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Ravishankar J
Assistant Professor, Department of orthopaedics, Sri Siddhartha Medical College, Siddhartha Academy of Higher Education University, Tumkur, Karnataka, India

Veeranna HD
Professor, Department of orthopaedics, Sri Siddhartha Medical College, Siddhartha Academy of Higher Education University, Tumkur, Karnataka, India

Yashavardhan TM
Junior Resident, Department of orthopaedics, Sri Siddhartha Medical College, Siddhartha Academy of Higher Education University, Tumkur, Karnataka, India

Madhusudan H
Junior Resident, Department of orthopaedics, Sri Siddhartha Medical College, Siddhartha Academy of Higher Education University, Tumkur, Karnataka, India

Correspondence
Veeranna HD
Professor, Department of Orthopaedics, Sri Siddhartha Medical College, Siddhartha Academy of Higher Education University, Tumkur, Karnataka, India

Functional outcome of distal third tibial fractures with intramedullary tibial locking nail and poller screws

Ravishankar J, Veeranna HD, Yashavardhan TM and Madhusudan H

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Abstract
Back Ground and Objectives: Tibia is the most commonly fractured long bone in the body with an annual incidence of Tibial shaft Fractures is 2 per 1000 individuals. Tibia is a large bone of the body and one of the principle load bearing bone in the lower extremity; Tibial fractures can cause a long morbidity and extensive disability unless treatment is appropriate. Various techniques are now available for the treatment of tibial fractures where the orthopedic surgeon must be aware of the advantages, disadvantages and limitation of each procedure to select the right choice of treatment for each particular patient. In case of tibial fractures the type; location; degree of comminution; age and patient's social and economic demand may influence the method of treatment. In distal tibia fractures; malunion and stiffness of joint are commonly encountered problems, due to which the use of non-operative treatment of widely displaced distal tibia fractures may result in poor functional outcome.
Hence the present study was undertaken to provide satisfactory functional outcome and to know the advantage and complications of the Tibial Interlocking nail with polar screws.
Materials and Methods: The present study was conducted in Department of Orthopaedics at Sri Siddhartha medical college, hospital and Research Center Tumkur during the period from August 2015 and July 2017. A total of 30 patients attending the hospital during the study period with closed distal third diaphyseal fracture of Tibia aged more than 18 years who were medically fit for surgery were included in the study.
Results: In this study, the mean age of patients with this fractures was 37.2 years and maximum patients were in the age group of 31-40 years. Males predominated in our study. Road traffic accidents are the main cause of fractures followed by fall.
In our series most of the cases were transverse fractures 13 patients (43.37%) followed by oblique fractures 9 patients (30%) and 8 patients with spiral fractures (26.7%). All the fractures taken into the account occurred at the distal tibial region.
Results were excellent in 93.3% of the patients, good in 6.67% with no fair and no poor cases as graded according to Klemm and Bornner criteria.
Conclusion: The method has a long learning curve but with the excellent results, the advantages of rapid rehablitation and relatively few complications recommends this procedure and technique for wider use of distal tibia fractures.

Keywords: Distal third tibial fractures, intramedullary interlocking nails, Poller screws

Introduction
Tibia is the most commonly fractured long bone in the body with an annual incidence of Tibial shaft Fractures is 2 per 1000 individuals. Tibia is a large bone of the body and one of the principle load bearing bone in the lower extremity; Tibial fractures can cause a long morbidity and extensive disability unless treatment is appropriate. Various techniques are now available for the treatment of tibial fractures where the orthopedic surgeon must be aware of the advantages, disadvantages and limitation of each procedure to select the right choice of treatment for each particular patient. In case of tibial fractures the type; location; degree of comminution; age and patient"s social and economic demand may influence the method of treatment. In distal tibia fractures; malunion and stiffness of joint are commonly encountered problems, due to which the use of non-operative treatment of widely displaced distal tibia fractures may result in poor functional outcome.
Muller[1] defined the distal tibial metaphyseal region by constructing a square with the size of length defined by the widest portion of the tibial plafond within 4 cm of the tibial plafond to be

distal metaphyseal injuries and defined non articular fractures as those with no or simple extension of a non-displaced fracture line into the plafond. From the diaphysis to the distal metaphyses the tibia transitions from a triangular to rounded shape.

