A PROSPECTIVE STUDY OF FUNCTIONAL AND RADIOLOGICAL OUTCOME OF EXTRA ARTICULAR DISTAL FEMUR FRACTURES TREATED WITH SUPRACONDYLAR NAIL

Dissertation Submitted to

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ORTHOPAEDIC SURGERY BRANCH II

DEPARTMENT OF ORTHOPAEDICS

GOVT MOHAN KUMARAMANGALAM MEDICAL COLLEGE

THE TAMILNADU DR. M.G.R MEDICAL UNIVERSITY

CHENNAI, INDIA

MAY 2020

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This is to certify that this dissertation entitled **"A PROSPECTIVE STUDY OF FUNCTIONAL AND RADIOLOGICAL OUTCOME OF EXTRA ARTICULAR DISTAL FEMUR FRACTURES TREATED WITH SUPRACONDYLAR NAIL"** Which is being submitted for **M.S. ORTHOPAEDICS,** is a bonafide work of **Dr. A.MANIVANNAN,** Post graduate student of the Department of Orthopaedics, Government Mohan Kumaramangalam Medical College Hospital, Salem, during the academic year 2017 -2020.

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He has completed the necessary period of stay in the department and has fulfilled the condition required for submission of this thesis according to university regulations. The study was undertaken by the candidate himself and the observations recorded have been periodically checked by us.

Recommended and Forwarded

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CERTIFICATE

This is to certify that this dissertation titled **"A PROSPECTIVE STUDY OF FUNCTIONAL AND RADIOLOGICAL OUTCOME OF EXTRA ARTICULAR DISTAL FEMUR FRACTURES TREATED WITH SUPRACONDYLAR NAIL "** which is being submitted for M.S. Orthopaedics, is done by **Dr.A.MANIVANNAN,** Post graduate student of the Department of Orthopaedics, Govt Mohan Kumaramangalam Medical College Hospital, Salem under my guidance.

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DECLARATION

I, Dr.A.MANIVANNAN, solemnly declare that this Dissertation tilted **"A PROSPECTIVE STUDY OF FUNCTIONAL AND RADIOLOGICAL OUTCOME OF EXTRA ARTICULAR DISTAL FEMUR FRACTURES TREATED WITH SUPRACONDYLAR NAIL"** is a bonafide work done by me at Govt Mohan Kumaramangalam Medical College, Salem from October 2017 onwards under the guidance and supervision of **Prof. C. KAMALANATHAN M.S., ORTHO, D.ORTHO, DNB,** Professor and Head of the Department, Department of Orthopaedics, Govt Mohan Kumaramangalam Medical College, Salem.

I have not submitted this dissertation to any other university for the award of any degree or diploma previously. This dissertation is submitted to The Tamilnadu Dr. M.G.R. Medical University, Chennai towards partial fulfillment of the rules and regulations for the award of **M.S Degree in ORTHOPAEDIC SURGERY (BRANCH – II)**

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KUMAR M.S., (ORTHO) D.ORTHO, DR. MOHAN KUMAR M.S., (ORTHO) D.ORTHO.

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LIST OF CHARTS

LIST OF ABBREVIATIONS

AO - ARBEITSGEMEINSCHAFT FUR OSTEOSYNTHESEFRAGEN

AP - ANTEROPOSTERIOR

ECG - ELECTROCARDIOGRAM

IV - INTRAVENOUS

RTA - ROAD TRAFFIC ACCIDENT

DVT - DEEP VEIN THROMBOSIS

UTI - URINARY TRACT INFECTION

ABSTRACT

Extra articular distal femur(supracondylar region of the femur) extends upto 15cm from the articular surface. The fractures in this part of the femur managed with retrograde femoral nailing in the study.

AIM : To study the functional and radiological outcomes of extra articular distal femur fractures manged by retrograde femoral nail.

MATERIALS AND METHODS: This is a prospective study of 20 cases of extra articular distal femur fractures in the age group 25-70 years admitted in Govt Mohan Kumarangalam Medical College Hospital, Salem during the period from October 2017 to September 2019. The cases were classified under OA OTA classification. Patients with Grade III Open Fractures,with associated with Vascular Injury and Fractures with Intra Articular Extension were excluded. Cases were reduced with closed/percutaneous and open methods as well. Neers's scoring system was used to assess the outcome

DISCUSSION: In our study, the mean age age group of the patient was 55 years with a female preponderance. Accidental fall, RTA were the commonest mode of injury and the mean operating tome is 82 minutes with average union at 15 weeks post operatively. Post operatively the knee flexion was around 100 degree in average. And 12 patients had excellent outcome with neer's score and 1 has been classified as failure due to non union.

RESULTS: Retrograde femoral nailing technique has yielded excellent results in our study for the management of extra articular distal femur fractures either after

closed or open reduction. Prompt selection of cases and fracture patterns is mandatory for achieving fair results.

INTRODUCTION

Fractures of the Distal femur are complex injuries that pose a challenge to the orthopaedic surgeon. It constitutes about 6 % of all femoral fractures[1]. There is bimodal distribution of fractures. Most high energy distal femur fracture caused by motor vehicle accidents, sports and pedestrian accidents occurs in male between 15 & 50 years; while in women above 50 years, with osteoporosis, fractures occurs due to low velocity trauma such as fall from standing height at home[2.]

Orthopaedists in the past have treated these injuries conservatively because these aren't amenable for surgical fixations due to their complex nature. In 1967 Neer et al treated supracondylar femur fractures and reported good results in 84% of those patients managed conservatively and only 52% good results in patients treated with internal fixation.[3] However he also pointed out the pitfalls of conservative treatment like angular deformities, loss of knee joint motion prolonged bed rest and its complications.

Butt et al. in 1996 suggested that operative treatment had threefold decreased risk for complications of immobilisation like DVT, UTI, Pressure sore and pneumonia.[4]

Various treatment options are

- Conservative management
- Osteosynthesis with plates and screws
- Intramedullary nailing
- External fixation

The goals of management of these fractures are

- Restore the length and alignment of the limb
- Achieve Stable fixation that allows rapid mobilization of knee joint
- Maintain the fracture biology and minimize the soft tissue problems

Mainstay of internal fixation for these fractures is either intramedullary nailing or plating.

Fixation with condylar buttress plating had a higher complication rates of varus collapse, non union, malunion and delayed mobilization.

Angular Blade plates and Dynamic condylar screws require removal of large amount of bone during their insertion, which makes revision surgery difficult. However the procedure is technically demanding, requires extensive soft tissue dissection and can lead onto wound infection and dehiscence.

Recently with the advent of locking plates which could be inserted through MIPPO techniques have decreased problems with fracture healing and infection. However achieving reduction, maintaining the length, axis and alignment of the limb may be challenging

Intra medullary nailing of the distal femur can be inserted with less invasive surgical approach and minimal soft tissue dissection than with plates. Being a load sharing device, it also offers the potential advantage of early weight bearing and thereby promoting early range of motion in knee joint.

The modern technique of retrograde nailing was first introduced in 1988 by Green with the introduction of the Green Seligson-Henry (GSH) supracondylar intramedullary nail.

AIM OF THE STUDY

The aim of the study is to analyse the functional and radiological outcome of extra articular distal femur fractures treated with retrograde femoral nail at Govt. Mohan Kumaramangalam Medical college Hospital, Salem between October 2017 to September 2019.

REVIEW OF LITERATURE

During the initial years, all the distal femur fractures were managed conservatively owing to the poor knowledge about the principles of internal fixation and complexity of the fracture personality.

in 1966, Mahorner and Bradburn et al study concluded that out of 308 femur fractures, 31 involving the distal third had poor results with only one case being classified as good.[13]

In a study by Modlin et al during 1966,who treated 23 distal femur fractures by skeletal traction, reported fairly good results by his method.[14]

Umansky et al[15], White and Russian[16] during the same year of 1966 used blade plates and their studies showed good results.

In 1991, Leung KS[17] et al used intramedullary nailing for supracondylar fractures and simple intercondylar fractures of femur. They reduced the intercondylar component through closed methods. Their study also stated that the conventional open surgical approaches for distal femur fracture requires considerable soft tissue dissection, which increased the complication like infection and nonunion.

Lucas et al study showed good results with average knee flexion ranging between 0-100 degree for supracondylar fractures treated with the retrograde intramedullary nail in 34 patients.[18]

in 1994, Iannacone WM et al studied 41 distal femoral fractures treated with retrograde intramedullary nailing and the average knee flexion achieved was 0-90

degree. They concluded that supracondylar nailing for distal femur fractures would require further clinical trials and biomechanical testing[19].

In 1995, Danziger MB et al study reports 94% excellent to good results. They used open reduction techniques and treated the fractures with supracondylar nail. It embraces that the supracondylar nail is an excellent alternative for plate in the treatment of supracondylar and intercondylar femur fractures[20].

In the year 1995, Henry SL et al discussed about the usage of retrograde nail for management of supracondylar femur fractures above total knee arthroplasty. Due to the biomechanical stability, minimal complications encountered in the study, he reported the implant to be a competent option for the extra articular distal femoral fractures.[30]

Cadaveric study done by Firoozbaksh K during 1995 compared the mechanics of retrograde nailing versus plate fixation and showed that retrograde nailing had rigidity comparable to plating[32].

In 1998, The study of Scheerlinck T et al depicts that the distal femoral fracture healed within 2 to 7 months without any complications when treated with supracondylar nail in a group of 16 patients.[33]

In 1999, Leibner FD et al when treating the distal femoral fractures with retrograde intramedullary nailing had no major complication except in a case where there was fracture at the proximal end of retrograde intramedullary nail, might be due to the stress riser effect from the proximal end of nail.[34]

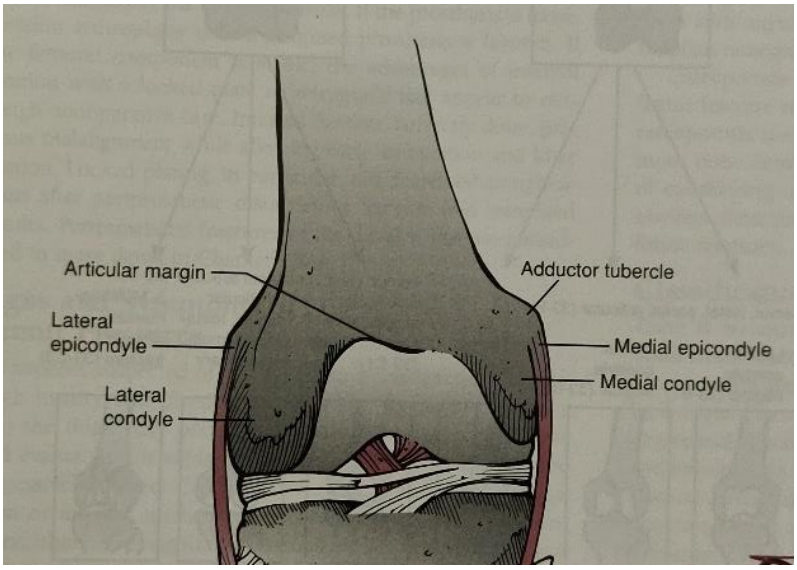
In 2002, Watanabe et al who treated 24 patients with distal femur fractures using supracondylar nail suggested that the range of knee flexion is inversely proportional to the patient's age indicating that the nail is beneficial to treat the distal femur fractures in younger individuals.[35]

In 2007, S El-Kawyet's study concluded that retrograde femoral nailing to be a surgically limited and suitable procedure for elderly patients with distal femur fractures without intraarticular extension.[36]

ANATOMY OF DISTAL FEMUR

Supracondylar area of the femur comprises the zone between the two femoral condyles and junction of the metaphysis with femoral diaphysis. It comprises about distal 15 cm of the femur measured from the articular surface.

The distal end of the femur broadens widely as a bearing surface for transmission of body weight to the tibia. This widened part has two curved condyles which are partly articular with the tibia [5]. Anteriorly the articular surfaces of the two condyles unite in the grooved shallow patellar surface. Though the patella articulates with both the condyles, its predominant articulation is with the lateral condyle as this condyle is broader and more anterior to its counterpart in the coronal plane. This prevents the lateral displacement of the patella. The tibial surface is divided by the intercondylar fossa but is anteriorly continuous with the patellar surface. Posteriorly the condyles are separated by the wide intercondylar fossa. It is intracapsular but largely extrasynovial. The lateral & medial wall of the fossa gives attachment to the proximal part of the Anterior Cruciate Ligament and Posterior Cruciate Ligament respectively[5].



ANATOMY OF DISTAL FEMUR

MEDIAL CONDYLE:

Medial condyle is longer and extends farther distally than the lateral femoral condyle. Proximally it receives the tendon of adductor magnus in the adductor tubercle, a facet like projection. The medial epicondyle is the medial eminence of the condyle lies anteroinferior to the tubercle. Its medial surface receives the medial collateral ligament[5]. The medial head of gastrocnemius is attached to the posterior surface of the distal femur a little above the medial condyle.

LATERAL CONDYLE:

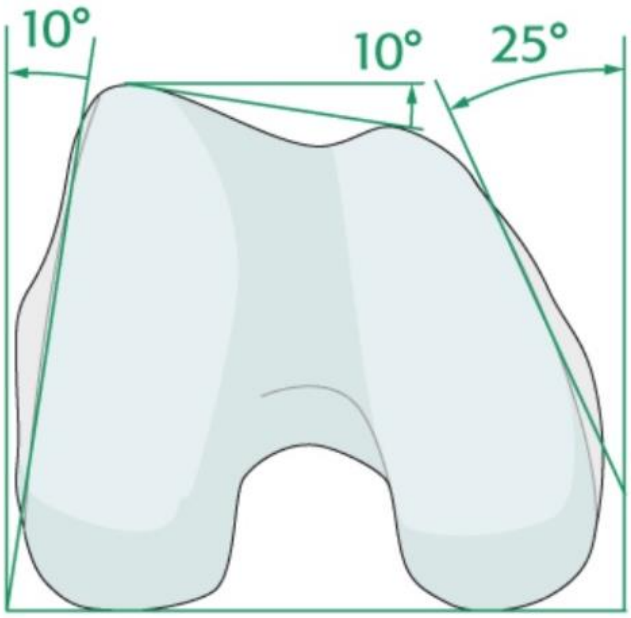
Lateral condyle is larger anteroposteriroly. Lateral epicondyle is the most prominent part of the lateral condyle gives attachment to the Fibular collateral ligament. A shallow groove just beneath it resides the Popliteus tendon, which inserts inferior and anterior to the ligament insertion[5]. This also holds the attachment of part of the lateral head of gastrocnemius.

