A COMPARATIVE STUDY ON FUNCTIONAL OUTCOME IN MANAGEMENT OF EXTRA ARTICULAR DISTAL FEMUR FRACTURES BY RETROGRADE INTRAMEDULLARY INTERLOCKING NAILING VS DISTAL FEMORAL LOCKING PLATE

DISSERTATION SUBMITTED FOR MS (ORTHOPAEDICS)

MADURAI MEDICAL COLLEGE MADURAI

2019

THE TAMIL NADU

DR. MGR MEDICAL UNIVERSITY CHENNAI,

TAMIL NADU

CERTIFICATE

This is to certify that the work "**A COMPARATIVE STUDY ON FUNCTIONAL OUTCOME IN MANAGEMENT OF EXTRA ARTICULAR DISTAL FEMUR FRACTURES BY RETROGRADE INTRAMEDULLARY INTERLOCKING NAILING VS DISTAL FEMORAL LOCKING PLATE"** which is being submitted for M.S. Orthopaedics, is a bonafide work of **Dr.R.MURALIDHARAN** , Post Graduate Student at the Department of Orthopaedics surgery & Traumatology, Madurai Medical College, Madurai.

The Dean,
Madurai Medical
College,
Madurai.

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DECLARATION

I, **Dr. R.MURALIDHARAN**, solemnly declare that the dissertation titled "**A COMPARATIVE STUDY ON FUNCTIONAL OUTCOME IN MANAGEMENT OF EXTRA ARTICULAR DISTAL FEMUR FRACTURES BY RETROGRADE INTRAMEDULLARY INTERLOCKING NAILING VS DISTAL FEMORAL LOCKING PLATE",** has been prepared by me. This is submitted to **"The Tamil Nadu Dr. M.G.R. Medical University, Chennai,** in partial fulfilment of the regulations for the award of M.S. degree branch II Orthopaedics.

Dr.R.MURALIDHARAN

PART A

PART –B

ANNEXURES :

a. BIBLIOGRAPHY
b. MASTER CHART
c. SPECIMEN PROFORMA
d. PATIENT CONSENT FORM
e. ETHICAL COMMITTEE APPROVAL
f. PLAGIARISM FIRST PAGE
g. ABBREVIATION

INTRODUCTION

Fractures of the distal femur are complex injuries that gives a challenge to every orthopaeditian. It involves about 1% of all fractures & 6-7% of all femur fractures. The incidence of supracondylar femur fractures is 37/100,000 patients per year. It occurs typically due to two discrete mechanism. In younger individuals it is due to high velocity trauma and associated with severe soft tissue injuries & open fractures. In elderly patients with already pre existing osteopenia, there will be isolated distal femur fractures from low energy trauma even after a simple accidental fall.

Treatment of distal femur fractures has lot of complications, because most of this fractures are located in close proximity to traversing neurovascular structures. Hence they are more prone for injury to vessels. These fractures are near the articular location in relation to knee joint, the movement of this joint affected very early , hence needs an adequate physiotherapy for good functional outcome.

The principles of internal fixation must be met regardless of the choice of fixation that includes anatomical reduction of the articular surface , stable internal fixation, minimal soft tissue damage and early active mobilization. Intramedullary implants offer potential biomechanical advantages over plates because their intramedullary location results in less stress on the implant, they have load sharing property and they can be

inserted with minimal soft tissue stripping & in closed manner without disturbing fracture hematoma. However, antegrade intramedullary nail has been associated with angular deformities because of the inability of distal interlock to achieve control of the small distal fracture fragment.

Locking compression plate techniques has got advantages of rigid and anatomical reduction and stabilization. Since it has got multiple purchases in distal fragment, shown good stability and rotation control in all plane. Locking screw design made this implant of choice in osteoporotic elderly patients. However because of extensive soft tissue damage & open reduction techniques in plating techniques has its own demerits. This study was conducted to comparative analysis the functional outcome in the management of extra articular distal femur fractures by Retrograde Supracondylar interlocking nail vs Distal femoral locking compression plate

AIM OF THE STUDY

The aim of the study is to comparatively analysis the functional outcome in the management of extra articular distal femur fractures by retrograde intramedullary interlocking nail against distal femoral locking compression plate

OBJECTIVE OF THE STUDY

- Comparatively analysis the functional outcome in the management of extra articular distal femur fractures by retrograde intramedullary interlocking nail against distal femoral locking compression plate.
- Comparisons in the functional outcome will be made on the objectives such as intra operative time, blood loss, time for union, knee range of movements, wound complications, knee society score.