The traditional treatment of tibia fractures has been long term immobilization in plaster of paris cast and functional cast brace which in itself is a invitation to well known "fracture disease".

Distal tibia fractures can be managed with the help of (1. Operative 2. Non operative) techniques. In operative procedures we have methods of external fixation and internal fixation. In external fixation procedures we have application of Illizarov method for fixation of the fracture by using a construct made of rings and different type of rods for fixation; on the contrary in internal fixation we have different systems of fixation of distal tibia fractures like using different plates and screws or with different nailing systems. In my study I intend to concentrate on treating distal tibia fractures in the metadiaphyseal and diaphyseal region with the help of various forms of interlocking nails like the multiple criss-cross expert nail and the standard two holed distal tibia interlock nail and the advantages of using these methods in general for treatment of fractures of distal tibia.

Management of fractured tibia requires the widest experience, greatest wisdom and best of clinical judgment in order to chose most appropriate treatment for a particular pattern of injury. (Watson & Jones) [2]

Methods

The present study was conducted in Department of Orthopaedics at Sri Siddhartha medical college, hospital and Research Center Tumkur during the period from August 2015 and July 2017. A total of 30 patients attending the hospital during the study period with closed distal third diaphyseal fracture of tibia aged more than 18 years who were medically fit for surgery were included in the study.

Methodical examination was done to rule out fractures at other sites. Local examination of injured tibia revealed swelling, deformity, abnormal mobility, crepitus, shortening, and loss of function. Any neuro vascular injury was looked for and noted.

Radiographs of the Tibia i. e., anteroposterior and lateral views, were obtained. The Knee and ankle joints were included in each view. The limb was then immobilized in above knee Plaster of Paris slab. The patient was taken up for surgery after the thorough pre operative work up including routine investigation.

Pre operatively the length of the nail is calculated by subtracting 3 to 4 cm from measurement taken from the knee joint line to tip of the medial malleolus clinically and medullary canal is measured at the isthmus on X-rays.

Surgical Technique

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

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

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

Further follow up is done at 6 weekly intervals i.e,. at 12 and 28 weeks and each patient is individually assessed clinically and radiographically according to the proforma.

Aims and Objectives

1. To study the management of distal tibia fractures with different types of interlocking nails.
2. To study the advantages and disadvantages of treating distal tibia fractures with interlocking nail.
3. To study the functional outcome of management of distal tibia fractures with interlocking nails.

Inclusion Criteria

1. Both males and females
2. Type of fractures: All closed fractures
3. Distal third extra articular tibial fractures including fractures at the diaphyseal and metadiaphyseal region.
4. Patient willing to follow treatment protocols and follow up protocols

Exclusion Criteria

1. It excludes patients of age < 17 years and more than 65 years.
2. Types of fractures:

a. Compound fractures and open injuries
b. Metadiaphyseal fractures of distal tibia with a displaced or undisplaced line extending into the ankle joint (intraarticular Pilon Fractures).
c. Segmental loss of bone.
d. Pathological fractures.
e. Patients who died during admission, post injury or patients who are unable or unwilling to give consent or were unable to follow treatment protocols.

Results

Age Distribution

Majority of the patients are from aged group 31-40 years (36.7%). The youngest patient was 17 years old and the oldest patient was 65 years.

Sex Distribution

Majority of the patients are male (73.3%) and only 26.7% are female patients.

Side Affected

Right side tibial fracture constitutes majority of patients 18 (60%) in our study.

Mode of Injury
Major causes of fracture in our study was road traffic accidents 83.3%.

Type of the fracture
The predominant distal tibial fracture pattern was transverse 43.3%. In our study according to O.T.A classification. The predominant type of fracture pattern was type A-III (46.67%). According to Tscherne type the majority of the cases were C0 and C1 (93.04%)

Duration of Fracture Union
In our study 12 patients 40% the time taken by the fracture to unite was 20 weeks. The range of time taken for the fracture union in our study was between 4 to 6 months.

Commencement of Pwb: In our study most of the patients were mobilized (NWB crutch walking / walker) on next day. In most of the patients partial weight bearing was started between the 4th and 6th week. (93.4%)

Commencement of Full Weight Bearing.
17 patients were commenced to protective full weight bearing at 10 weeks post operatively.

Secondary Procedure
In our study 6.7% of the patients required secondary procedure in the form of dynamisation. This included 2 patients out of the total series of 30 patients.