RADIOLOGIC ANATOMY:

From the end on view, the distal femur is trapezoidal in shape with the posterior part of the condyle wider than the anterior part. It creates an inclination of 10 degree on the lateral surface and 25 degree on the medial surface to the vertical[6].

The patellofemoral inclination line drawn from the anterior aspect of the lateral femoral condyle to the anterior aspect of the medial femoral condyle slopes approximately 10 degree. These anatomical details are important when placing implants

across the condyles from lateral to medial, the implants placed anteriorly appear to be of appropriate length on AP view will actually be too long causing painful irritation[7]. In order to avoid joint penetration, these devices should be placed parallel to both the patellofemoral and tibiofemoral joints planes.



Radiologic anatomy of distal femur

RELATIONS OF THE ARTICULAR SURFACE OF DISTAL FEMUR:

The distal femur is involved in two joints namely the Patellofemoral and the Tibiofemoral joints

TIBIOFEMORAL JOINT:

This is a complex synovial joint. Its a part of the knee joint which also comprises the proximal tibiofibular joint and the Patellofemoral joint. Both the femoral condyles bears their convex articular cartilages with which they articulate with the proximal tibia.

The tibiofemoral joint congruency is maintained by the shape of the articular surface of distal femur and the menisci. The inner two-thirds of each meniscus consists of radially organized collagen bundles, suited to resist compressive forces and the peripheral third consists of larger circumferentially arranged fibres capable of resisting tensional forces[5].

Medial Menisci:

The medial meniscus is semicircle in shape. Its anterior horn is attached to the anterior tibial intercondylar area in front of the anterior cruciate ligament. The posterior horn is attached to the posterior intercondylar area of tibia, between the lateral meniscus and posterior cruciate ligament[5].

Lateral Menisci:

Its anterior horn is attached in front of the intercondylar eminence, posterolateral to the anterior cruciate ligament. Its posterior horn is attached behind this eminence, in front of the posterior horn of the medial meniscus. The popliteus tendon separates it from the fibular collateral ligament attaching to the most posterolateral part and hence so mobility of its posterior horn may be controlled by the meniscofemoral ligaments and by popliteus. The posterior horn near its posterior attachment, sends the

a. **Posterior meniscofemoral ligament (Ligament of Wrisberg)** behind the posterior cruciate ligament to the medial femoral condyle.
b. **An anterior meniscofemoral ligament (Ligament of Humphry)** connecting the the medial femoral condyle anterior to the posterior cruciate

ligament. The meniscofemoral ligaments are often the sole attachments of the posterior horn of the lateral meniscus[5].

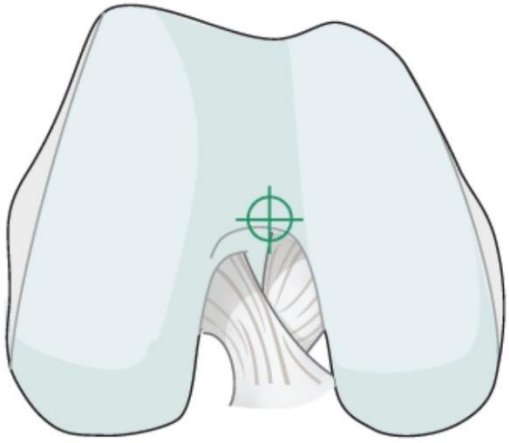
Cruciate Ligaments:

The cruciate ligaments are very strong intracapsular structures that cross each other at a point little posterior to the articular centre. These are named anterior and posterior with reference to their tibial attachments.

The anterior cruciate ligament is attached to the anterior part of the intercondylar area of tibia, just anterior to the anterior horn of the lateral meniscus and posterior to the anterior horn of medial meniscus. Its femoral attachment is on the posteromedial aspect of the lateral femoral condyle[5].

The posterior cruciate ligament is a fan shaped thicker and stronger ligament. It is attached to the lateral surface of the medial femoral condyle and extends up onto the anterior part of the roof of the intercondylar notch, where its attachment is extensive in the anteroposterior direction. They pass distally and posteriorly to a fairly compact attachment posteriorly in the intercondylar eminence and in a depression on the adjacent posterior part of tibia[5].

Knowing the anatomy of these intra articular structures of knee is essential as the entry point for the retrograde femoral nailing is situated anterior to femoral the attachment of Posterior Cruciate ligament on the intercondylar notch.



Entry point for the retrograde femoral nailing

Capsule and other soft tissues:

The capsule is a fibrous membrane. Anteriorly this is replaced by the patellar tendon and does not pass proximal to the patella. Lateral to the patella and its tendon, it lies beneath the expansions from vastus medialis and vastus lateralis and forms medial and lateral patellar retinacula. Posteriorly the capsule contains vertical fibres running between the articular margins of the femoral condyles and the intercondylar notch to the proximal tibia[5]. Medially the capsule is supported by medial collateral ligament, along with the tendons of gracilis, Sartorius and Semitendinosus forming the pes anserinus. The capsule lies deep to these structures on the medial aspect. Laterally the capsule lies deep to lateral patellar retinaculum, lateral collateral ligament, popliteofibular ligament, fabellofibular ligament and arcuate ligament[5]. The lateral joint capsule is thin and the singlemost stabilizer of the knee joint on the posterolateral aspect is the popliteofibular ligament.

PATELLOFEMORAL JOINT:

The patellofemoral joint is a synovial joint comprising the articular surface formed by the groove formed by the condyles and the articular surface of the patella.

The tendon of quadriceps femoris on continuing distally to the patella forms a central band named the Patellar tendon. Proximally it is attached to the apex of patella and its adjoining margins to the superior smooth area of the tibial tuberosity[5].

The intra articular entry point for the retrograde nailing of distal femoral fractures can be approached either with the Parapatellar approach or the Patellar tendon splitting approach.

BLOOD SUPPLY:

The distal femur is supplied by the descending branch of nutrient artery of the femur. The nutrient artery is derived from the first and second perforating branch. Knee joint is supplied by the anastomosis formed by the genicular vessels.

NERVE SUPPLY:

The joint is supplied from the branches of femoral nerve, from the posterior division of obturator nerve and from the sciatic nerve through its genicular branches of the tibial and common peroneal nerves.

MECHANISM OF INJURY

The mechanism of injury for supracondylar fractures of femur is axial loading with varus, valgus or rotational force. A bimodal distribution of high energy trauma and low energy is seen with young patients and elderly patients respectively. High energy

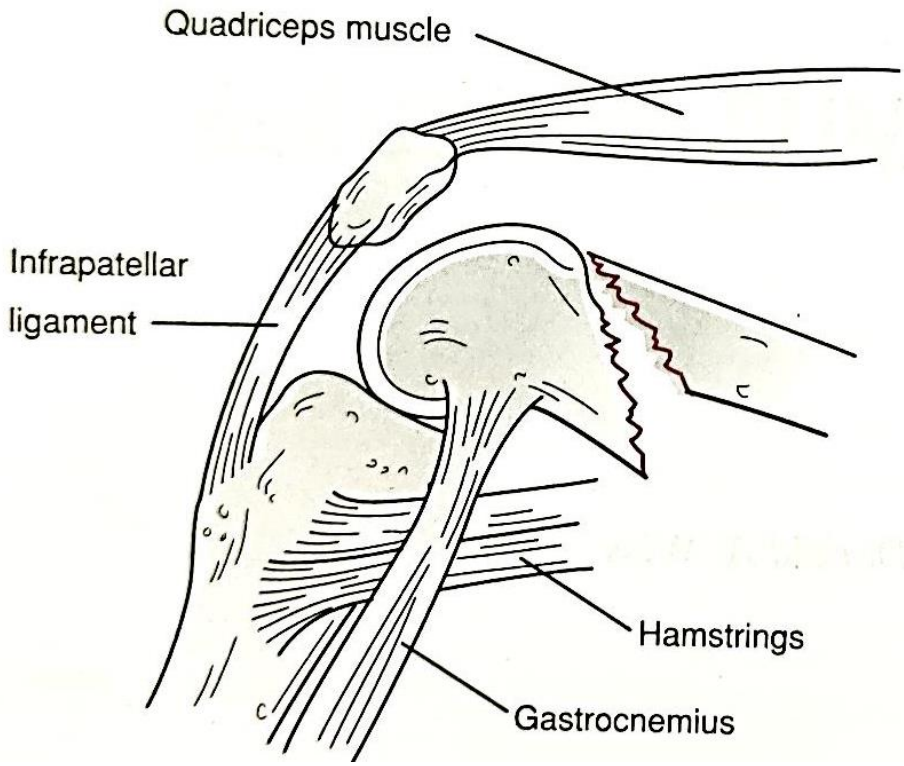
trauma due to motor vehicle or motorcycle accidents are the major cause in younger patients. These injuries may produce significant displacement of fracture, comminution, and other soft tissue injuries including open wounds[7]. Ground level fall on a flexed knee produces these fractures in elderly patients with osteoporotic bones.

The deformities following the distal femur fracture are primarily due to the fracture displacements. Secondarily, due to the contraction and spasm of thigh muscles produces further deformities. The quadriceps, hamstring and adductors are responsible for shortening and varus angulation of the limb. The contraction of the gastrocnemius produces apex posterior angulation and displacement of the distal fragment. [37]

Due to the High energy axial bending loads responsible for production of the supracondylar fractures may lead to concomitant injuries to the same extremity. Physical examination and radiographic assessment must assess the possible presence of a fracture to the acetabulum, femoral neck, segmental fractures involving the femoral shaft and fractures of tibial plateau or shaft. Open fractures occur in 5-10% of all supracondylar fractures. The traumatic wound is most commonly over the anterior aspect of thigh with some damage to the distal quadriceps muscle or tendon. Concomitant ligament injuries can occur with these fractures, not usually diagnosed preoperatively. **Anterior cruciate ligament is the most commonly injured ligament.[8]**

Injuries to the femoral arteries could occur in femoral shaft fractures and injuries to popliteal artery can occur following knee dislocations and displaced proximal tibial fractures. The chances of vascular injury is low in supracondylar fractures because the

vascular bundle is tethered proximally in the adductor hiatus and distally by the soleus arch. These tight attachments leave little room for fracture distortion.[8]



Deformities after Distal femur fracture

CLASSIFICATION

The OA OTA classification is widely accepted and being followed in our study. It is easy to classify the fractures and to predict the outcome of these fractures.

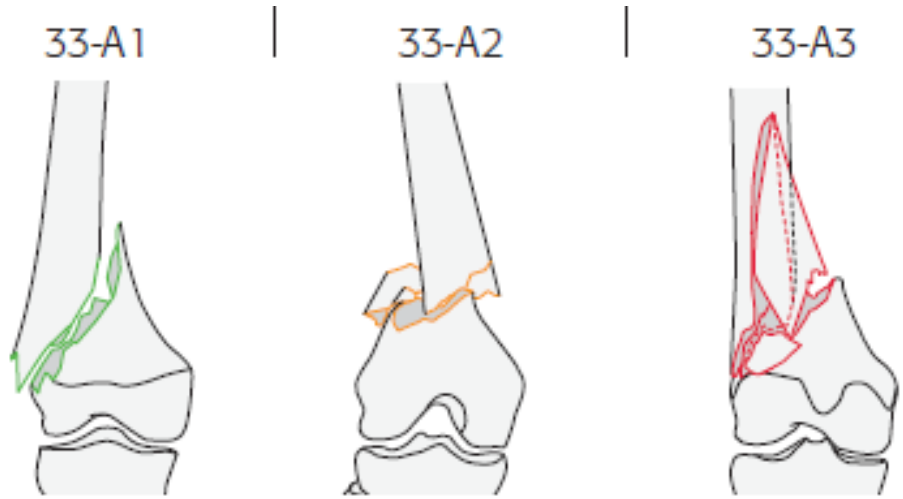
OTA Classification[9]:

Type A are Extra articular fractures

33-A1 Simple extra articular fracture

33-A2 Metaphyseal wedge/fragmented wedge

33-A3 Metaphyseal complex



33-A extraarticular fracture

33-A1 simple

33-A2 metaphyseal wedge and/or fragmented wedge

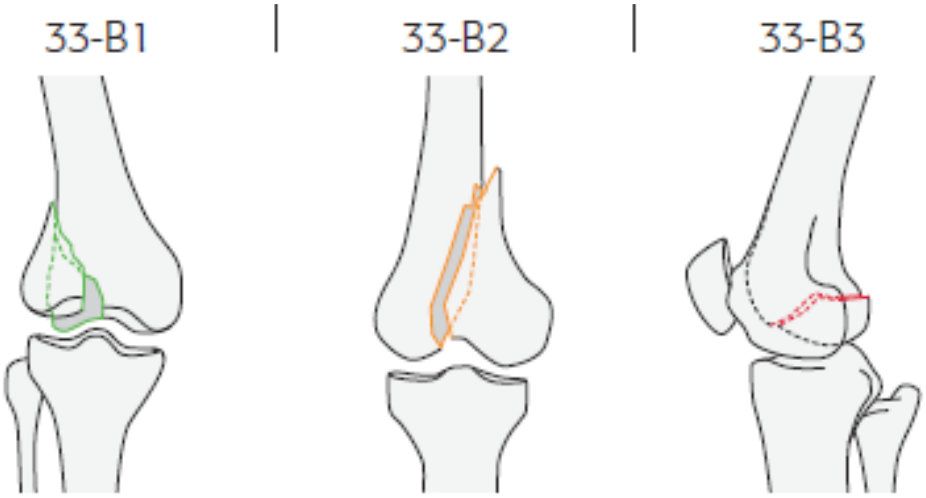
33-A3 metaphyseal complex

Type B are Partial articular fracture

33-B1 Lateral condyle in the sagittal plane

33-B2 Medial condyle in the sagittal plane

33-B3 Partial articular fracture in the coronal plane



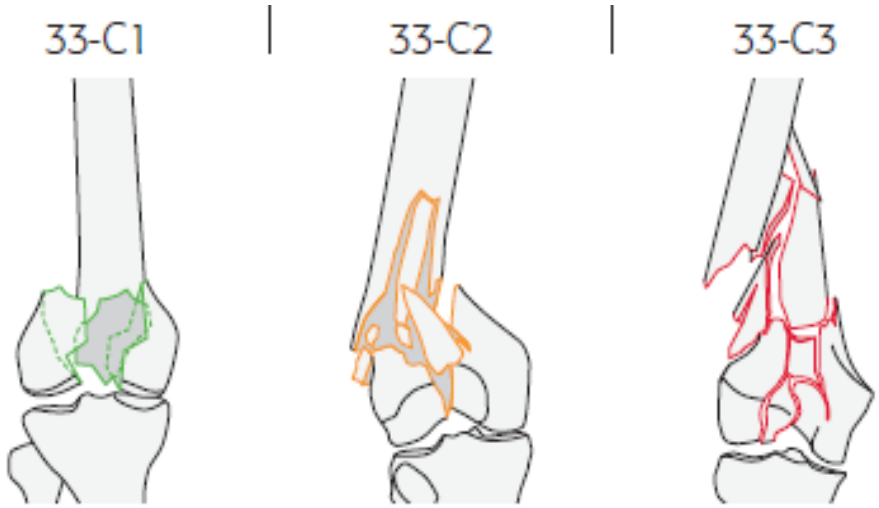
33-B partial articular fracture
33-B1 lateral condyle, sagittal
33-B2 medial condyle, sagittal
33-B3 coronal

Type C are Complete articular fracture:

33-C- Articular simple, metaphyseal simple

33-C2 Articular simple, metaphyseal multi fragmentary

33-C3 Articular multi fragmentary.



33-C complete articular fracture

33-C1 articular simple, metaphyseal simple

33-C2 articular simple, metaphyseal multifragmentary

33-C3 articular multifragmentary

AO OTA CLASSIFICATION[10]:

33A - EXTRAARTICULAR FRACTURE

33A1- Extraarticular Avulsion fracture

33A1.1- Lateral epicondyle fracture

33A1.2- Medial epicondyle fracture

33A2- Extraarticular Simple fracture

33A2.1- Spiral fracture

33A2.2- Oblique fracture

33A2.3- Transverse fracture

33A3- Extraarticular wedge or multifragmentary fracture

33A3.1- Intact wedge fracture

33A3.2- Fragmentary wedge fracture

33A3.3- Multifragmentary fracture

33B PARTIAL ARTICULAR FRACTURE

33B1- Fracture of lateral condyle in sagittal fracture

33B1.1-Simple through the notch

33B1.2-Simple through the load bearing surface

33B1.3- Fragmentary fracture

33B2- Fracture of medial condyle in sagittal fracture

33B2.1-Simple through the notch

33B2.2- Simple through the load bearing surface

33B2.3- Fragmentary fracture

33B3 –Fracture in frontal/coronal fracture

33B3.1- Anterior and lateral flake fracture

33B3.2- Posterior unicondylar fracture (Hoffa)

33B3.3- Posterior bicondylar fracture (bilateral Hoffa)

33C COMPLETE ARTICULAR FRACTURE

33C1- Simple articular, simple metaphyseal fracture

33C1.1- Above transcondylar axis

33C1.3- Through or below transcondylar axis

33C2- Simple articular, wedge or multifragmentary metaphyseal fracture

33C2.1- Intact wedge metaphyseal fracture

33C2.2- Fragmentary wedge metaphyseal fracture

33C2.3- Multifragmentary metaphyseal fracture

33C3- Multifragmentary articular fracture, simple, wedge or multifragmentary metaphyseal fracture

33C3.1- Simple metaphyseal fracture

33C3.2- Wedge metaphyseal fracture

33C3.3- Multifragmentary metaphyseal fracture

RETROGRADE FEMORAL NAIL

In1977, Zickel used two flat flexible rods for supracondylar nailing of the femur which were inserted from the medial and lateral condyles and held in place with large condylar anchoring screw.[11]

In 1986, Green and Seligson developed the supracondylar nail with a bend to match the axis of the distal femur in the lateral plane. They both suggested that there should be no way to place the implant. In general the nail is to be inserted with the apex of the angle anterior. Thus the introduced new intramedullary device placed in a retrograde fashion came into use for orthopaedic surgeries.[12]

Intramedullary nails have many of the same advantages as locking plates such as percutaneous placement without disruption of blood supply, indirect fracture reduction, success in osteoporotic bone and have been reported to lead to high healing rates in fractures of the distal femur

Indications:

Fractures of type 33-A1, A2, A3

Fractures of type 33-C1 to C3.1

Fractures of type 32-A to C

Contraindications:

Fractures of type 33-B, 33-C3.2 and 33-C3.3

Proximal femoral fractures and high subtrochanteric fractures

This being an intramedullary cannulated stainless steel implant provides improved mechanical resistance acting as load bearing device. Nails of outer diameter 9mm, 10mm, 11mm, 12 mm were available. All the nails had length ranging between 20cm, 25cm, 30 cm & 35cm. Nail has a 5 degree anterior bend. Distally the nail has got two 6.4mm locking options and one 4.9mm locking option. Proximally there are two locking options of 4.9mm. All the locking options were lateral to medial. All the locking screws were inserted with targeting device. The nail tip has to countersunk few mm into the intercondylar notch.

METHODOLOGY

This is a Prospective single centre clinical study done from October 2017 to September 2019.

20 patients with Extra articular Distal femoral fractures admitted to Orthopaedic wards, Govt. Mohan Kumaramangalam Medical College & Hospital were taken up for the study after getting an valid and informed written consent from them.

A detailed history is taken, systemic examination is done and all the basic investigations and the required x rays taken. Patients were assessed using Neer's et. al Rating system.

INCLUSION CRITERIA:

1. Patients with Extra Distal Femur Fractures (AO OTA Type A1, A2, A3)
2. Age > 25 & < 70 years
3. Fractures 6cm above Joint line
4. Grade I and Grade II open fractures

EXCLUSION CRITERIA:

1. Grade III Open Fractures
2. Age< 25 or > 70 years
3. Associated with Vascular Injury
4. Fractures with Intra Articular Extension
5. Patients Unfit /Not willing for surgery

On admission of the patient, a careful history was elicited from the patient and/or attenders to know the mechanism of injury and violence of the trauma. The patients were then assessed clinically to evaluate their general condition and the local injury.

General condition of the patient was assessed and prompt resuscitation with Intravenous Fluids, Parenteral analgesics, Blood transfusion were provided. Systematic Musculoskeletal examination from head to foot was done to identify the other injuries and fractures

Injured limb was examined carefully to look for any open injuries. Distal neurovascular status of the limb was assessed.

Limb was immobilized in a Thomas splint on admission and afterwhich patient is transported to the radiology department. Radiographic projections of the injured limb along the knee joint, pelvis with both the hip joint were taken.

Upper Tibial Pin traction was applied in strict aseptic precautions under Local anaesthesia, through which continuous traction is applied over a Bohler Braun splint till surgery.

Pre operative Planning:

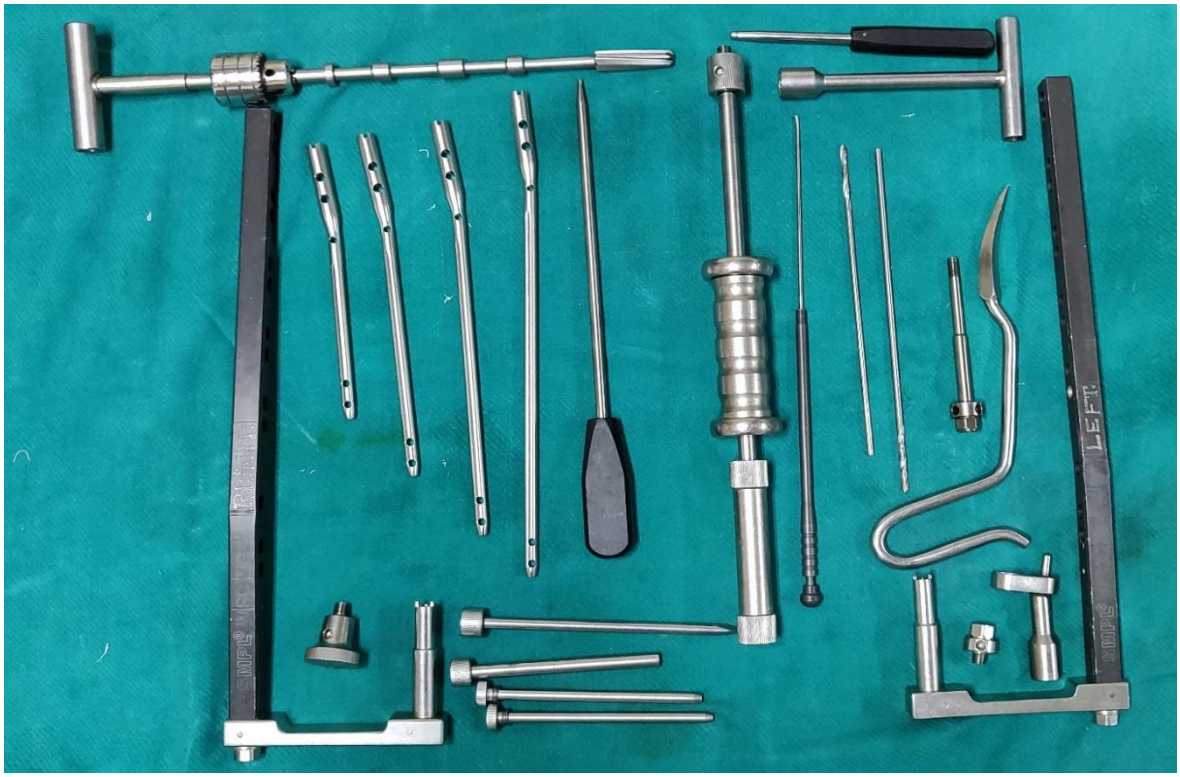
Patients were explained about the procedure, its advantages and benefits, complications. Valid written and informed consent was obtained from all the patients.

Routine blood investigations, serological blood investigations, ECG, chest X-ray were done and all cases were posted for surgery after obtaining anesthetic fitness.

The nail length and diameter were calculated with the pre operative radiographs after eliminating the magnification factor.

Instruments used for Retrograde Nailing:

1. Supracondylar nail Jig
2. Bone awl
3. Conical bolt
4. Entry reamer
5. Cannulated reamers & Flexible reamers
6. Drill bits 4mm & 5mm
7. Trocar
8. Drill Sleeves
9. Depth Gauge
10. Box Spanner
11. Allen Key
12. Screw driver



Surgical Technique:

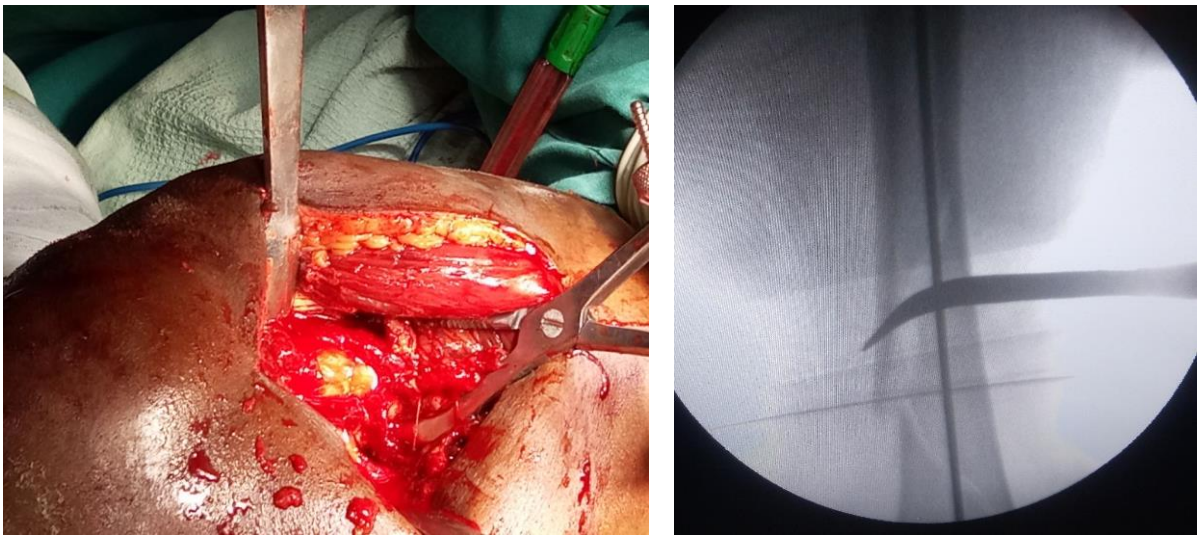
1) Patient Positioning:

Patient is positioned supine on table with knee flexed to 30 degree using a bolster underneath it and a sand bag beneath the ipsilateral hip. This knee flexion helps to relax the gastrocnemius for helping in reduction of fracture.

Patient position for Retrograde nailing

2) Reduction of fracture:

Closed reduction of the fracture was done using fluoroscopy guidance. If closed reduction could not be achieved, reduction techniques like use of bone hook to aid in reduction was also used. Even then if reduction wasn't feasible, the fracture site was opened using the lateral approach to the femur, reduction attained using bone holding forceps and was maintained till the nail is locked.



