

Evaluation of Outcome of Proximal Tibia Fractures managed with MIPPO

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Abstract

Background: The concept of minimally invasive Osteosynthesis using percutaneous plate was established when it is realized that the length and alignment of proximal tibia can be restored with indirect manipulation and reduction technique. Biological fixation with percutaneous plating augments the healing process without additional risk of wound disruption and infection.

Purpose: The aim of the study was to evaluate the result of proximal tibial fractures with minimal invasive percutaneous plate osteosynthesis and to assess the clinical, radiological and functional outcome of the same.

Method & Material: The present study was conducted in the Department of Orthopaedics, during the period of August 2013 and August 2015, at Acharya Vinoba Bhave Rural Hospital, Wardha. The design of study was prospective cohort study. This study included 32 patients with the fracture proximal tibia of the patients and age of patient ranging from 20 to 75 years. All the patients with proximal tibia fractures were included in the study.

Result: A total of 32 patients of proximal tibial fractures were treated with minimally invasive percutaneous plate osteosynthesis technique. There were 29 male and female patient, with maximum patients in the age group of 31 to 40 years. Road traffic accident evolved as most common mode of injury. Fractures were classified according to AO classification. C1 type of fracture seen in 8 (25 %) patients and A2 type in 7 (21.9%) patients. Rasmussen's clinical and radiological scoring system was used for final evaluation of the results. The average Rasmussens clinical score was 23.53 and average radiological score was 14.3. In present study according to Rasmussen clinical score good result were seen in 26 (81.4 %) patients and poor result seen in only 1 (3.1 %) patient. According to Rasmussen's radiological score good results were seen in 26 (81.3 %) patients and only in 1 (3.1 %) patient poor result was seen. In only 2 (6.4%) patients there was implant related problem in the form of screw back out and plate prominence. The average range of knee flexion was 136.25 degree and 17 patients (53.12 %) achieved 131 -140 degrees of flexion. While 14 (43.75 %) patients achieved extension up to -2 degrees.

Conclusion: Minimally invasive percutaneous plate Osteosynthesis is better technique, and should be considered as primary option for the surgical treatment of the proximal tibia fractures. Clinical outcome of MIPPO technique are favourable and comparable to world literature in terms of fracture union, early mobilization and functional outcome. MIPPO technique preserve the soft tissues around the fracture site hence healing of the fracture is early. For the same reason MIPPO can be a treatment option for the grade I compound fractures. MIPPO technique can be successfully used for the simple or grade I compound fracture of proximal tibia.

Key words: Tibia, Minimal Invasive Plate Osteosynthesis, Clinical, Functional, Radiological

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Introduction

The proximal tibia fractures accounts for 5-11% of all tibia fractures. Fractures of the proximal tibia can be quite challenging to manage. They are notoriously difficult to reduce, align and stabilize and are prone to develop wound infections. Several different methods have been described for the treatment of these fractures. Conventional methods of treatment of proximal tibial fractures are commonly associated with the problems:

- Closed reduction and cast application and other conservative treatment -knee stiffness, prolonged treatment and mal-union.
 - Interlocked nailing- biomechanically not suitable.
 - Fixation with screws -inadequate fixation and residual deformities.
 - open conventional plating -wound infections and skin necrosis, extensive soft tissue dissection
 - External stabilization with pins and rods- pin site infections, septic arthritis of knee joint and arthritis.
- Recent developments by using minimally invasive percutaneous plate osteosynthesis technique have led to improvement in the results of treatment of these fractures. These include:
- Indirect reduction technique.
 - Preservation of soft tissue and vascularity of the bone.
 - Preservation of the osteogenic hematoma.
 - Improvement in the quality of the fixation with angular stable plates.

Indirect reduction and minimal invasive percutaneous fixation appear to have a proven value in the management of these fractures. Key to success includes early surgery, preservation of the biological healing potential and careful attention to surgical details.