Type of Nail Used and Use of Poller Screws
In our series 60% of the patients (18) were treated as a multiple criss-cross expert nail and 40% (12) were treated with the help of standard Indian stainless steel distal tibia nail.

Postoperative complications
The infection rate in our study was 6.7% (2 patients) which included 2 superficial infections. Superficial infections healed by dressings and antibiotics. Anterior knee pain was seen in 2 patients (6.7%). In 1 patient was nail was abutting the Pateller Tendon and tibial tuberosity. The cause for knee pain in another patient could be hetrotrophic ossification of the patella tendon. 1 patient developed ARDS and 1 patient suffered F. E. Syndrome in our study. 86.7% of the patients in our study had no complications.

Functional Results
Detailed analysis of function of the patient was done on the basis of the following criteria by KLEMM and BORNER[3].

Excellent
Full knee and ankle motion.
No muscle atrophy
Normal radiographic alignment

Good
Slight loss of knee and ankle motion (<25º)
Less than 20 mm of muscle atrophy
Angular deformity (< 5º)

Fair
Moderate (25º) loss of knee (or) ankle motion
More than 2 cm of muscle atrophy
Angular deformities (5-10º).

Poor
Marked loss of knee or ankle motion (> 25º)
Marked muscle atrophy
Angular deformities (> 10º)

The results of the functional outcome was as follows:

	No. of cases
Excellent	28
Good	2
Fair	0
Poor	0

Discussion
This study includes 30 patients who were admitted to the orthopedic wards of Sri Siddhartha medical college. This group of 30 patients comprising male and females patients in the age group of 17-65 years were included in the study.
In our study; the fractures were fresh closed metadiaphyseal and diaphyseal fractures of distal tibial region treated with intramedullary interlocking nail.

Age incidence
In our study the majority of the patients were in the age group of 31-40. There were 11 patients in the age group. The average age of the patients in our study was 37.23 years. Tibial fractures in the distal third region were seen in the younger age group as they are the persons who are physically active and were engaged in increased various outdoor activities and as a result most of the injuries sustained were high velocity injuries.
Court Brown *et al.* [4] (1990) noted the average age to be 32.4 years. Average age was seen to be around 37 years in a study by Court Brown *et al.* in 1995 in a study titled "The Epidemiology of Tibial Fractures".
Our series with an average of 37.23 years is comparable to other series with the respect to the average age of the patient in the fractures of tibia.

Sex Incidence
In our series males predominated females. There were 22 male patients (73.3%) and 8 female patients (26.7%). The incidence of males is higher because of their more outdoor activities; while women majorly confine themselves to domestic activities.
Court Brown *et al.* [4] (1990) in their series noted the male incidences to be around 81.3 % while the female incidence to be around 18.7%.
Our series of 73.3% males; the incidences are slightly lower when compared to above other workers series whereas 26.7% females in our study is a higher when compared to workers series.

Mode of Injury
In our series we have found that majority of distal tibial fractures occurred due to road traffic accidents (25 patients). In majority of patients they involved patients who were the moderest while remaining patients tended to be pedestrians or motor vehicle occupants. The incidence of fracture due to road traffic accident seemed to be higher in our series (83.3%) as compared to Court Brown *et al.* (1995). In whose series the incidence was around 37.5%. But in this series also the commonest mode injury was R.T.A. followed by sports injuries. Our series results can be attributed to poor road traffic sense and poor qualities of roads leading to higher

incidence of road traffic accidents in our country.
Lawrence B Bone *et al.* [5] (1986) reported in a series (90%) incidence of R.T.A. in tibial fractures.
Hooper *et al.* [6-8] (1991) reported a 59% incidence in his series.

Type of Fracture
In our series type A fractures were the commonest according to O.T.A classification. They constituted (96.67%) 29 patients type A fractures are unifocal fractures and in our series the subtype A-III fractures constituted (46.67%) 13 patients which is comparable to the series of Court Brown *et al.* (1995) who found the type A accounted for 54% of all tibial fractures.
Our series had a higher incidence of transverse fractures in 43.3% cases (13 patients) and oblique fractures constituted 20% (9 patients) and spiral fractures 26.7% (8 patients) respectively. Transverse and oblique fractures made up 73.3% of our cases (22 patients).
This is comparable to Senkarsan Patro *et al.* [6 5] (1995). In whose series; there were 59% fractures, Court Brown *et al.* (1995) reported 37.2% and Arne Ekelend62 (1988) reported 42% of transverse and oblique fractures.