Open reduction using Bone holding Forceps

Use of Bone Hook for fracture Reduction

3) Skin Incision:

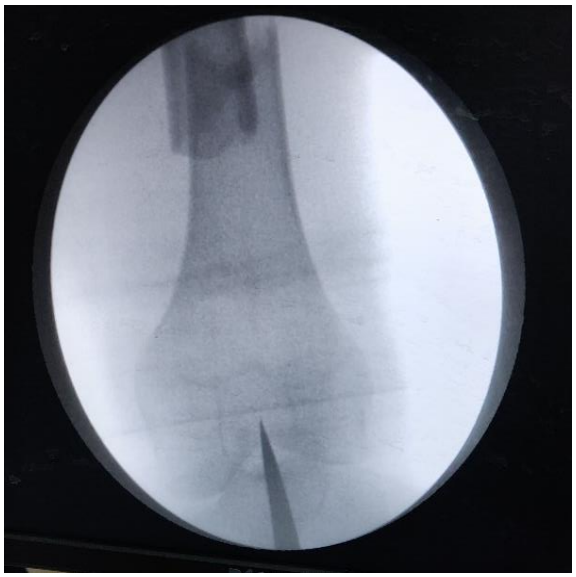
4 cm longitudinal midline skin incision extending from the inferior pole of patella till the tibial tuberosity. In our study, Patellar tendon spitting approach was used for all cases.

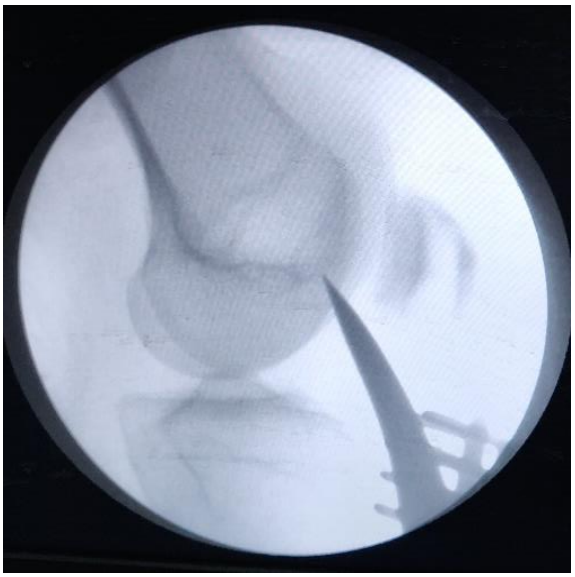
Skin Incision

4) Entry Portal:

The entry point can be located either with palpation or radiographically. It is few mm anterior and lateral to the femoral attachment of Posterior Cruciate Ligament and in line with the canal of the femur. Radiologically, the entry point must be at the apex of the Blumensaat's intercondylar roof line on lateral view. On AP view, it is in the middle of the intercondylar notch.

Making the Entry point with Bone awl

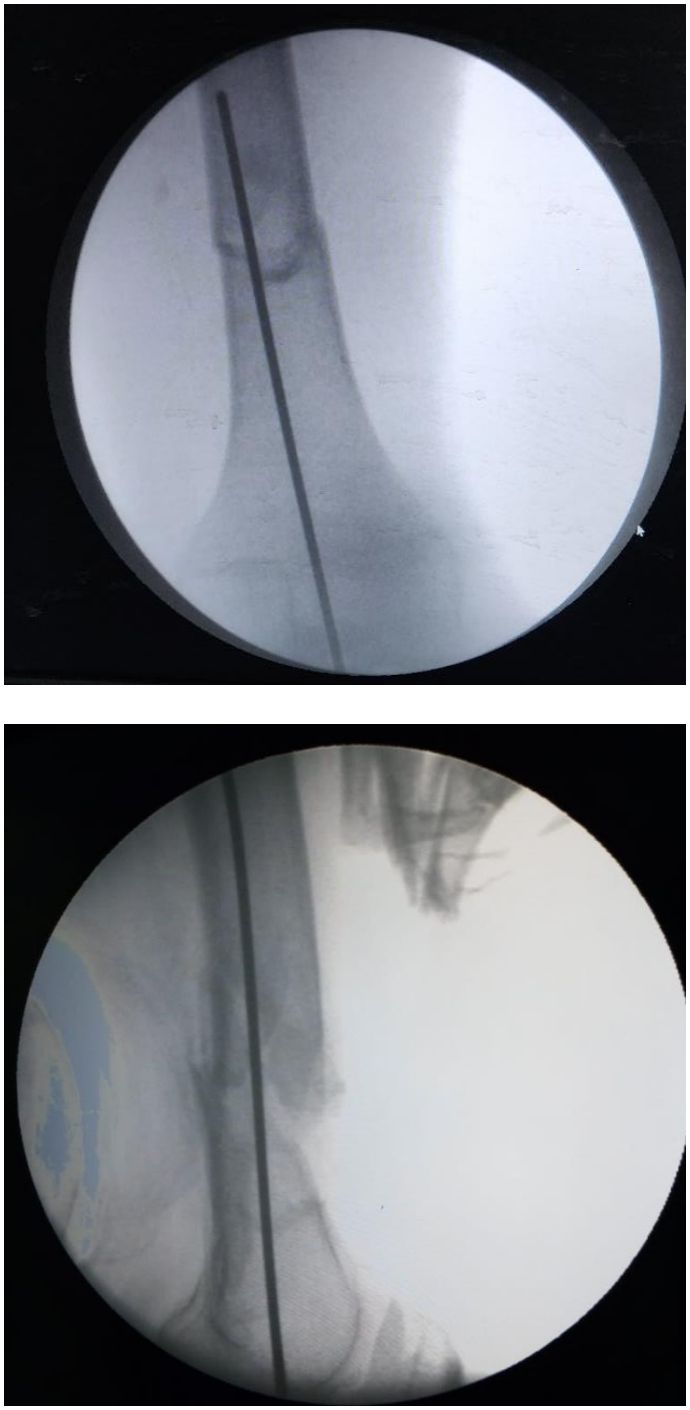




Making the Entry point with Bone awl

5) Guide wire Insertion:

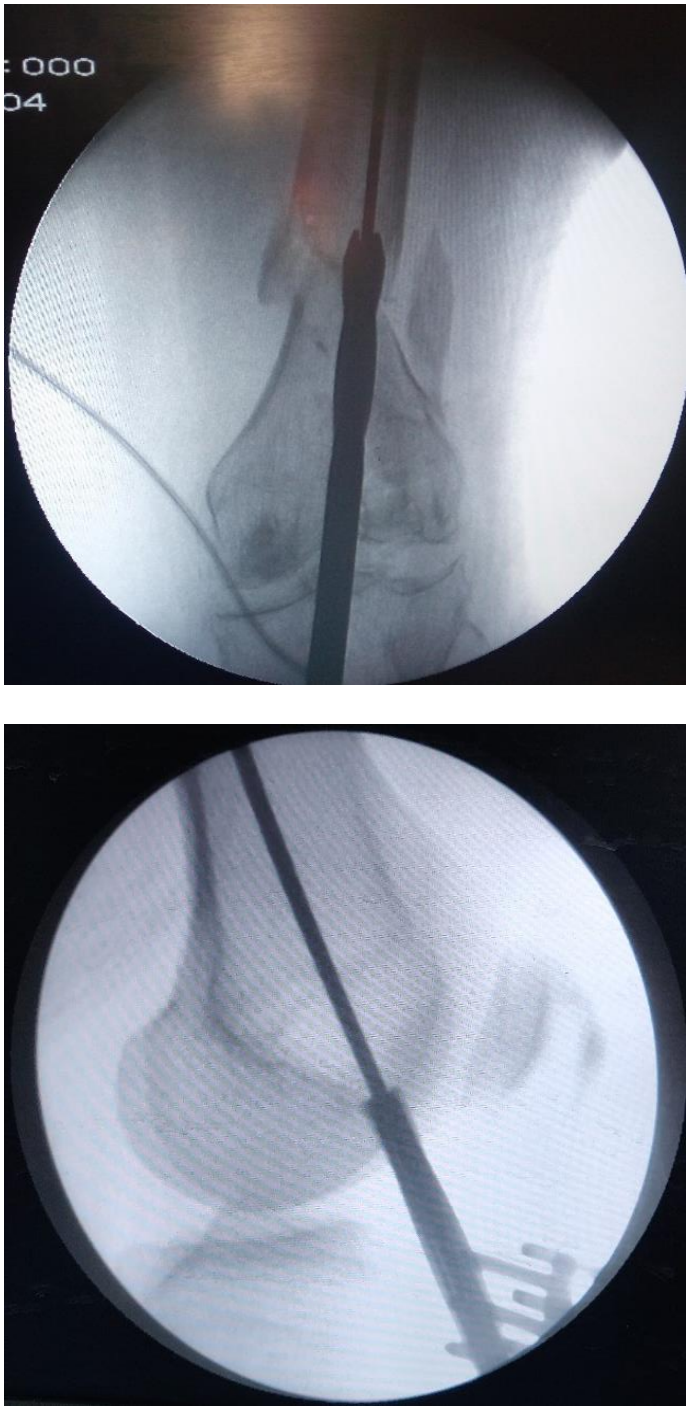
Guide wire is inserted and its position is checked under C-arm control. It should be centre-centre position. It has to be in line with femoral canal in the AP view and anterior to the Blumensaat's line in lateral as there is no safe zone posterior to it.



Guide wire insertion

6) Reaming:

Serial reaming of the femoral medullary canal is done using either flexible or manual reamers. The canal has to be overreamed by at least 1 mm greater than the desired nail diameter. The fracture reduction has to be maintained during reaming.



Reaming of the femoral canal

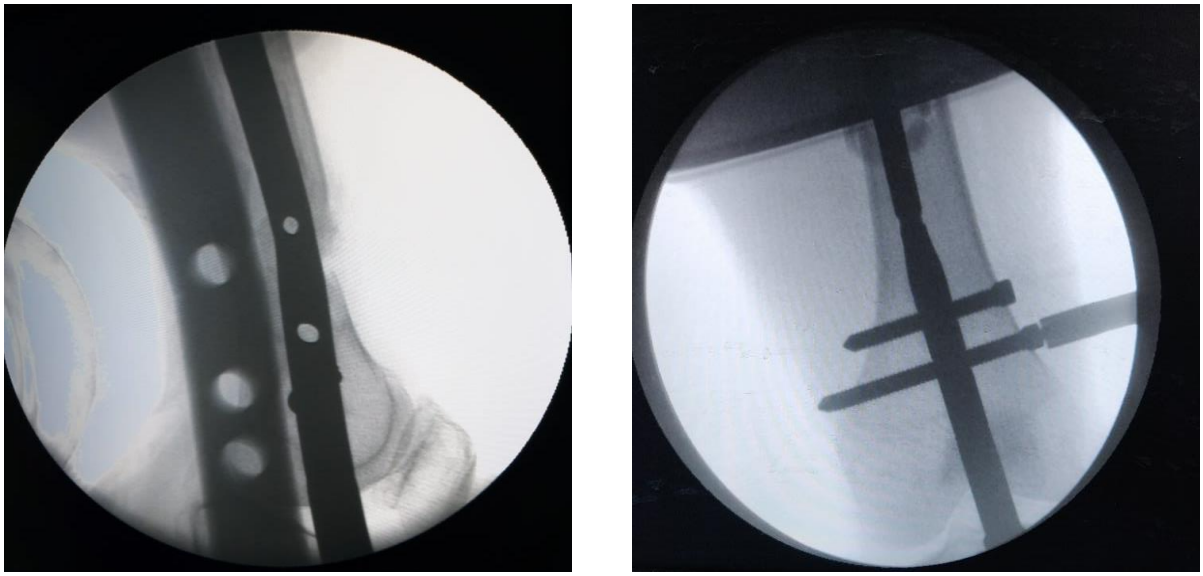
7) Insertion of the Nail:

The nail has to been driven gently into the canal. It requires gentle hammer taps to ensure proper advancement of the nail. During the insertion process, it is important that the assistant has to apply traction to the limb in order to prevent shortening and angulation. The nail must countersunk several mm into the intercondylar notch below the subchondral bone in order to avoid damage to the patellar articulation surface.

Nail insertion

8) Distal Locking:

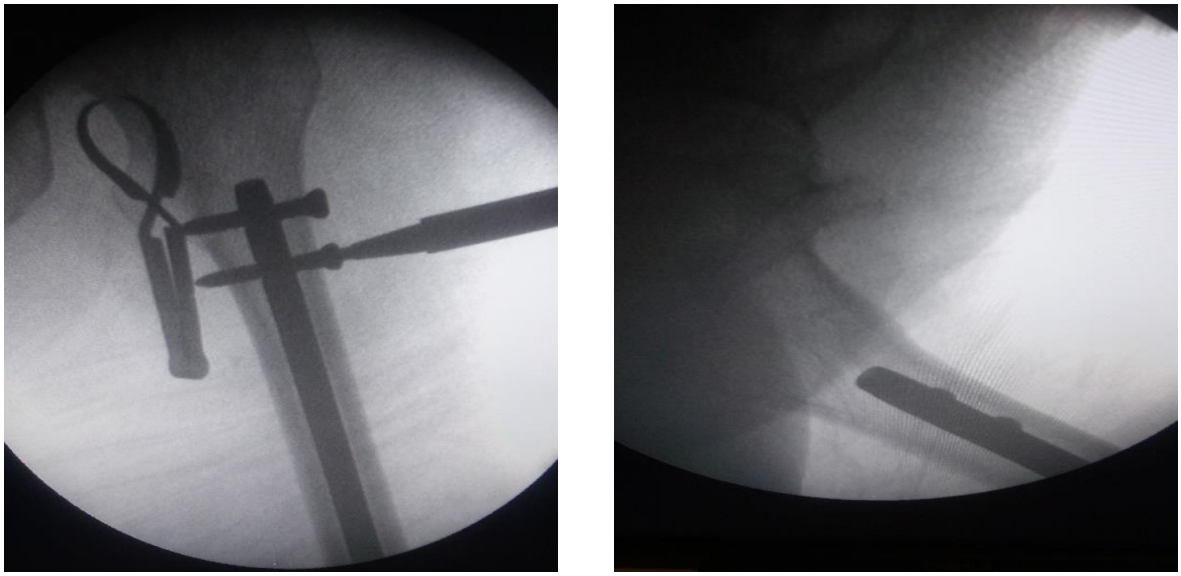
It is done prior to the proximal locking. Performed using the appropriate targeting device attached to the insertion handle. At least Two locking screws must be applied for all the distal femoral fractures.