The aim of the study was to evaluate the result of proximal tibial fractures with minimal invasive percutaneous plate osteosynthesis and to assess the clinical, radiological and functional outcome of the same.

Material and Methods

The present study was conducted in the Department of Orthopaedics, during the period of August 2013 and August 2015. The design of study was prospective cohort study.

This study included 32 patients with the fracture proximal tibia of the patients and age of patient ranging from 20 to 75 years. The aim of the study was to evaluate the results of proximal tibial fractures with minimal invasive percutaneous plate osteosynthesis and to assess the clinical and radiological outcome of the same.

Patients between 20 – 75 years of age were included, patients with unilateral, closed, widely displaced extra-articular proximal tibial fractures up to Grade-I compound were included. Patients with displaced medial unicondylar fractures, medially tilted bicondylar fractures, and patients who were painless, ambulatory (without support) and squatting before trauma.

Patients with open fractures more than Gustillo and Anderson's grade I, Pathological fracture, Compartment syndrome or impending compartment syndrome, Poor skin condition/skin disorders, Any knee deformity, Surgery on ipsilateral knee, Associated any other fracture in ipsilateral tibia, History of arthritis, Non ambulatory patient, Any medical contraindication to surgery were excluded.

A thorough examination of the affected limb with examination of the neighbouring joints was done. Special attention was given regarding the neurovascular status of the limb. Detailed general and systemic examination of the patient was done. Immediate posterior splinting of the limb was done with plaster of Paris slab and elevated. These patients were subjected to radiological evaluation to know the type of fracture. Pre anaesthetic check-up of all patients were done and taken for surgery only after the final fitness by anaesthetist, also the cardio-respiratory evaluation was done.

Observation and Results

Out of 32 patients, the eldest patient in our study was 75 year old whereas youngest patient was 20 year old. The mean age of all patients was 42.31±14.35 year. However, 53.2% of our patients were from 31-50 age group. The male gender was predominantly (91%) forming the sample size where as 9% females in the sample size. 27 patients had fracture due to road traffic accident, 1 had due to fall from height, 1 due to assault and 3 patients due to slip and fall. 2 patients had

associated femur fracture and 30 patients did not have any associated injury. 31 fractures were simple (closed) fracture and 1 was Compound Grade 1. There were 7 patients with 41A2, 6 with 41A3, 3 with 41B1, 1 with 41B2, 1 with 31B3, 8 with 41C1, 4 with 41C2, and 2 with 41C3 type of Fractures respectively.

AO type A was in 13 patients whereas B and C type fracture were in seen in 5 and 14 patients respectively. Out of all type C1, A2 and A3 were the most common type of fracture in (65%) patients.

8 patients were managed with fixation with lateral buttress plating, 12 patients with fixation with medial buttress plate, 6 with medial plate with lateral canulated cancellous screw, 1 with lateral buttress plate with medical canulated cancellous screw, and 5 with medial and lateral buttress plating. 62.6% of patients were managed with Buttress plating, 9.4% of patients were managed with L plate and 28.1% of patients were managed with T – plate. 22 patients were managed with locking plate and 10 patients were managed with non – locking plate. There are disadvantages of these locking plate are costly, removal of plate is difficult, Plate cannot be contoured according to special need Locking head screws gives false feeling of the hold, Lag effect cannot be given, in proximal tibial locking plates the peroneal nerve is at risk when used through the lateral approach. 2 Patients had superficial infection and 1 had deep infection.

Rasmussen clinical and radiological scores were used to express the result at the end of last follow up which is basically based in functional improvement and radiological parameters. Good results were observed in 26 patients whereas 5 had excellent, 1 showed fair and 1 showed poor result.