Preoperative; Operative and Nailing procedure
In our series we had 30 closed distal tibial fractures with Tscherne C0 fractures in 14 patients and Tscherne C1 fractures in 14 patients and Tscherne C2 fractures in 2 cases.
All the fractures were operated after 2 days to maximum of 7 days after injury. The causes of delay for surgery included associated systemic illnesses like aenemia, hypertension and diabetes.
In our series; we have used intramedullary interlocking nails like the expert tibial nail and the distal tibial nail ranging from 8 mm to 10 mm in diameter and from 300 mm to 380 mm in length.
28 reamed and 2 unreamed closed intramedullary nailings were done in our studies.
Christie [9] (1986) noted embolic phenomenon during nailing. In our series we have come across 2 patients who developed symptoms of ARDS and F.E. syndrome postoperatively.
Postoperatively in our studies; 2 patients developed complications like fat embolism and ARDS. There were no cases of compartment syndrome, neurological or vascular injury, superficial infections occurred in 2 patients at the site of surgical incidence over the knee joint which were treated by dressings and antibiotics.
In majority of our patients active hip, knee and ankle movements and quadriceps exercises were started on the first post-operative day. Majority of patients were mobilized with the help of a walker from the second or the third post operatively without bearing weight on the operated leg. Suture removal was done at 12 days in all the cases. Complete relief of pain was seen in the majority of patients by 10-12 days.
Follow up was done at the 4th, 6th, 10th, 12th, 16th, 20th week and 6 months.
At follow ups clinical and radiological assessment was done regularly with suitable follow up advice.
Depending upon the type of fracture and stable fixation partial weight bearing was started in our series. Partial weight bearing was started in majority of patients 93.4% (28 patients) between 4th and 6th weeks.

Full Weight Bearing
FWB in our series was started at the 10th week in 56.7% (17 patients), 12th week in 23.37% (7 patients), 8th week in 13.3% (4 patients) and 14th week in 6.63% (2 patients).
The appearance of bridging callus was used to assess and allow patients full weight bearing. The average time of full weight bearing was 10.46 weeks.
Gross and Kempf [10] (1991) allowed full weight bearing at 8.5 weeks.
28 patients in our series (93.3%) recovered and got normal knee, ankle and subtalar joint movements.
In 2 patients there was restricted mobility of knee, ankle and subtalar joint movements.

Fracture Union
Fracture union was considered when patient was full weight bearing without pain, fracture site was not tender on palpation and radiographical showed osseous union.
In our series majority of fractures united within 20 weeks 40% (12 patients). The average time of union was 20.47 weeks. This is comparable to Anglen J. O *et al.* 70 (1995) where 22.5 weeks was the average union time.
Lawrence B Bone *et al.* [5] (1986) reported average union time at average weeks.
Court Brown *et al.* [4] (1990) reported average union time at 16.7 weeks.

Functional Outcome
Final assessment in our series was done at 6 months using Klemm and Bornner criteria taking into account the range of motion at the knee, ankle and subtalar joints, muscle atrophy, radiographic alignment, any other deformity, shortening and presence of radiological union. Functional outcome was graded into excellent, good, fair and poor. In our study 28 cases (98.33%) were graded as excellent and 2 cases (6.67%) as good cases with no fair and no poor cases.
Klemm *et al.* [11] (1986) reported in a study 62.50% excellent, 31.8% good, 4.5% fair and 1.2% poor result.
Arne Ekeland *et al.* [12] (1988) reported 64.4% excellent, 28.8% good and 4.4% cases as fair.

Conclusion
We conclude
- Distal tibial fractures are common seen in physically active young individuals and seen as a result of road traffic accidents.
- The interlock nailing combines control of length, alignment and rotation and preserves periosteal blood supply some amount of endosteal blood supply and with biological osteosynthesis lowers the rate of infection and malunion The advantage of locking screws over conventional method reduces the rate of malunion, loss of alignment, angulation and shortening which are commonly found in plaster cast or functional brace. The addition of locking screws extends its indications to within 5 cm of ankle joint in distal tibial fracture.
- The method of treatment employs closed intramedullary interlock nailing to stabilize both principle fragments on the nail is an excellent method for simple close fractures and also fractures with comminution.
- Patients operated with this technique can be ambulated early and they can resume work as early as tolerated and this procedure reduces hospital stay and boosts up the morale of the patient. The method of intramedullary interlocking nail is ideal for fractures of the distal tibia

because of excellent results (93.3%) which is comparable to other workers series.