Distal locking screw application

9) Proximal locking screw:

Two lateral to medial locking screws are applied using the free hand perfect circle technique or with the use of the targeting device itself.



Proximal Locking Screw Application

Post Operative care:

- Crepe bandage appliaction, limb elevtaion for first few post operative days was advised to reduce swelling in the operated limb and to minimize wound complications**.**
- Mobilization was started on the first post operative day with strict non weight bearing walking of the operated limb. Passive mobilization was also started for other joints.
- Intravenous antibiotics were given as per the protocol
- Drain removal done after 48 hours
- Wound inspection done on second Post operative day and thereafter for every two days
- Suture removal was done on 12-14th post operative day.

FOLLOW UPS:

- Patients were followed up at 6th week, then monthly for first 3 months, then at 6th month and 1 year. During each visit functional outcomes and radiological union were assessed for.
- The fracture was considered as united only when there is formation of callus in any three of the four cortices assessed using the standard AP and lateral radiographs views when the patient is able to weight-bear without any discomfort.
- Weight bearing was started depending upon the radiological union and consolidation at the fracture site.

OBSERVATION AND RESULTS

Patient and fracture characteristics:

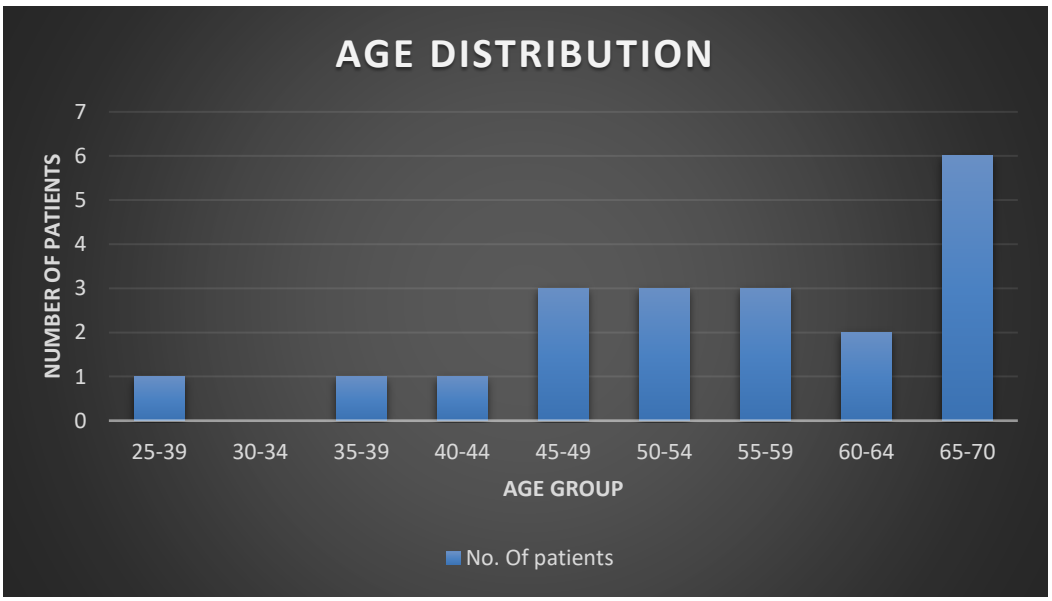
Age Distribution:

The age of the patient included in our study is between 25 years to 70 years and most of the patients were in the age group of 5-6th decade with the mean age of 55.45 years.

Table No.1

Age Group (In Years)	No. Of patients	Percentage
25-39	1	5
30-34	-	
35-39	1	5
40-44	1	5
45-49	3	15
50-54	3	15
55-59	3	15
60-64	2	10
65-70	6	30

Chart No. 1



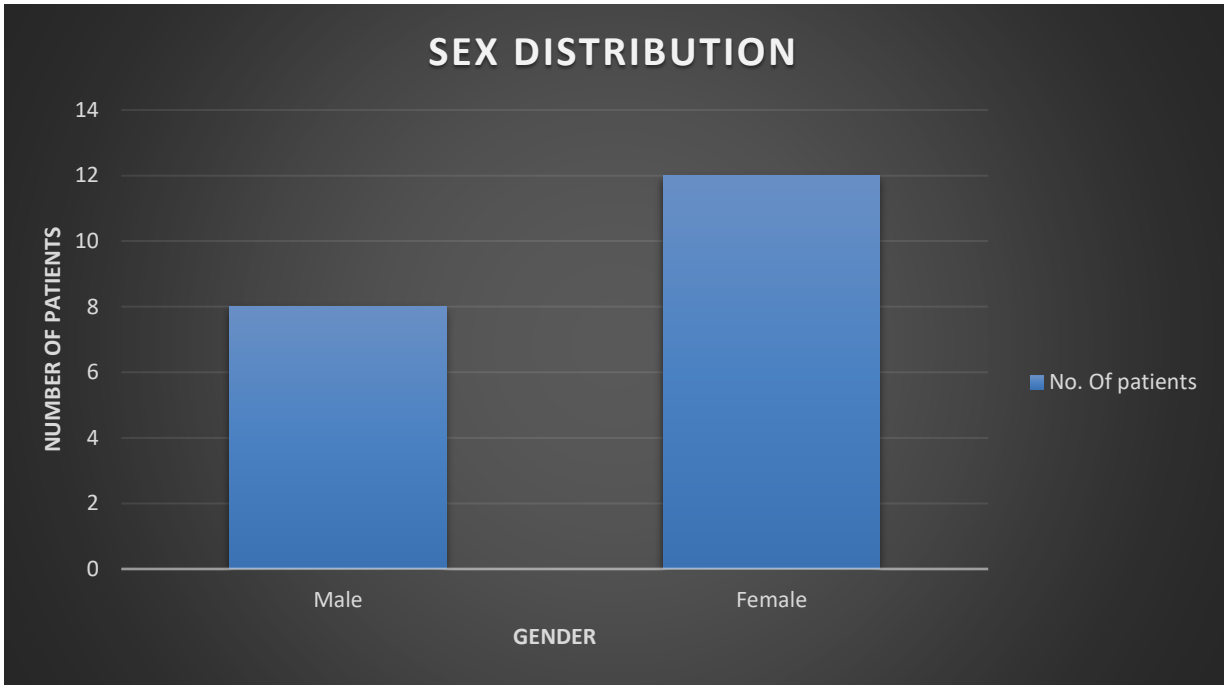
Sex distribution:

The predominant population in our study are the female patient.

Table No.2

Sex	No. Of patients	Percentage
Male	8	40
Female	12	60

Chart No. 2



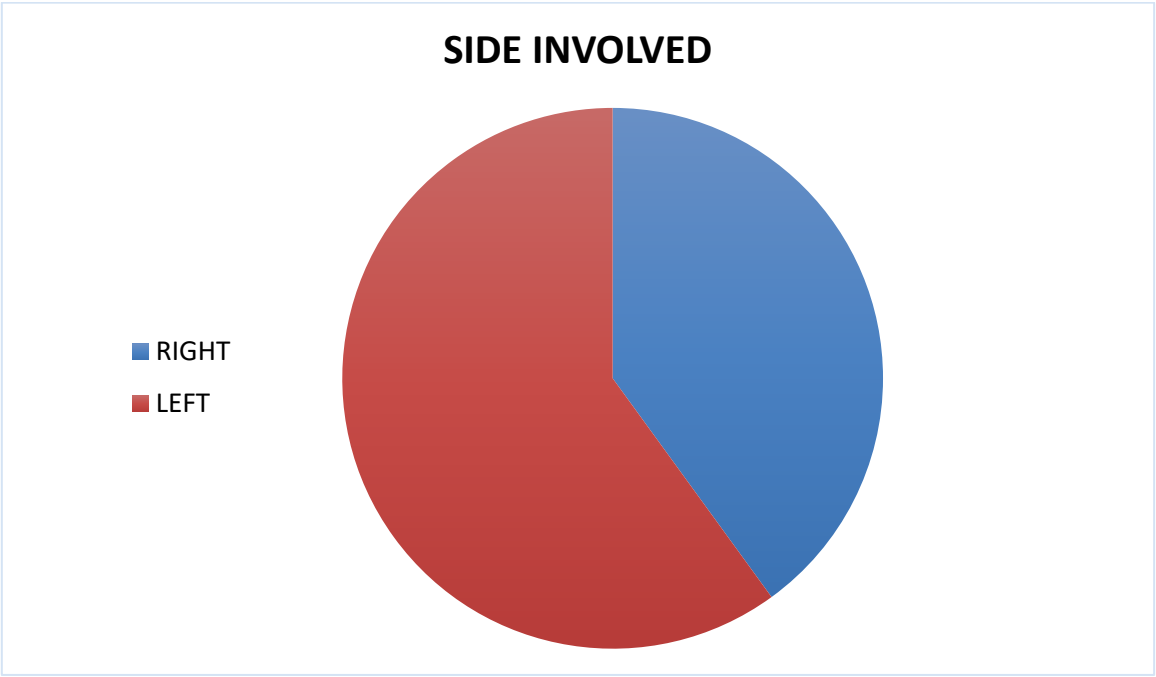
Side Involved:

There was a left sided predilection seen in the study.

Table No.3

Side	No. Of patients	Percentage
Right	8	40
Left	12	60

Chart No. 3



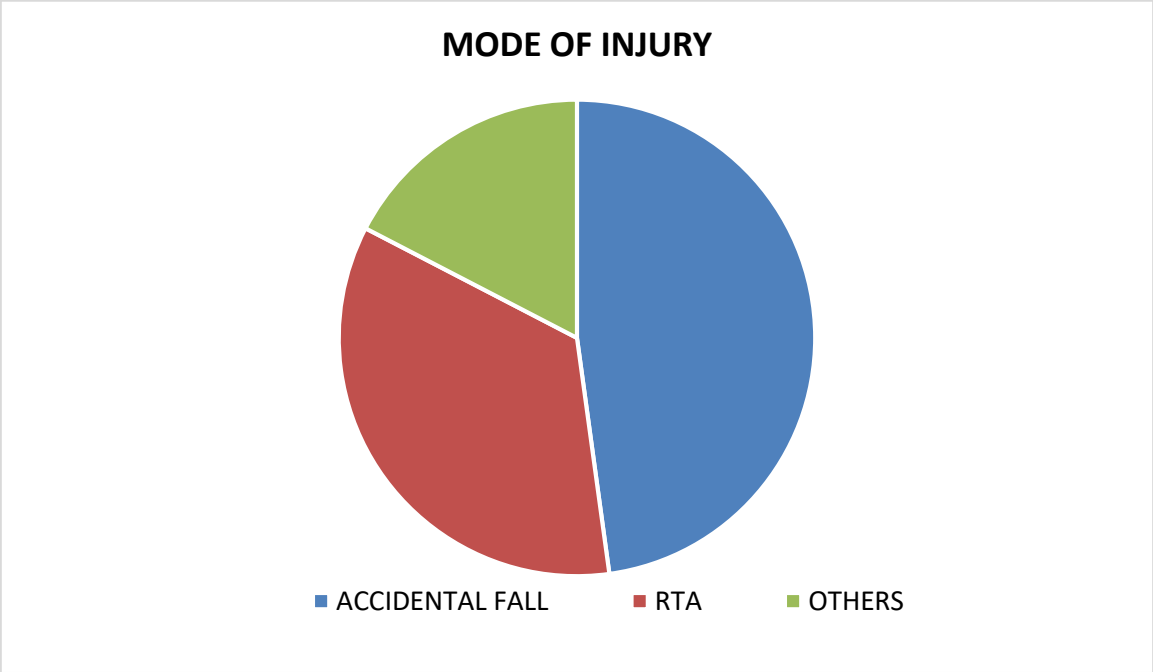
Mode of Injury:

The majority of patients in our study sustained fractures due to accidental fall, with Road Traffic Accidents next to it.

Table No.4

Mode	No. Of patients	Percentage
Accidental fall	11	55
Road Traffic Accidents	8	40
Others	1	5

Chart No. 4



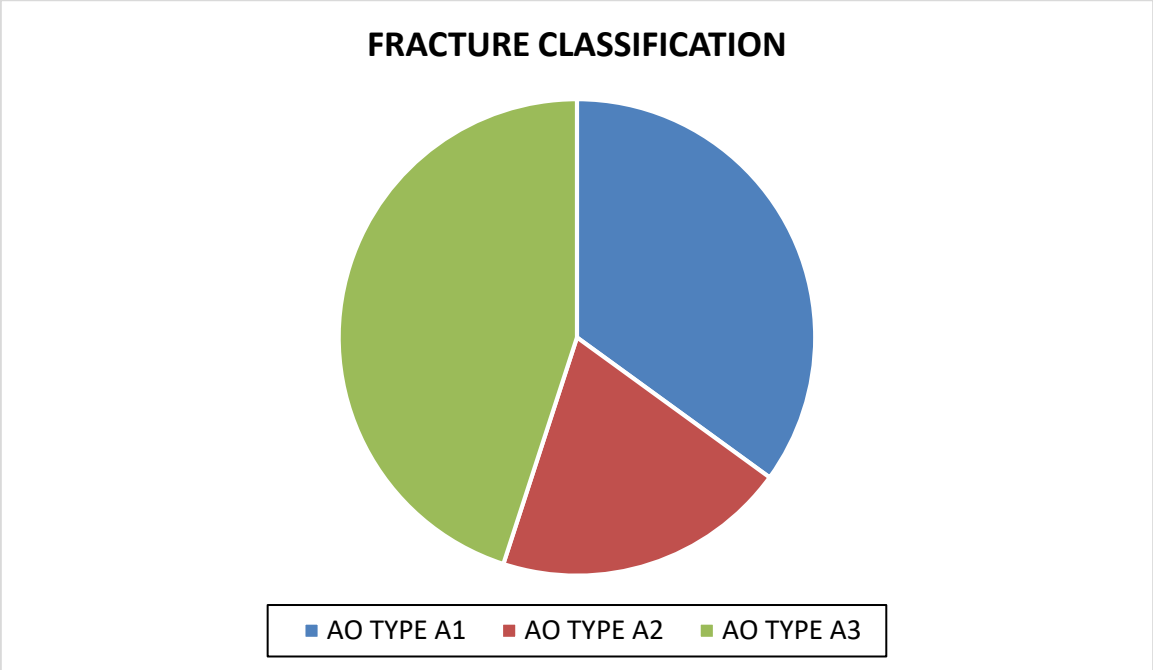
Fracture Pattern:

Most of the patients in our study fall under AO Type A3 and A1.