REVIEW OF LITERATURE

1933 - MAHORNER and his Colleague BRADBURN reported unsatisfactory results with Russel traction.

1937 - TEES suggested skin traction for reduction and immobilization.

1945 - FUNSTEN AND LEE observed fractures of the distal third healed earlier than that of middle or proximal third.

1948 - UNMANSKY used the reverse Blount plate for fixing the distal femoral fracture.

1951 - DELMORE, WEST and SCHRIBER suggested fibrosis or arthro fibrosis after trauma as the prime cause of knee stiffness.

1953 - LAING P.G studied the blood supply and concluded no major vessels entering distal femur and the abundant blood supply was through genicular vessels and soft tissue attachments.

1955 - WATSON - JONES recommended non operative treatment.

1963 - SIR JOHN CHARNLEY recommended non operative treatment.

1965 - MULLER suggested L shaped compression plate (ASIF condylar plate) and suggested postero lateral incision

1966, MARCUS J. STEWART, SISK and WALLACE retrospectively reviewed 213 cases of supracondylar and inter condylar femur fractures and recommended, two pin traction as the treatment of choice.

1967 - NEER – classified the supracondylar fractures of femur and advised conservative management.

1971 - BROWN & DARCY modified blade plate for use in osteoporotic supracondylar fractures.

1972-OLERUD in his study shows 93% good results in fractures treated with condylar buttress plates, but the procedure was technically demanding with high rate of implant failure which resulted in re fracture after implant removal. The failure rate was high especially in osteoporotic bone.

1973 - CONNOLY advocated closed reduction and cast brace ambulation.

1974 - SCHATZKER reported superior results using operative methods.

1974 - NEER – classified supracondylar / inter condylar fractures, used straight plate and screws and considered conservative treatment was superior to internal fixation.

1979 - SCHATZKER J - concluded that results of blade plate fixation were better.

1980 - FRANK SEINSHEIMER - classified distal femoral fractures and advocated fixation for intra articular fractures.

1984 - SWIONTKOWSI et al. described retrograde intramedullary nailing though insertion in the medial femoral condyle which is in line with the center of the femoral shaft in the coronal plane.

1984 - AO/ASIF Universal tibial and femoral nails were used with entry point in the medial femoral condyle.

In 1986 REGAZONNI, RUEDI and ALLGOWER used the Dynamic condylar screw implant system for fractures of the supracondylar fracture femur, but the main disadvantage of condylar screw implant was that the fixation of condylar lag screw results in removal of a large amount of bone which made redo surgery more difficult and varus collapse of the distal fragment was a recognized complication.

1990 - MULLER classified fracture of distal femur (AO classification)

1991 - MARK S BULTER et al. used interlocking intramedullary nailing for ipsilateral fractures of the femoral shaft and distal part of femur.

1991 - GREEN S, SELIGSON D, HENRY SL, TRAGER S primarily used GSH Supracondylar nail (retrograde interlocking nailing)

1991-SANDERS.R.,SWIONTKOWSKI,used double plating for comminuted, unstable fractures of distal femur.

In 2000, LCP was approved as new AO plate standard

In 2001 KREGOR P.J. STANNARD J., ZLOWODZKI. M. reported early results with L.I.S.S for distal femoral features.In 2003 FRIGG. R. published an article about the "Development of the locking compression plate".

In 2003 SOMMER C, GAUTIERE, MULLER M, HELFET DL,WAGNER reported first clinical results of the locking compression plate.