- The method has a long learning curve but with the excellent results, the advantages of rapid rehablitation and relatively few complications recommends this procedure and technique for wider use of distal tibia fractures.

Age Distribution

Table 1

Age group (yrs)	Frequency	Percent
11 - 20	4	13.3
21 - 30	6	20.0
31 - 40	11	36.7
41 - 50	4	13.3
51 - 60	4	13.3
61 - 70	1	3.3
Total	30	100.0

Sex Incidence

Table 2

Sex	Frequency	Percent
Female	8	26.7
Male	22	73.3
Total	30	100.0

Side of Fracture

Table 3

Involved_limb	Frequency	Percent
Left	12	40.0
Right	18	60.0
Total	30	100.0

Mechanism of Injury

Table 4

Mode_of_injury	Frequency	Percent
Fall	5	16.7
R.T.A.	25	83.3
Total	30	100.0

Type of Fracture

Type_of_fract	Frequency	Percent
oblique	9	30.0
Spiral	8	26.7
Trans	13	43.3
Total	30	100.0

Table 5

OTA_classification	Frequency	Percent
A1.1	1	3.3
A1.2	5	16.7
A1.3	1	3.3
A2.1	1	3.3
A2.2	3	10.0
A2.3	4	13.3
A3.1	2	6.7
A3.2	4	13.3
A3.3	8	26.7
C3.2	1	3.3
Total	30	100.0

Table 6

Tscherne_Type	Frequency	Percent
C1	14	46.7
C2	2	6.7
Co	14	46.7
Total	30	100.0

Table 7: Duration of Fracture Union

Weeks	Frequency	Percent
18	7	23.3
20	12	40.0
22	8	26.7
24	3	10.0
Total	30	100.0

Table 8: Results

Results	No. of patients	Percentage
Excellent	26	81
Satisfactory	6	19
Unsatisfactory	-----	—
Failures	——	——

Complications

Table 9: Complications

	Frequency	Percent
ARDS	1	3.3
F.E.syndrome	1	3.3
Nil	26	86.7
Knee Pain	2	6.67
Sup.Inf.	2	6.7
Total	30	100.0

Table 10: type_of_nail_used

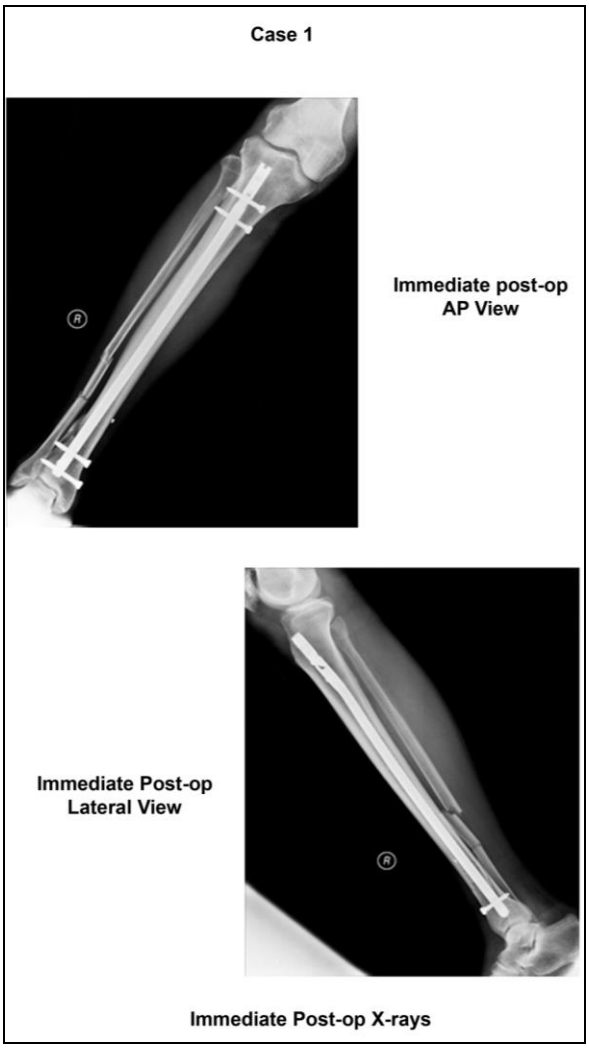
type_of_nail_used	Frequency	Percent
d.t.n.	12	40.0
expert	18	60.0
Total	30	100.0