Rasmussen clinical and radiological criteria was calculated and plotted over chart with rasmussen clinical minimum and maximum score 14 and 24 respectively with standard deviation of 2.699, and rasmussen radiological minimum and maximum score 12 and 18 respectively with standard deviation of 1.897. There were 2 cases of implant related problems. Screw back out was seen in 1 patient. Screw back out with loosening of hardware seen in another patient. The patient with loosening of implant also had deep infection. In the present study, the range of knee flexion was 100 to 146 degrees, with a mean flexion of 136 degrees. Out of 32 patient 31 patient had no extension lag only 1 patient had extension lag more than 10 degree who had showed poor compliance to pain and physiotherapy

Other than infection other complication included, delayed union(2) varus deformity(1), post traumatic arthritis in 2 patients. No complications like Compartment syndrome, DVT, Iatrogenic foot drop and Avascular necrosis. Out of 32 patients 12 patient had radiological union at 12 weeks with average time for union was 15 weeks. Majority of our patients 75% started started walking in 18-20 weeks.

Discussion

Opinions are still divided regarding the appropriate management of the proximal tibial fractures. All the techniques have their merits and demerits. Minimally invasive plate osteosynthesis technique (MIPPO) in the management of properly selected proximal tibial fractures has an upper hand over other methods.

In the present study 32 patients were treated with MIPPO technique for proximal tibial fractures. Out of 32 patients 29 (90.6%) were male and 3 (9.4%) were female. According to the epidemiological study by Kretekk et al¹ and Koval et al² there was male preponderance.

The eldest patient in our study was 75 year old and the youngest was 20 year old. The mean age was 41.3 years. Maximum numbers of patients were from the age group between 31 and 40 years. As this age group is the mostly male from this age given were mostly the earning member of the society and engaged in outdoor occupation e.g., driver, labour, farmer etc., and hence are more vulnerable to road traffic accidents. According to Joon-woo kim et al³ out of 30 patients of proximal tibia fractures the mean age was 44.4 years in the range of 24-69 years.

The mode of injury was road traffic accidents in 27(84.4 %) cases followed by slip and fall in 3 (9.4%) and fall from height in 1 (3.1%) cases and a case (3.12%) of direct injury (assault). Monappa et al⁴ also described in their study of 49 tibia fracture 41 were due to road traffic accidents and 6 were due to fall from height

Most of our patient had type A 13 patients, type B were 5 and 14 patients in type C fracture, out of which 96.9% (31) were closed and 3.1%(1) was of compound grade I. These are similar to studies by Oh et al⁵ who observed in 23 fractures, there were 13 type A, 5 were type B and 5 type C out of 23 fractures. There were four open fractures (grade I- 3, grade III A-1 case). In our study we have included open fractures only up to grade I as higher grade of open fractures are associated with increased chances of deep infections and subsequent implant failure. Radiographic classifications of the fractures have been hallmark of the injury severity assessment. Fractures of the same group are similar in mechanism of injury and require similar approach in their treatment and also behave similar in prognosis. The AO classification is unique as it classifies fracture in such a way that they organize fractures in the ascending order of the severity. Types A generally are less severe than Type B, and Type C fractures have greatest severity. This system has been followed by most of the investigators. G thiruvengita Prasad et al⁶ used Schatzker type of classification in their 43 patients.

In our study all of the patients have used stainless steel T and L buttress plates in all 32 patients for the surgery. Nithyananth et al⁷ using T-plate or L-plate minimally invasive percutaneous plating of tibial plateau fracture found good result. This study describes the use of non-angled stable implants for MIPPO of proximal

tibial fractures through only on the medial side. All five patients had excellent result and concluded that the use of buttress plates for MIPPO of selected proximal tibial fractures can result in outcomes comparable to angled stabled implants. Kankate et al⁸ also used T and L buttress plates for the MIPPO.

We have used proximal tibial locking plates in 22 (68.8%) of patients. The main advantages we observed of locking compression plates for proximal tibial are that the plate can be used in patients with diminished bone quality and better angular stability. Gonzalez et al⁹ also described that plate can be used with severe soft tissue damage as the plates are considered to preserve the periosteal blood supply and so reduced need for bone grafting.