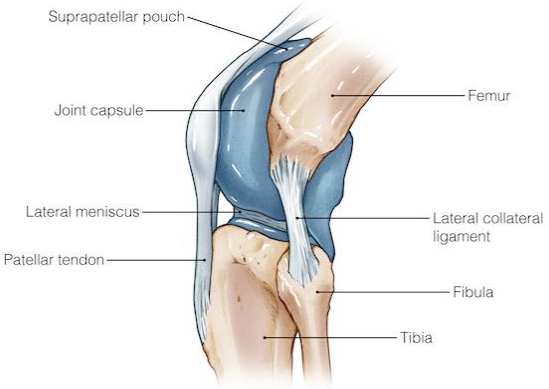
In 2005 SEAN E. WORK, DANIEL N., studied association between supracondylar- Intercondylar distal femur fractures and coronal plane fractures.

ANATOMY

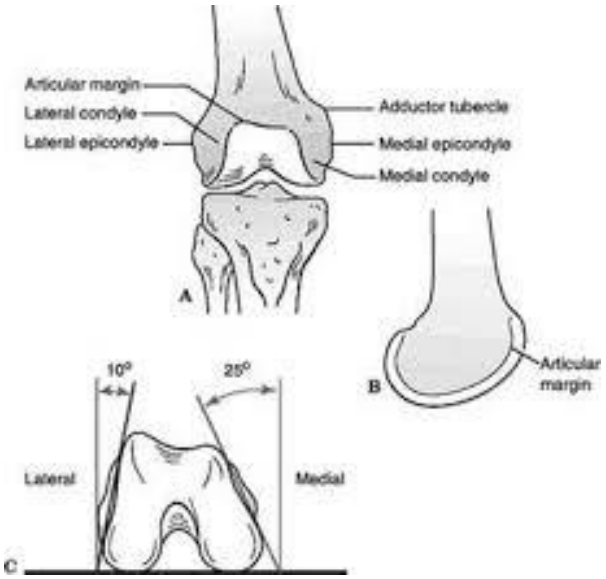
Supracondylar femur is defined as the zone between the femoral condyles and junction of the metaphysis with femoral shaft. Supracondylar femur comprises about distal 15 cm of the femur measured from the articular surface. Femur has two curved condyles at the junction of distal diaphysis and metaphysis. The anterior surface will have a shallow depression for articulation with the patella between the two femoral condyles. The posterior surface between the two condyles is separated by a deep intercondylar fossa.

Medial condyle is longer and extends distally than the lateral femoral condyle. Medial condyle is convex in shape , and it has an epicondyle on the surface which gives attachment to the medial collateral ligament. Another prominence named Adductor tubercle is present on medial surface of the medial condyle in proximal aspect to which the adductor magnus is inserted. The medial head of gastrocnemius arises from the back of medial condyle.

Lateral condyle is stronger & broader than the medial condyle. The lateral condyle will be more anterior compared to the medial condyle in the coronal plane. Lateral displacement of patella will be prevented by this anatomical arrangement. Lateral epicondyle is a prominence in lateral condyle to which fibular collateral ligament is attached.



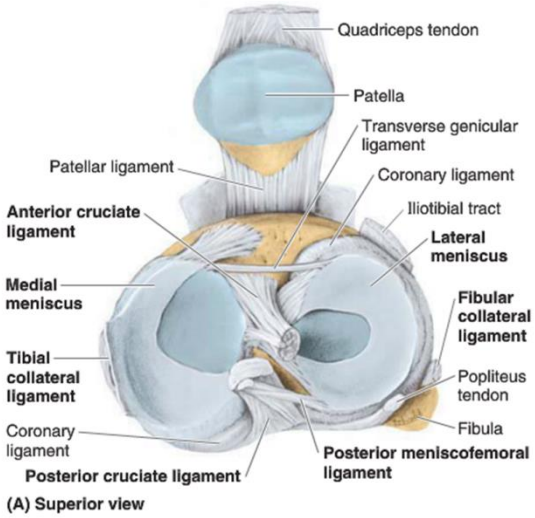
Distal femur end is trapezoidal in shape compared with the cylindrical shaped shaft. Lateral wall inclines 10 degrees and medial wall inclines 25 degrees. On average, the anatomical axis (angle between the shaft of femur and the knee joint) has a valgus 12 angulation of 9 degrees.



Tibial articular surface is convex antero posteriorly as well as from medio laterally. Lateral & medial meniscus creates greater articulating surface between the femur & Tibia. Tibial articular surface has an intercondylar eminence.