Table No.5

Type	No. Of patients	Percentage
AO Type A1	7	35
AO Type A2	4	20
AO Type A3	9	45

Chart No. 5



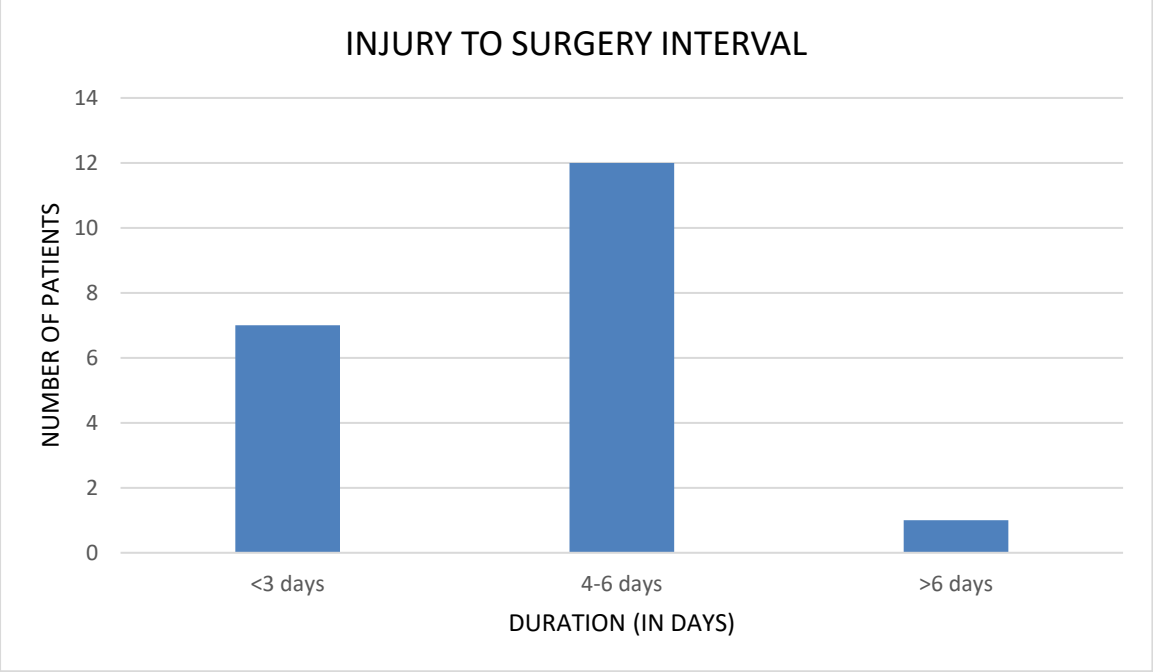
Injury to Surgery Interval:

The mean time taken for internal fixation of the fracture in our study was 4 days. The delay in taking for surgery was due to the associated injuries the, co morbidities of the patient.

Table No.6

Injury to surgery Interval	No. Of patients	Percentage
<3 days	7	35
4-6 days	12	60
>6 days	1	5

Chart No. 6



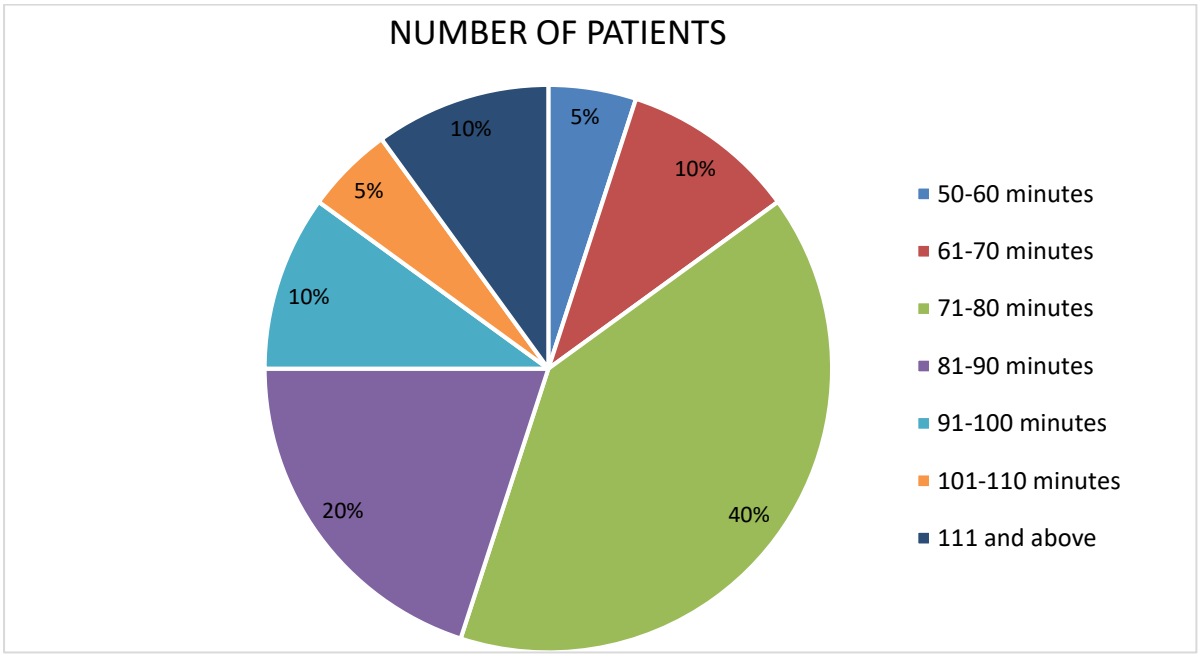
Duration of surgery:

The average duration of surgery in our study is 82.75 minutes. However there were cases which went had prolonged duration around 100 minutes due to additional procedure like Tibia Nailing, Tension Band wiring for patella fracture.

Table No.7

Duration of surgery	No. Of patients	Percentage
50-60 minutes	1	5
61-70 minutes	2	10
71-80 minutes	8	40
81-90 minutes	4	20
91-100 minutes	2	10
101-110 minutes	1	5
111 and above	2	10

Chart No. 7



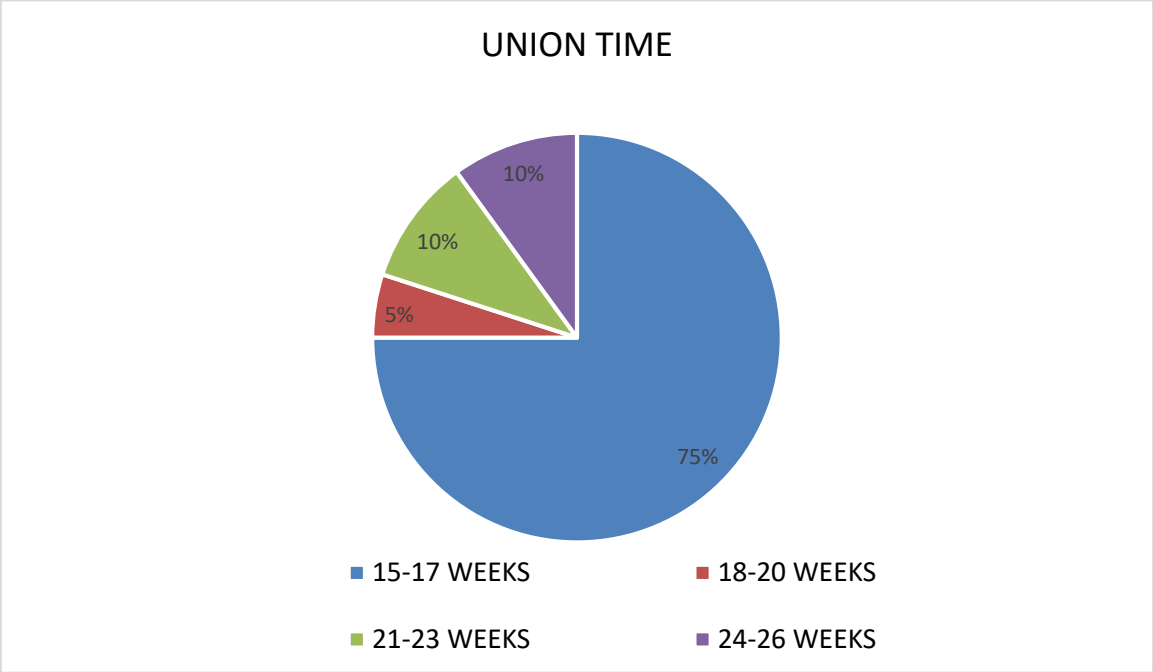
Time of Union:

The fracture is said to be united when the patient is able to weight-bear without any discomfort in the presence of radiological bridging callus on atleast three cortices, assessed using both standard AP and lateral radiographs. The mean time of union of fractures in our study is 15.15 weeks. One case went for non union and was treated with Bone graft and LRS. In that case,the fracture didn't unite till the end of this study.

Table No.8

Fracture Union (in weeks)	No. Of patients	Percentage
15-17	14	75
18-20	1	5
21-23	2	10
24-26	2	10

Chart No. 8



Complications:

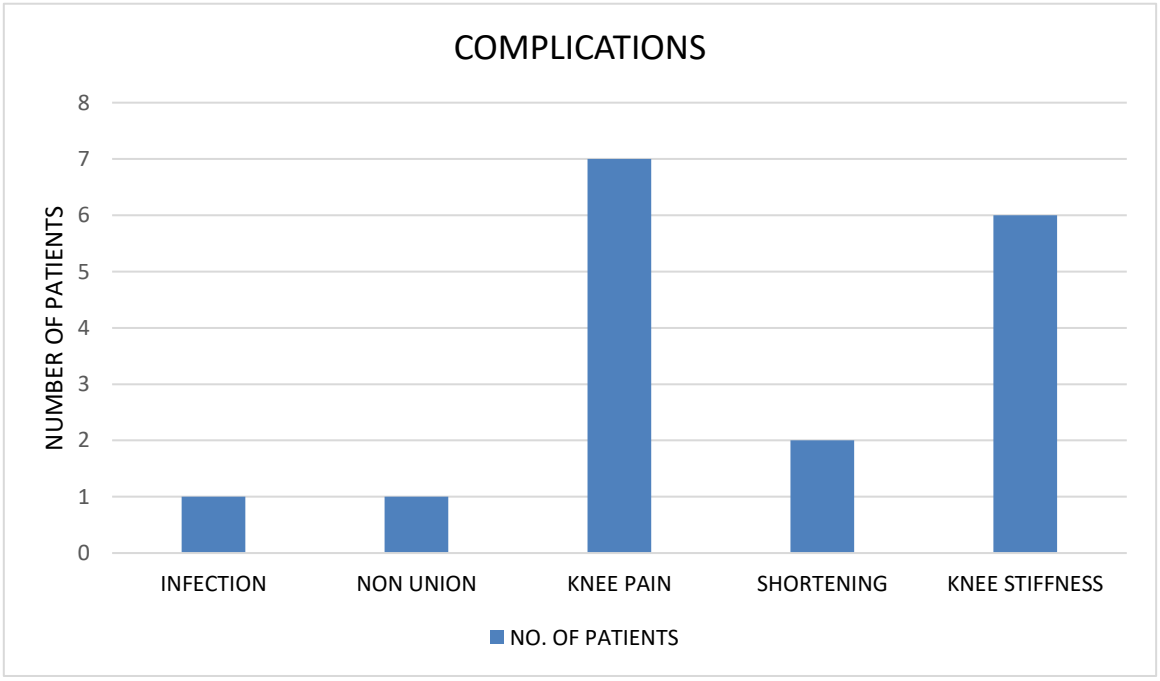
The Complications like anterior knee pain, shortening of the limb, knee stiffness, Infection and Non union were encountered in our study.

Patients with anterior knee pain didn't have any implant protrusion into the knee joint. They were treated with analgesics and reassurance was given.