In addition to the medially inserted percutaneous screws and plate, in 15/32 cases we have used additional 6.5 mm cc screw from lateral side to fix the lateral condylar fragment. According to Sirkin et al¹⁰, once the anatomic reduction of the articular surface has been verified, percutaneous screw placement acts as an adjunct to percutaneous plate. A lag screw and washer is placed at the apex of the condylar fracture to provide a buttressing effect and prevent axial displacement of the condyle.

The menisci were not visualized. No meniscal or ligamentous injuries were treated operatively in our study. None of the patient in our study appeared to have symptoms related to the residual abnormalities of the meniscus, and none had subsequent operation for the meniscal injury. According to Marsh et al¹¹ meniscal injury is uncommon after simple condylar fracture. Moore et al¹² found no difference in laxity between the injured and the non-injured knees of 208 patients at least 1 year after the fracture.

The average time for union was 15 weeks (range of 12-20 weeks), although 12/32 patients had radiological union at 12 weeks. Raiturker and Salunkhe¹³ had a union in a range of 16-20 weeks, Singh et al¹⁴ had union at 21 weeks and Ha et al¹⁵ had union at 13.7 weeks. In present study we observed delayed union was observed in 1 patient, who had metaphyseal comminution and was of grade I compound injury. In this case PRP (platelet rich plasma) injections were given up to 6 months after the surgery for bony healing. The fracture united eventually. None patient required bone grafting. Also there was no case of non-union. In the series of Collinge et al¹⁶ bone grafting was carried out in 6 patients, 4 of which had a significant bone loss, which most likely would have delayed healing regardless of the implant or technique used.

In the present study, the range of knee flexion was 100 to 146 degrees, with a mean flexion of 136 degrees which is comparable with the other studies by Kretekk et al¹, Kankate et al⁸, and Ha et al¹⁵ in which they observed 136, >130 and 136 degrees of knee flexion respectively at final follow up. In our study average extension lag (range -0 to -10 degrees) was -2.3 degrees which is

comparable with other studies by Kretek et al¹, Kankate et al⁸.

We analysed our results at the last follow up using the parameters of post-operative resumption of function and radiological findings. The results were assessed as per the Rasmussen's clinical and radiological scores¹⁷. Out of 32 patients, 2 (6.25%) had excellent, 26 (81.25%) good, 3 (9.37%) fair and 1 (3.12%) poor clinical score. Rasmussen's Radiological Scores in present study were 5 (15.6%) excellent, 26 (81.3%) good, and 1 (3.12%) poor. The Rasmussen's clinical score was between the ranges of 14 to 24, with mean score of 20.06. Rasmussen's radiological score was in the range of 12 to 18. The mean radiological score was 14.88. Our results were comparable with the study of Lee et al¹⁸. Other

investigators who got results with different other scoring systems are given in the table no D3.

According to Tilley et al¹⁹ outcome scoring is vital in the accurate evaluation of interventions around the knee. The most commonly used scoring systems quoted in the literature include the WOMAC, the Hospital for Special Surgery (HSS) knee score, knee society scores, Rasmussen and Iowa scores. The Rasmussen and Iowa scores address fractures around the knee specifically. The Rasmussen score, described in 1973 assesses subjective complaints of pain and walking capacity and clinical signs of knee extension, range of movement and stability. It has additional advantage of radiological assessment also.

Different scoring system used by investigators

Investigator	Scoring system used	Mean score
Nithyananth et al ⁷	Rasmussens score	Clinical- mean 28.6 Radiological – 16
Egol et al ²⁰	WOMAC scores	91
Lee et al ¹⁸	Rasmussens score	Clinical- mean 25.6 Radiological – 16
Kankate et al ⁸	Rasmussens score	Clinical- mean 28 Radiological – 17
Keogh et al ²¹	Rasmussens score	Clinical- mean 28.6 Radiological – 16
Cole et al ²²	Knee society score	139
Pasa et al ²³	IKDC (International Knee Documentation Committee) score	67
	Lasinger score	24
Kim and Min ²⁴	IOWA knee	89.1
Our study	Rasmussens score	Clinical- mean 20.6 Radiological – 14.88