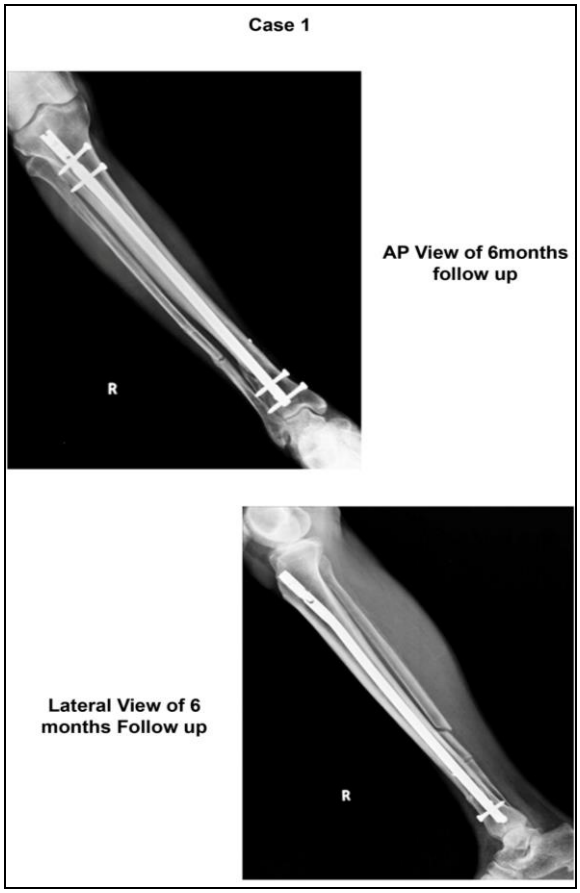
Table 11

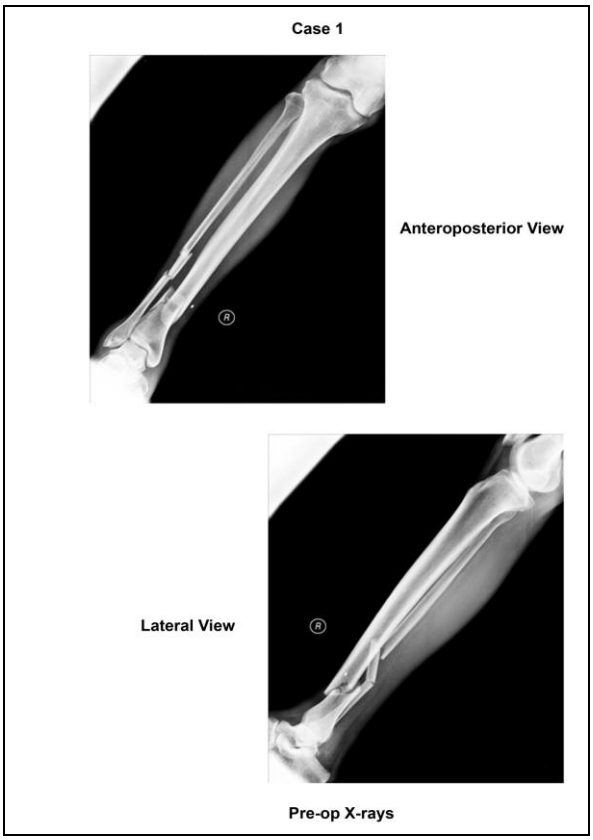
Poller_screw	Frequency	Percent
1	5	16.7
2	1	3.3
Nil	24	80.0

