infection | 0 | — | 3 | 15 |
| Valgus >50 (angulation) | 4 | 20 | 3 | 15 |
| Stiffness of knee | 3 | 15 | 0 | |
| Stiffness of ankle | 1 | 5 | 5 | 25 |
| Non–union | 1 | 5 | — | — |
| Implant irritation | 0 | — | 5 | 25 |
| Implant failure | 1 | 5 | 0 | — |


**Fig 1:** Pre op xray


**Fig 2:** Immediate post op xray


**Fig 3:** Post op xray (after 5 months)

**Fig 4:** Pre op xray

**Fig 5:** Immediate post op xray

**Fig 6:** Post op (3 months)

## Discussion

Present comparative study of locking plate fixation and closed inter medullary ILN in the management of extra-articular distal tibia fractures 43 A.1– 10 (50%) ILN, and 10 (50%) plating 43 A.2–6 (30%) ILN, 4 (20%) plating, 43A.3–4 (20%) ILN, 4 (30%) plating. duration of surgery 40–60 min – 14 (70%) ILN, 8 (40%) plating, 61–80 min 6 (30%) ILN, 8(40%) plating, and >80 min 4 (20%) only in plating surgery. duration of total weight bearing after surgery 8–10 weeks 14 (70%) in ILN, 3 (15%) in plating, 11–12 weeks 6 (30%) ILN, 6 (30%) plating, 13–14 weeks 8 (40%) in plating, and >14 weeks 3 (15%) observed only in plating. duration of fracture union (radiological study) – 17.12 (SD ± 1.57) ILN 21.28 (SD ± 1.78) plating *t*-test –6.2 $P < 0.001$ (*P*-value was highly significant). study of post-surgical complications – pain in anterior knee – 5 (25%) in ILN, Superficial infection – 1 (5%) in plating Deep infection, 3 (15%) in plating valgus (angulations) >50 4 (20%) in ILN, 3 (15%) plating stiffness of knee 3 (15%) in ILN, stiffness of ankle 1 (5%) in ILN, 5 (25%) in plating, non-union 1 (5%) in IUN, implant irritation 5 (25%) in plating, and implant failure 5 in ILN. These findings are more or less in agreement with the previous studies [10-12]. Distal tibial fractures are one of the most challenging fractures experienced by orthopedicians. It is due to sub-cutaneous location, minimal vascularity and reduced muscular cover. There are chances of complications such as non-union, delayed union, infection, and dehiscence [13, 14]. The methods ILN and plating are popularly used to treat distal tibial fractures but these procedures are also associated with various complications. Non-operative treatment is also used in the case of stable fractures with severe morbidities but complications such as delayed union, malunion, and joint stiffness are very common. Locking plate fixation gives good rigid construct, anatomical reduction and biomechanical superior to intramedullary nailing [15]. However, it results in extensive soft-tissue dissection resulting in wound complications and infections. Hardware complications are more in locking plates warranting implant removal more frequently. With use of minimally invasive techniques, the complications have significantly reduced. Intermedullary nail is commonly used for distal tibia fracture where the fracture is away from the plafond allowing two or more distal locking than plating technically more challenging to achieve and maintain reduction because of anatomic characteristics of distal tibia. Hence, management of distal tibia fractures with intramedullary interlocking tibia nail given better results compared to fractures managed with distal tibia locking plate.

## Conclusion

The present study concluded that closed intermedullary nailing and locking plate fixation are equally safe and effective in the treatment of distal tibia fractures, according to the results of this research. Interlocking nailing, on the other hand, seems to be superior in terms of early weight bearing, rapid union, and reduced problems. Adding to that, it's inexpensive.

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