Two (6.3%) of our patients had superficial infection. First patient had uncontrolled diabetes mellitus; he stopped taking prescribed oral hypoglycemic after discharge from the hospital. The culture reports revealed Staphylococcal aureus, which healed with daily dressing and responded to IV Vancomycin, expect case of diabetes which required implant removal after fracture union. In one case reason for the superficial infection couldn't be explained. 1 (3.12%) patient developed deep infection which was a case of grade I compound. Patient was treated with culture specific intravenous antibiotic and later on after fracture union the implant was removed. Cole et al²² reported 9 (11%) cases of superficial infections and a case of seroma. Raiturker and Salunkhe¹³ also reported 10% superficial infection rate in their series.

In our study none of our patient had rate of deep vein thrombosis and compartment syndrome after the surgery. Patients were closely observed for the deep vein thrombosis and compartment syndrome clinically. They were encouraged to do static exercises

and breathing exercise to reduce the risks and complications of DVT. It could be because by this technique, the surgical insult to the surrounding tissue and vessels is limited and thus predisposes to better muscular function and blood flow. Barei et al²⁵ reported 2% rate of compartment syndrome and 20% rate of DVT diagnosed on Color Doppler examination.

One (3.12%) out of 32 healed with varus of 6 degrees, none complained of functional instability. In rest of the cases assessment of the fracture in terms of varus and valgus deviation indicated appropriate alignment. Lee et al¹⁸ reported 1, Oh et al⁵ reported 2 and Cole et al²² reported 7 cases of varus angulations more than 5 degrees. Cole et al²² stated that post-operative malalignments are due to unfamiliarity with the closed reduction techniques. To reduce the rates of malalignment it is important to have good intraoperative radiographs. Honkonen²⁶ observed that 69% of patients with more than 10 degrees varus or valgus deformity after surgery had OA at the end follow up. Lasinger et al²⁷ reported varus or valgus

instability of knee on clinical examination was necessary for poor outcome.

Implant related problems were observed in 2 patients. Screw back out was seen in 1 patient, loosening plate and screw with hardware prominence

It was observed that with MIPPO technique there was no reported foot drop post operatively in various series **Krettek et al¹**, **Kanake et al⁸** And **Lee Et Al¹⁸**. However with the implant inserted through a lateral approach has a potential risk for injury to the superficial peroneal nerve.¹

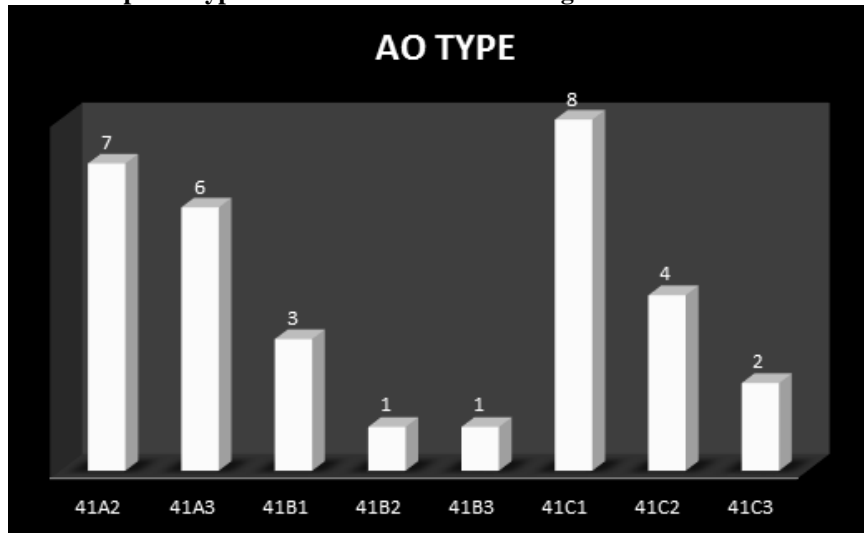
In the present study there was no case of avascular necrosis of the tibial condyle. 3 cases of avascular necrosis were reported by **Schulak et al²⁸** in their study.

seen in another patient who was associated with deep infection. Both of these patients underwent implant removal after union of the fracture. **Cole et al²²** reported 4 cases of hardware irritation. **Nithyananth et al⁷** also reported 1 screw back out.