Photos

Case 1







Clinical Photos of Case No. 1

Good Plantar flexion

Good Dorsi flexion

Patient able to sit in squatting position

Case No. 2

Anteroposterior View

Lateral View

Pre-op X-ray

Case No. 2

Immediate Post-op AP View

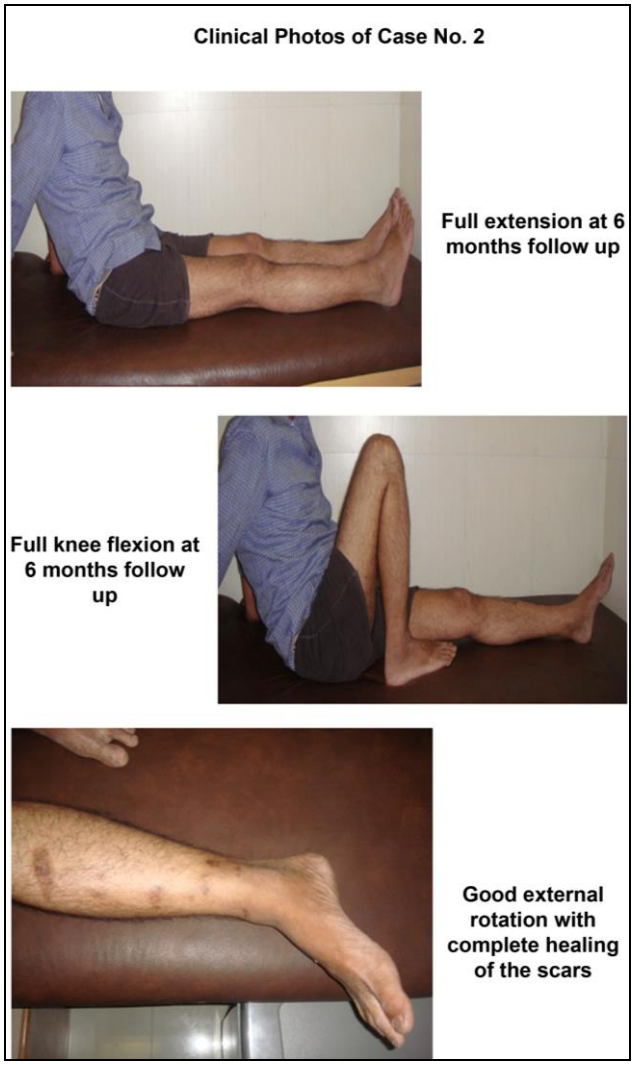
Immediate post-op Lateral View

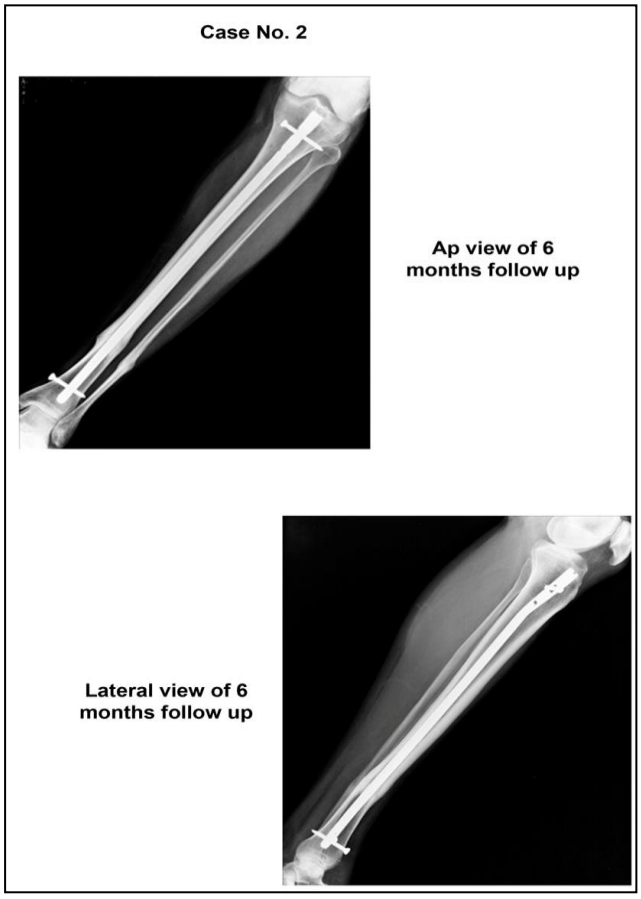
Clinical Photos of Case No. 2

Good internal rotation

Patient able to sit in cross legged position

Patient able to sit in squatting position





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