Table No. 9

Complication	**No. Of Patients**	**Percentage**
Infection	1	5
Non Union	1	5
Knee pain	7	35
Shortening	2	10
Knee stiffness	6	30

Chart No. 9

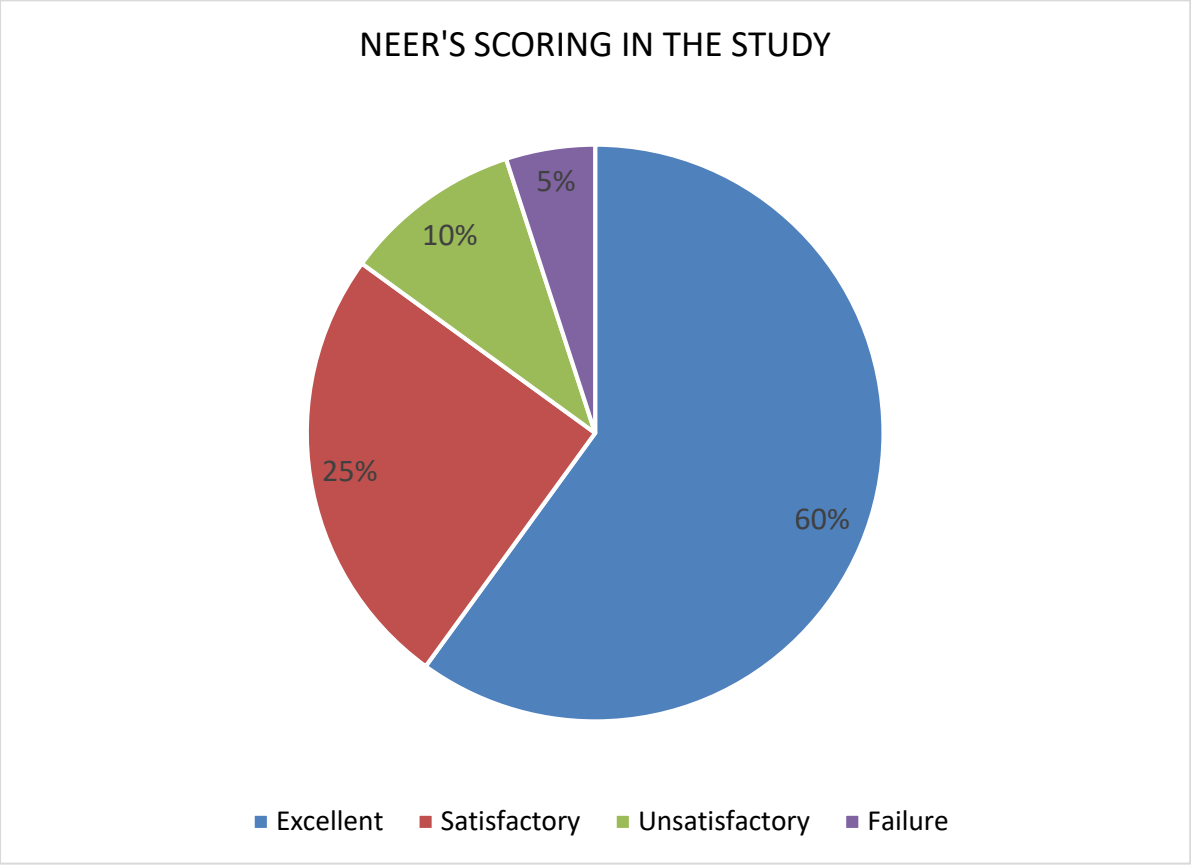


NEER'S SCORING OF THE PATIENTS IN OUR STUDY:

Table No. 10

Neer's scoring	No. of Patients	Percentage
Excellent	12	60
Satisfactory	5	25
Unsatisfactory	2	10
Failure	1	5

Chart No. 10



NEER'S SCORING SYSTEM

FUNCTIONAL (70 POINTS)		ANATOMICAL (30 POINTS)	
A. PAIN(20 POINTS)		**A. GROSS ANATOMY(15 POINTS)**	
NO PAIN	20	THICKENING ONLY	15
INTERMITTENT	16	5 DEGREE ANGULATION OR 0.5 CM SHORTENING	12
WITH FATIGUE	12	10 DEGREE ANGULATION OR ROTATION,2 CM SHORTENING	9
LIMITS FUNCTION	8	15 DEGREE ANGULATION OR ROTATION,3 CM SHORTENING	6
CONSTANT	4	HEALED WITH CONSIDERABLE DEFORMITY	3
B. WALKING CAPACITY(20 POINTS)		NON UNION OR CHRONIC INFECTION	0
SAME AS BEFORE ACCIDENT	20	**B. ROENTGENOGRAM (15 POINTS)**	
MILD RESTRICTION	16	NEAR NORMAL	15
RESTRICTED STAIR SIDE WAYS	12	5 DEGREE ANGULATION OR 0.5 CM DISPLACEMENT	12
USE CRUCTCHES OR OTHER WALKING AIDS	4	10 DEGREE ANGULATION OR 1 CM DISPLACEMENT	9
C. JOINT MOVEMENTS (20 POINTS)		15 DEGREE ANGULATION OR 2 CM DISPLACEMENT	6
NORMAL OR 135 DEGREE	20	UNION BUT WITH GREATER DEFORMITY, SPREADING OF CONDYLES AND OSTEOARTHRITIS	3
UPTO 100 DEGREE	16	NON UNION OR CHRONIC INFECTION	0
UPTO 80 DEGREE	12		
UPTO 60 DEGREE	8		
UPTO 40 DEGREE	4		
UPTO 20 DEGREE	0		
D.WORKING CAPACITY (10 POINTS)			
SAME AS BEFORE ACCIDENT	10		
REGULAR BUT WITH HANDICAP	8		
ALTERS WORK	6		
LIGHT WORK	4		
NO WORK	2		

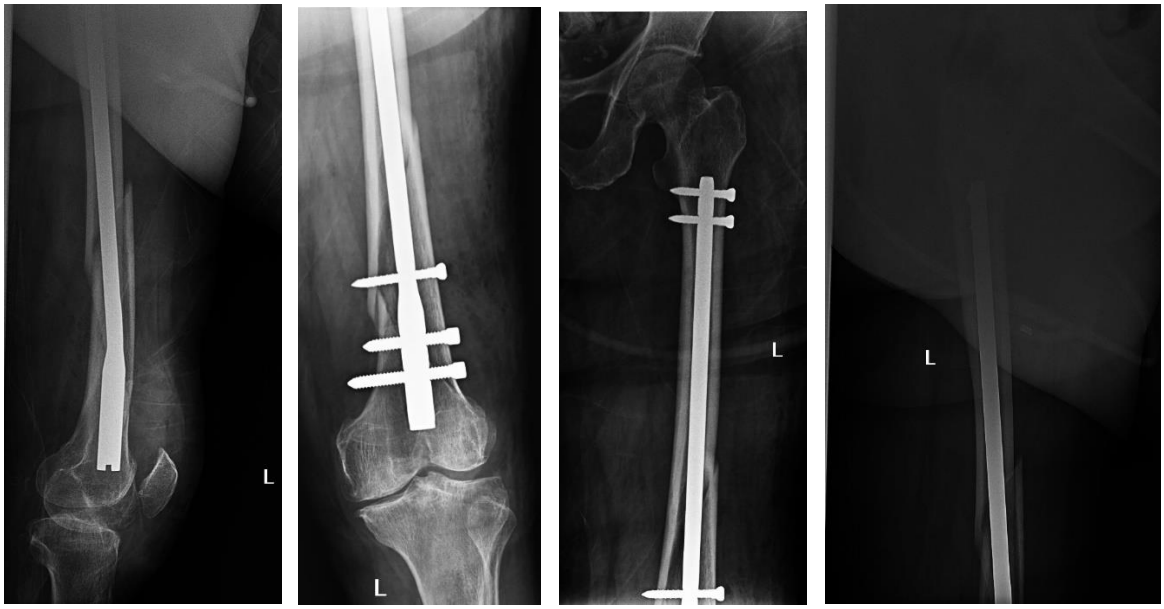
CASE ILLUSTRATION:

CASE-1

Name	Pappathi
Age/sex	65/F
Mode of injury	Accidental fall
Side	Left
Fracture classification	Type A2
Associated injury	Nil
Injury to surgery duration	6 days
Method of reduction	Open
Knee flexion	120 degree
Neer’s score	86
Complication	---

PRE OPERATIVE RADIOGRAPHS AP AND LATERAL VIEW

IMMEDIATE POST OPERATIVE RADIOGRAPHS AP AND LATERAL VIEW



3 MONTHS POST OPERATIVE RADIOGRAPHS AP AND LATERAL VIEW

6 MONTHS POST OPERATIVE RADIOGRAPHS AP AND LATERAL VIEW

1 YEAR POST OPERATIVE RADIOGRAPHS AP AND LATERAL VIEW

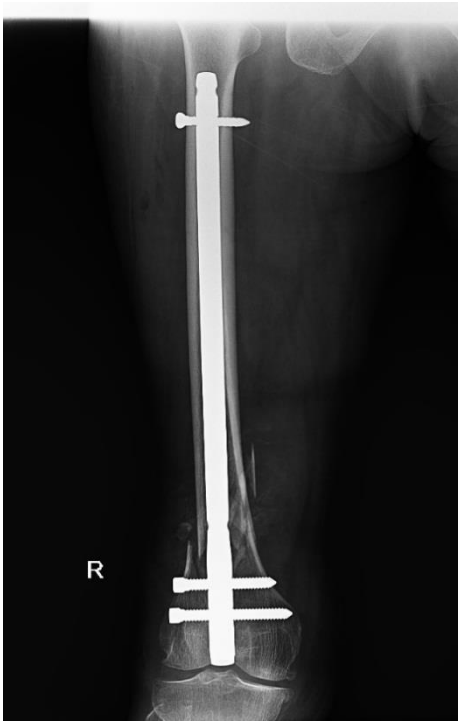
CLINICAL OUTCOME

CASE-2

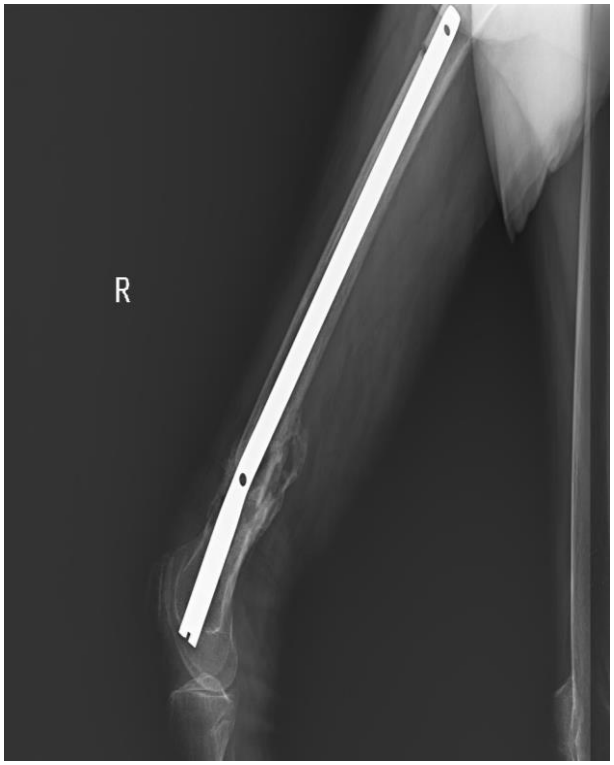
Name	Pappa
Age/sex	70/F
Mode of injury	Fall
Side	Right
Fracture classification	Type A2
Associated injury	Nil
Injury to surgery duration	3 days
Method of reduction	Closed
Knee flexion	120
Neer’s score	86
Complication	Knee pain

PRE OPERATIVE RADIOGRAPHS AP AND LATERAL VIEW

IMMEDIATE POST OPERATIVE RADIOGRAPHS AP AND LATERAL VIEW

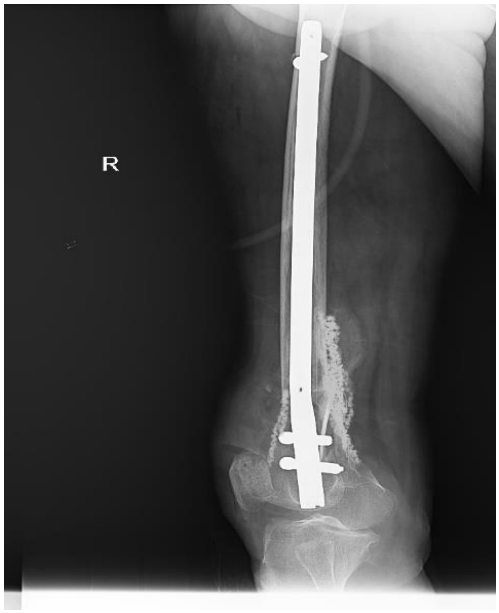


3 MONTHS POST OPERATIVE RADIOGRAPHS AP AND LATERAL VIEW



6 MONTHS POST OPERATIVE RADIOGRAPHS AP AND LATERAL VIEW

1 YEAR POST OPERATIVE RADIOGRAPHS AP AND LATERAL VIEW



CLINICAL OUTCOME:

CASE-3

Name	Palanisamy
Age/sex	60/M
Mode of injury	RTA
Side	Left
FRACTURE CLASSIFICATION	Type A3
Associated injury	# Both bone leg left side
Injury to surgery duration	3 days
Method of reduction	Closed
Knee flexion	110
Neer’s score	87
Complication	Knee pain

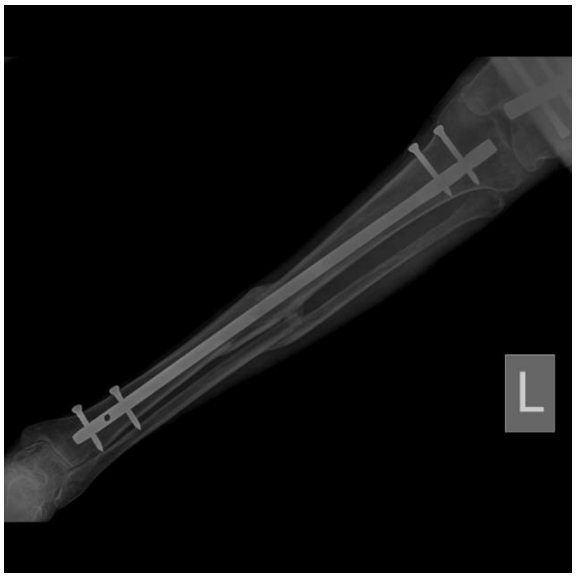
PRE OPERATIVE RADIOGRAPHS AP AND LATERAL VIEW

IMMEDIATE POST OPERATIVE RADIOGRAPHS AP AND LATERAL VIEW

3 MONTHS POST OPERATIVE RADIOGRAPHS AP AND LATERAL VIEW

6 MONTHS POST OPERATIVE RADIOGRAPHS AP AND LATERAL VIEW

1 YEAR POST OPERATIVE RADIOGRAPHS AP AND LATERAL VIEW



CLINICAL OUTCOME

CASE-4

Name	Bothambal
Age/sex	70/F
Mode of injury	Accidental fall
Side	Left
Fracture classification	Type A3
Associated injury	Nil
Injury to surgery duration	3 days
Method of reduction	Closed
Knee flexion	80
Neer’s score	76
Complication	Stiffness