Conclusion

Minimally invasive percutaneous plate osteosynthesis offers a good treatment option for the proximal tibial fractures. A MIPPO provides a fast and good functional recovery so that patient can get back to their normal life as soon as possible. With our experience of present study we recommend this as an effective option, though careful technique and patient selection are crucial.

Graph 1: Type of Fractures based according to AO Classification



Graph 2: Fixation with type of Implant

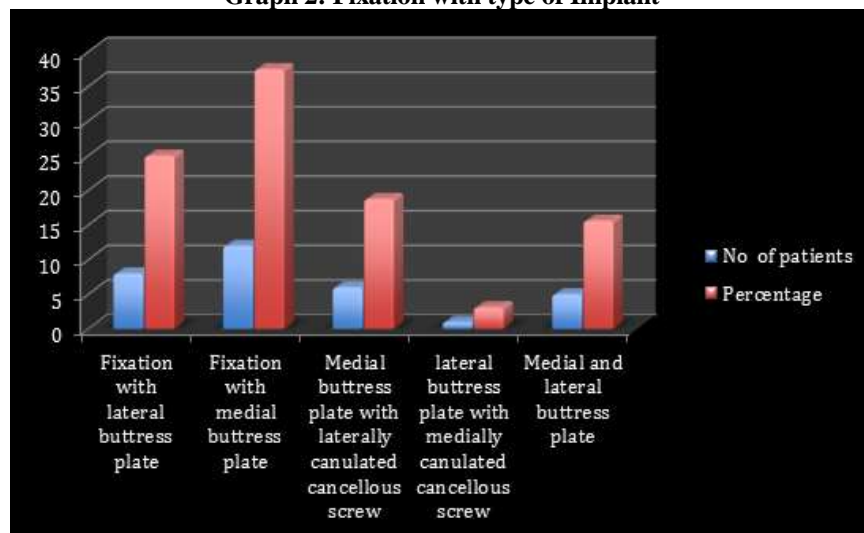


Table 1: Rassmussen Clinical Score

Range	Results	No of patients	Percentage %
18	Excellent	5	15.6%
12-17	Good	26	81.3%
6-11	Fair	0	0%
<6	Poor	1	3.1%