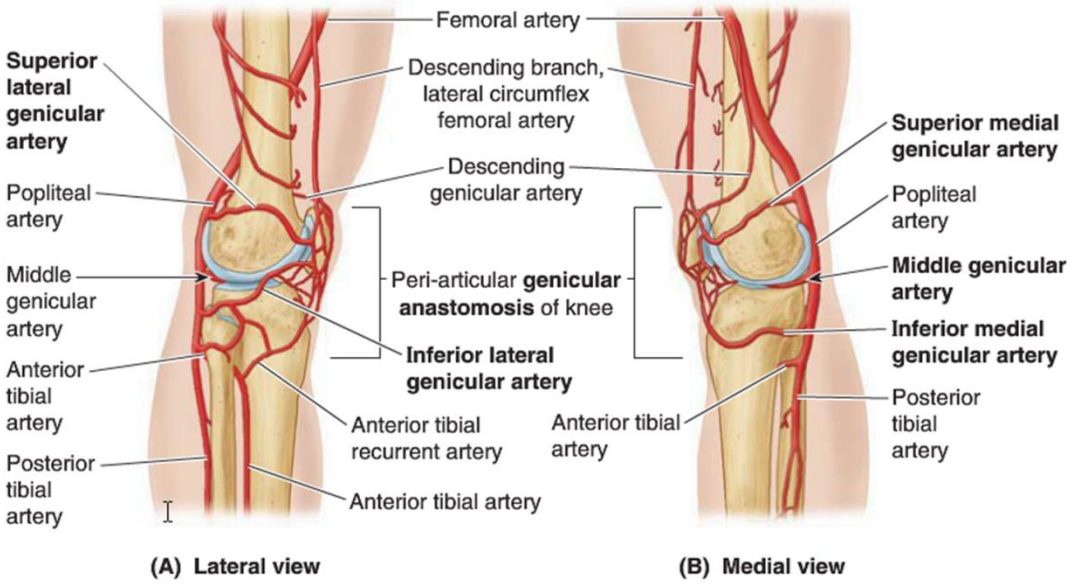
Capsule of knee joint is attached posterior to proximal margins of femoral condyles and the inter condylar region. Medially the capsule is attached proximal to the groove for popliteus tendon.The capsular attachment is deficient above the level of the patella anteriorly. The capsule consists of a synovial & fibrous membrane separated by fatty deposits anteriorly and posteriorly .

The cruciate ligaments are a pair of strong ligaments connects tibia to femur. These ligaments are intra capsular and are extra synovial. Anterior cruciate ligament is attached to anterior part of tibial plateau between the attachments of anterior horns of medial and lateral menisci. It runs postero laterally and is attached to the lateral femoral condyel in posteromedial aspect. Posterior cruciate ligament is stronger, shorter compared to posterior cruciate ligament and tibial attachment is to smooth impression on posterior part of tibial inter condylar area. It runs antero medially and is attached to medial femoral condyle in the anterolateral aspect.



The intra articular entry point of the retrograde supra condylar nailing is situated about 3mm anterior to the attachment of posterior cruciate ligament in the inter condylar notch. There are three major muscle groups in the thigh: the adductors,quadriceps, and hamstrings.quadriceps & hamstrings cross the knee and are integral to its function. Anteriorly, the quadriceps muscles provide power to the knee extensor apparatus and are supplied by the femoral nerve. The quadriceps muscle distally becomes tendon and envelopes the patella and terminates via the patellar tendon at the tibial tubercle. Posteriorly, the “hamstring” muscles that flex the knee are supplied by the sciatic nerve. The semitendinosus and semimembranosus muscles terminate medially and biceps femoris laterally on the proximal tibia as multiple tendon insertions. The gastrocnemius muscle bellies also cross the posterior aspect of the knee from their origin in the supracondylar area.