PRE OPERATIVE RADIOGRAPHS AP AND LATERAL VIEW

IMMEDIATE POST OPERATIVE RADIOGRAPHS AP AND LATERAL VIEW

3 MONTHS POST OPERATIVE RADIOGRAPHS AP AND LATERAL VIEW

6 MONTHS POST OPERATIVE RADIOGRAPHS AP AND LATERAL VIEW

1 YEAR POST OPERATIVE RADIOGRAPHS AP AND LATERAL VIEW

CLINICAL OUTCOME

CASE-5

Name	Chellammal
Age/sex	70/F
Mode of injury	Accidental fall
Side	Right
Fracture classification	Type A3
Associated injury	Nil
Injury to surgery duration	3 days
Method of reduction	Open
Knee flexion	120 degree
Neer’s score	86
Complication	Knee pain

PRE OPERATIVE RADIOGRAPHS AP AND LATERAL VIEW

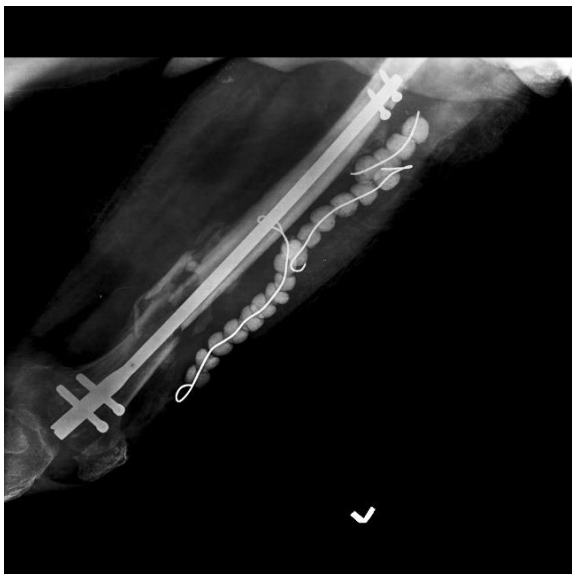
IMMEDIATE POST OPERATIVE RADIOGRAPHS AP AND LATERAL VIEW

1 YEAR POST OPERATIVE RADIOGRAPHS AP AND LATERAL VIEW

CLINICAL OUTCOME:

COMPLICATIONS:

CASE 1- Infection,managed with antibiotic beads



CASE 2- Non union, managed with Dynamisation, Bone grafting and LRS

DISCUSSION:

OUR ANALYSIS:

Age distribution:

Name of the study	Range of age (in years)	Mean age (in years)
Dileep KS et al[22]	24-77	50
Gellman et al[23]	26-84	50
Kumar A et al[21]	62-100	83
Seifert et al[24]	17-92	44
Singh et al[25]	24-70	42.7
Robert F.Ostrum[26]	16-66	24.7
Dunlop[27]	55-98	82
Present study	25-70	55.45

The mean age of the patient in our study is 55.45, as comparable with the studies of Gellman et al, Dileep KS et al.

Sex Predilection:

Name of the study	Total No. Of Males	Total No. Of Females
Dileep KS et al[22]	15	6
Gellman et al[23]	10	12
Seifert et al[24]	29	18
Singh et al[25]	16	4
Robert F.Ostrum[26]	15	5
Dunlop[27]	28	3
Present study	8	12

There was a clear female preponderance in our study with the percentage of female patients in our study being 60%.

In the prospective study conducted by Dulop, the proportion of female patients were higher as in our study.

All the other above mentioned studies had majority of male patients.

Fracture Personality:

Name of the study	Type of Fracture (AO Type)			No. Of Closed Fracture	No. of Open Fracture
	A1	A2	A3		
Dileep KS et al[22]	15	3	3	18	3
SPS Gill et al[28]	16	18	8	30	12
Kumar A et al[21]	4	11	1	16	0
Dunlop[27]	1	9	8	30	0
Present study	7	4	9	20	0

The majority of the fracture pattern in our study is the A3 type of fractures. All the cases were closed fractures.

In the study by Dunlop, the majority of the cases were A2 type and all were closed fractures.

In the other studies said above, there were cases of Grade I and Grade II open injury. With the majority of the fracture classification being Type A1, A2.

Time taken for Union:

Name of the study	Time taken for Union (in weeks)
Dileep KS et al[22]	19.4
Kumar A et al[21]	14.5
Singh et al[25]	11.4
Robert F.Ostrum[26]	14.7
Moed BR & Watson JT[31]	15
Present study	15.15

The average union time in our study is 15.15 weeks as comparable to the other above said studies.

Knee Flexion:

Name of the study	Range of Knee flexion (in degrees)
Dunlop[27]	104
Kumar A et al[21]	100.6
Gellman et al[23]	106
Papadokostasis et.al[29]	104
Henry et al[30]	93
Present study	100

In our study the mean range of knee motion was between 0-100.05 degrees similar to the results seen in the other studies.

Complications:

In our study, one of the patients had deep seated infection in the third post-operative week for which antibiotic bead application has been done. The antibiotic Beads were removed at 6 weeks after application. Patient went to achieve fracture union during the late post operative period.

One patient had non union of the fracture site for which, initially dynamisation was done at 6 weeks. Later radiologically there was no signs of union at 3 months, following which bone grafting has been done. During the followup, the fracture site did not show signs of union, hence redo bone grafting and compression of the fracture site

was done with LRS application. Till the end of the study the fracture site did not unite and the patient is still under followup. The neer's scoring of this patient has been categorized under Failure. Patient factors like smoking, poor nutrition were also implicated for the cause besides the surgical factors.

Shortening seen in two cases after Retrograde nailing of the distal femur fracture. This issue was managed with shoe raise.

Knee stiffness and knee pain was seen in 6 and 7 patients respectively. Both of these complications were attributed to the presence of confounding factors like associated fractures of the both bone leg, patella fractures, presence of osteoarthrithtis of the knee joint.

From our study of retrograde femoral nailing for extra articular femoral fractures, we could summarize the following salient points:

- 20 skeletally mature patients with extra articular distal femur fractures treated with retrograde femoral nailing were followed up for an average period of 1 year.
- Patients in the age group between 25 years to 70 years were included with the mean age of 55.45 years.
- Of the 20 patients, patients were 8 male and patients were 12 female.
- Most commonly affected side is left.
- Fall followed by RTA were the major mode of injury.
- All the patients in the study had closed fractures.

- There were 7 Patients of AO Type A1, 4 Patients of AO Type A2, 9 Patients of AO Type A3
- Most of the fractures (14 patients) were reduced by closed methods with 6 fractures requiring open reduction.
- The mean operating time is 82.75 minutes.
- The average union time is 15.15 weeks
- Post operatively, one case had Non union till the end of the study. One patient developed infection, in which fracture went onto heal with antibiotic bead application. 2 patients had shortening of 1.6 cm and 2.4 cm, managed with shoe raise. 6 patients had knee stiffness and 7 patients had anterior knee pain.
- The average range of knee flexion is 0-100.05 degree.
- By Neer's Scoring system, patients has been graded 12 excellent, patients has been graded 5 satisfactory, patients has been graded 2 unsatisfactory, patients has been graded 1 failure.

CONCLUSION

Retrograde nailing offers a better option in fixation of the supracondylar femur fractures. The major advantage of using nailing is to achieve reduction by closed or percutaneous methods. Closed reduction of these fractures offers the advantages of minimal periosteal stripping, reduced blood loss, operating time and early mobilisation of the patients. Although open reduction has yielded similar results in our study, closed reduction has to be attempted whenever feasible. The use of a single incision for the treatment of patients with floating knee injuries has lead to good clinical results too. Making Prompt selection of patients and fracture patterns helps yielding excellent results when using the retrograde nailing technique.

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PROFORMA

A.

Name :

Age/sex :

Address :

Phone:

RELIGION :

O.P No :

I.P No :

D.O.A :

DATE OF SURGERY :

D.O.D :

B. CHIEF COMPLAINTS :

Duration of symptoms :

C.**PAST HISTORY :**

D.PERSONAL HISTORY :

SMOKER

ALCOHOLIC

E.**INITIAL ASSESSMENT OF PATIENT**

1. Vitals:

PR :

BP :

2.GENERAL SIGNS:

K.SYSTEMIC EXAMINATION:

CVS :

RS :

CNS :

ABDOMEN:

LOCAL EXAMINATION :

CLINICAL DIAGNOSIS:

X-RAY:

DIAGNOSIS:

INVESTIGATIONS

A. HB%

B. GROUPING & TYPING

C. BT/CT

D. PC

E. HIV

F. ECG

G. URINE:

Albumin

Sugar

H. BLOOD:

RBS

BLOOD UREA

SER.CREATININE

ANAESTHESIA:

SURGICAL PROCEDURE:

COMPLICATIONS:

OUTCOME OF TREATMENT:

PATIENT CONSENT FORM

STUDY TITLE:

"A PROSPECTIVE STUDY OF FUNCTIONAL & RADIOLOGICAL OUTCOME OF EXTRA ARTICULAR DISTAL FEMUR FRACTURES TREATED WITH SUPRACONDYLAR NAIL"

Department of Orthopaedics, GMKMCH

PARTICIPANT NAME : AGE : SEX: I.P. NO :

I confirm that I have understood the purpose of surgical/invasive procedure for the above study. I have the opportunity to ask the question and all my questions and doubts have been answered to my satisfaction.

I have been explained about the possible complications that may occur during and after medical/ surgical procedure. I understand that my participation in the study is voluntary and that I am free to withdraw at any time without giving any reason.

I understand that investigator, regulatory authorities and the ethics committee will not need my permission to look at my health records both in respect to the current study and any further research that may be conducted in relation to it, even if I withdraw from the study. I understand that my identity will not be revealed in any information released to third parties or published, unless as required under the law. I agree not to restrict the use of any data or results that arise from the study.

I hereby consent to participate in this study for various surgical/invasive procedures and their outcomes.

Time :

Date : Signature / Thumb Impression Of Patient

Place : Patient's name:

Signature of the Investigator : _____

Name of the Investigator _____

MASTER CHART

SL. NO	NAME	AGE & SEX	SIDE OF INJURY	CLASSIFI-CATION	MECHA-NISM OF INJURY	SURGERY INJURY INTERVAL	DURATION OF SURGERY (IN MINUTES)	REDUCTION TYPE	RADIO LOGICA-L UNION	KNEE FLEXION (IN DEGREES)	NEER'S SCORING	FUNCTIONAL OUTCOME	COMPLICATIONS
1	PALANISAMY	62/M	LEFT	TYPE A3	RTA	3 DAYS	129	CLOSED	12 WEEKS	110	87	EXCELLENT	KNEE PAIN, SHORTENING
2	BOTHAMMAL	70/F	LEFT	TYPE A3	FALL	4 DAYS	74	CLOSED	12 WEEKS	80	76	SATISFACTORY	STIFFNESS
3	GOVINDHAMMAL	65/F	RIGHT	TYPE A1	FALL	4 DAYS	77	CLOSED	14 WEEKS	60	61	UNSATISFACTORY	STIFFNESS, SHORTENING
4	PAPPA	70/F	RIGHT	TYPE A2	FALL	3 DAYS	54	CLOSED	12 WEEKS	120	86	EXCELLENT	KNEE PAIN
5	CHELLAMMAL	70/F	RIGHT	TYPE A3	FALL	3 DAYS	72	OPEN	12 WEEKS	120	86	EXCELLENT	KNEE PAIN
6	NALLAMMAL	70/F	LEFT	TYPE A3	FALL	5 DAYS	97	CLOSED	12 WEEKS	100	86	EXCELLENT	KNEE PAIN
7	KANCHANA	55/F	LEFT	TYPE A1	FALL	6 DAYS	70	OPEN	13 WEEKS	100	73	SATISFACTORY	--
8	RAKKIYANNAN	52/M	LEFT	TYPE A3	RTA	3 DAYS	91	OPEN	24 WEEKS	60	65	UNSATISFACTORY	INFECTION, STIFFNESS
9	MARIMUTHU	50/M	RIGHT	TYPE A3	RTA	4 DAYS	62	CLOSED	---	50	50	FAILURE	NON UNION, STIFFNESS
10	PAPPATHI	65/F	LEFT	TYPE A2	FALL	6 DAYS	86	OPEN	12 WEEKS	120	86	EXCELLENT	--
11	SIRAJ NISHA	54/F	RIGHT	TYPE A2	RTA	7 DAYS	104	CLOSED	15 WEEKS	100	75	SATISFACTORY	KNEE PAIN
12	IMRAN	27/M	LEFT	TYPE A2	RTA	3 DAYS	75	CLOSED	12 WEEKS	120	87	EXCELLENT	--
13	VELLACHI	45/F	RIGHT	TYPE A1	WALL COLLAPSE	4 DAYS	116	CLOSED	16 WEEKS	110	86	EXCELLENT	KNEE PAIN
14	GANAPATHY	46/M	LEFT	TYPE A3	RTA	3 DAYS	82	CLOSED	15 WEEKS	100	86	EXCELLENT	--
15	SELVI	44/F	RIGHT	TYPE A3	RTA	4 DAYS	84	OPEN	18 WEEKS	110	86	EXCELLENT	--
16	PARTHIBAN	39/M	RIGHT	TYPE A3	RTA	4 DAYS	77	CLOSED	14 WEEKS	100	80	SATISFACTORY	STIFFNESS
17	KANAGARAJ	49/M	LEFT	TYPE A1	FALL	3 DAYS	85	OPEN	16 WEEKS	105	80	SATISFACTORY	STIFFNESS
18	VALLIYAMMAL	55/F	LEFT	TYPE A1	FALL	5 DAYS	75	CLOSED	15 WEEKS	106	86	EXCELLENT	--
19	KUMAR	57/M	LEFT	TYPE A1	FALL	5 DAYS	71	CLOSED	24 WEEKS	110	90	EXCELLENT	--
20	POUNAMMA	64/F	LEFT	TYPE A1	FALL	5 DAYS	74	CLOSED	20 WEEKS	120	90	EXCELLENT	--