Graph 3: Rassmussen Clinical and Radiological Score

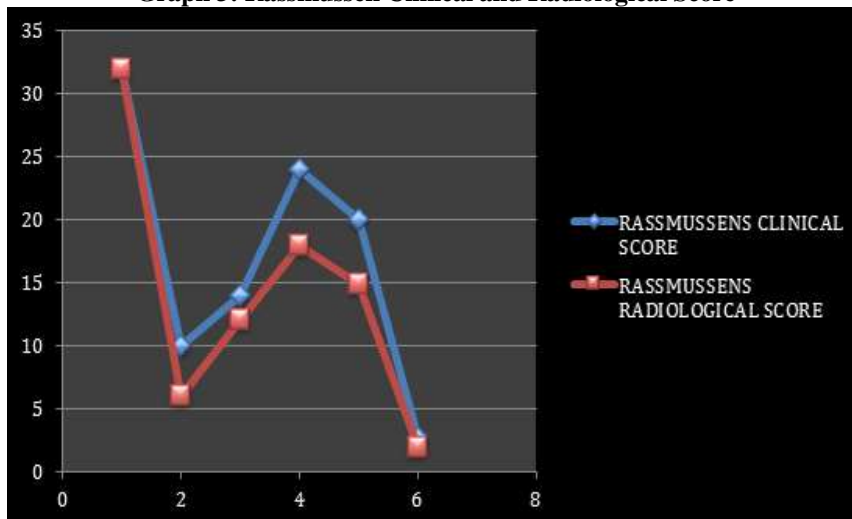
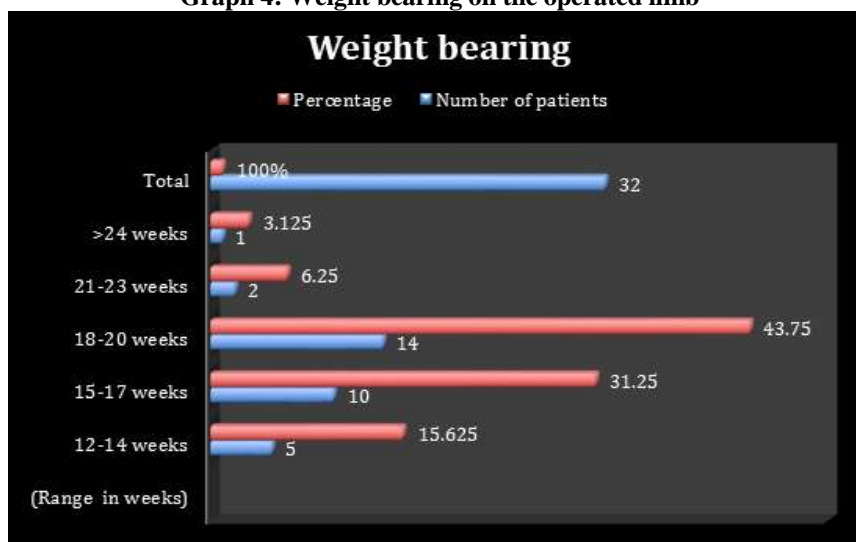


Table 2: Range of Movements

Range of movement	No of patients	Percentage
<100	-	-
100—110	3	9.37%
111-120	1	3.12%
121-130	6	18.75%
131-140	17	53.12%
141-150	5	15.63%

Graph 4: Weight bearing on the operated limb



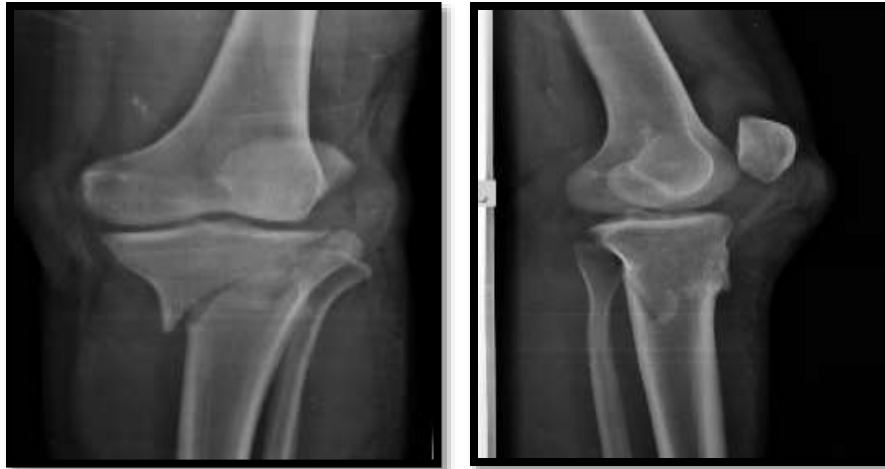


Fig. a & b: suggestive of fracture proximal tibia (pre – operative X - ray)



Fig. c & d: immediate post – operative x – ray



Fig. e & f: 6 weeks follow – up x –ray



Fig. g & h: 12 weeks follow – up X – ray



Fig. i & j: Knee range of motion exercise at 18 weeks follow – up

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