Blood supply of the distal femur:



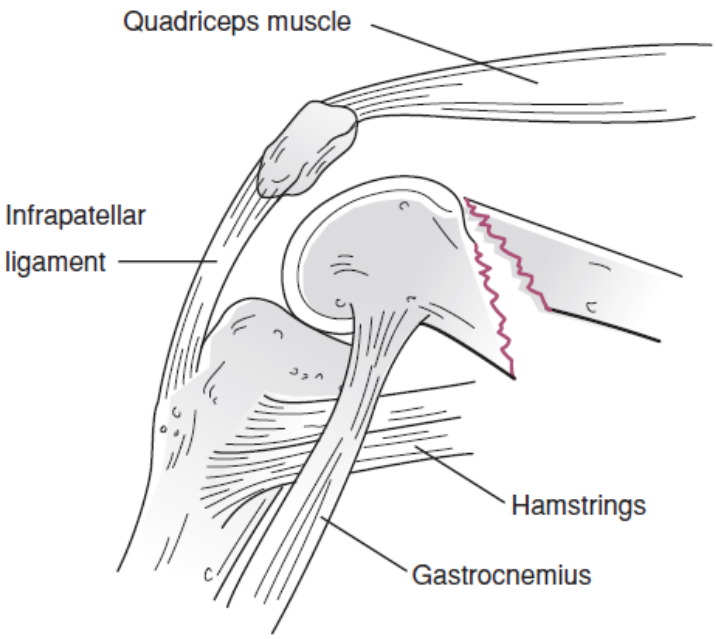
Distal Femur has a very rich blood supply supplied from the anastomoses around the knee joint whose chief contributors are the five genicular collaterals of the popliteal artery namely superior medial genicular,middle genicular & inferior medial genicular artery medially & superior lateral genicular & inferior lateral genicular artery laterally.

NERVE SUPPLY:

The joint is supplied from the femoral nerve from lumbo sacral plexus though its branches to the three vasti, from the sciatic nerve by genicular branches of the deep tibial and common peroneal components and from the obturator nerve by the branch from its posterior division.

BIO MECHANICS OF INJURY

Most distal femur fractures are the result of axial loading with both severe varus, valgus or rotational forces. In younger age group this amount of force is typically the result of high velocity trauma such as motor vehicle accidents which commonly produce these fractures. In older age group due to pre existing osteopenia even a simple accidental fall may produce distal femur fractures. After fracture, the deformities observed are usually results of femoral shortening with posterior angulation, and posterior deviation of the distal fragment and are produced by the quadriceps femoris, posterior muscle group hamstrings, and gastrocnemius muscles.



Varus deformity may result from the pull of the adductor muscles. If an inter condylar fracture is present, there will be rotational misalignment of the condyles because of the separate attachments of the gastrocnemius muscles to each condyle.

In 50% of these patients there is proximal fracture extension into the femoral diaphysis. Ipsilateral injuries to the tibia, ankle, and foot are also common. The axial bending loads applied to the femur in the production of a supracondylar fracture may produce additional injuries to the same extremity. There may be presence of a fracture to the acetabulum , femoral neck and shaft. Approximately 5% to 10% of distal femur fractures are open injuries. The site of the open wound is usually in the anterior thigh proximal to the patella that may damage the quadriceps muscle and extensor mechanism.

Concomitant ligamentous injuries to the knee are uncommonly associated with distal femur fractures . A bony avulsion injuries to the collateral or cruciate ligaments can be identified on the initial injury radiographs. Midsubstance tears and capsular disruptions cannot be assessed clinically at the time of injury because of pain and guarding. The anterior cruciate ligament is the most commonly injured ligament. In supracondylar fractures with significant comminution of the articular surface, the anterior cruciate ligament can be detached with one of the fracture fragments.

Vascular injury associated with supracondylar femur fractures is uncommon, but is a potentially devastating injury . Most injuries to the superficial or profunda femoral arteries occur after fractures of the femoral shaft. The incidence of popliteal artery injury is so low after supracondylar fracture because the vascular bundle is tethered proximally in the hiatus of the adductor magnus muscle and distally by the arch of the soleus.

CLASSIFICATION

Many classification systems have been used for fractures of distal femur like Neer et al., Schwatzker and Tile, Seinsheimer and Muller et al. The most widely accepted and used is that of Muller et al.

AO /ASIF CLASSIFICATION-MULLER CLASSIFICATION,

The classification described by Müller et al. and expanded in the AO/OTA classification is useful in determining treatment and prognosis. It is based on the location and pattern of the fracture and considers all fractures within the trans epicondylar width of the knee. AO Classification based on Muller et al. is as follows:

A Extra articular fracture

A1 Extra articular fracture, simple

A2 Extra articular fracture metaphyseal wedge

A3 Extra articular fracture metaphyseal complex

B Partial articular fracture

B1 Partial articular fracture, lateral condyle, sagittal

B2 Partial articular fracture, medial condyle sagittal

B3 Partial articular fracture, frontal

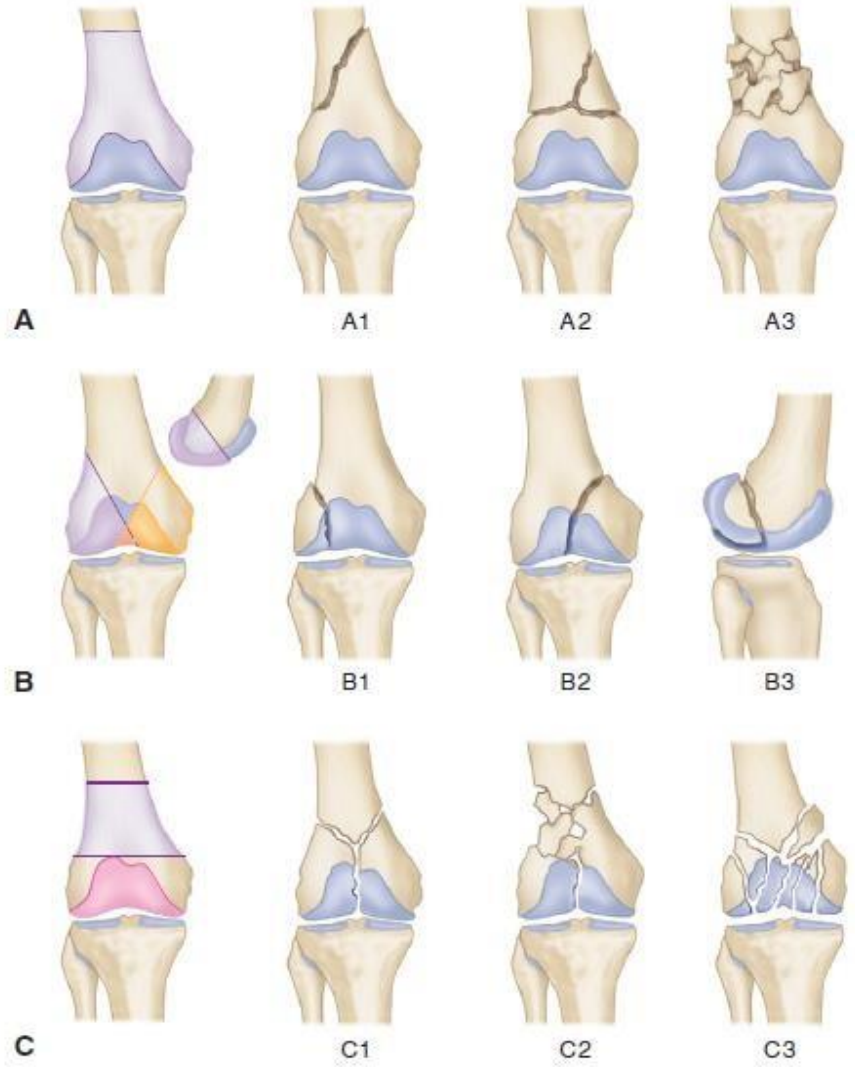
C Complete articular fracture

C1 Complete articular fracture, articular simple, metaphyseal simple

C2 Complete articular fracture, articular simple, metaphyseal multi fragmentary

C3 Complete articular fracture multi fragmentary.

This classification is widely accepted and although the classification is complex, severity of the fracture progressively increases from one type to the next. **Hence we have followed this classification in our study.**



METHODS OF TREATMENT

In 1960s, because of the lack of adequate internal fixation of the fractures, conservative methods such as traction of involved limb and cast bracing, produced better results than operative management, With the development of improved internal fixation devices, treatment options begin to change in 1980s. The blade plate designed by the AO group was one of the first used device and gain wide acceptance. Due to technical complications, a less technically demanding device Dynamic Condylar screw was introduced. The intramedullary nailing were used in the treatment of distal femoral fractures, because of their biological fixation. Nails have been designed specifically for retrograde insertion through inter condylar notch for the treatment of supracondylar and inter condylar femoral fractures. External fixation was used as temporary (or) definitive fixation in severe open distal femur fractures especially those associated with vascular injury. Management of distal femur fracture can be divided into two broad categories.

1. Conservative treatment
2. Operative treatment

CONSERVATIVE MANAGEMENT

Early attempts at internal fixation of these complex injuries were associated with high incidence of malunion, nonunion and infection. Because of the increased risk of complications, numerous authors concluded that closed methods were preferable to operative treatment. With the improvement in surgical techniques, availability of better implants, prevalence of better antibiotics, the conservative management has become almost not applicable for fracture of lower end of femur. In this modern era of fracture management, there is no single absolute indication for conservative treatment.

The relative indications for conservative therapy include.

1. Non displaced (or) Incomplete fractures.
2. Impacted stable fracture in elderly osteoporotic patients.
3. Lack of modern internal fixation devices.
4. Unfamiliarity or inexperience with surgical techniques.
5. Significant underlying medical disease.
6. Advanced osteoporosis
7. Spinal cord injury with fractures.

The goals of conservative treatment are not anatomical reduction of fracture fragment but restoration of overall length and axial alignment.

The criteria's for acceptable fracture management include

< 7^{o} mal alignment in frontal plane.

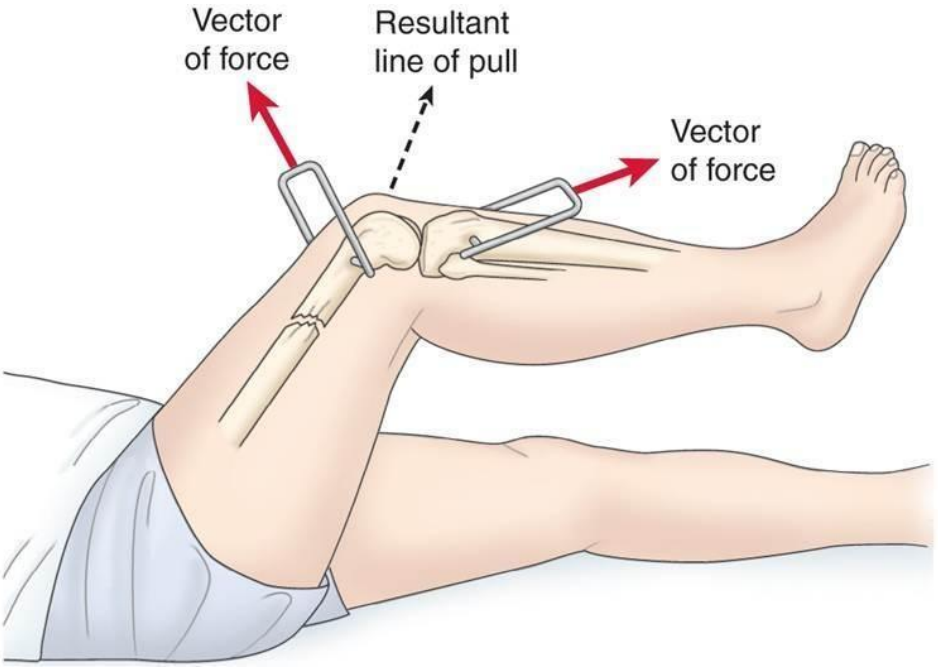
< 10^{0} mal alignment in sagittal plane

Limb shortening < 1.5 cm.

Articular incongruity < 2 mm

Various methods of conservative management include

1. Two pin method of skeletal traction – One through upper tibial and other through lower femoral pin.
2. Skeletal traction with single pin followed by cast immobilization.
3. Ambulatory cast brace method.
4. Fracture Brace technique.



TRACTION

Traction can be used for management of Muller type A and B supracondylar femoral fractures as long as it is possible to restore limb longitudinal alignment, axial rotation, and limb length. Commonly, it involves skeletal traction with one pin placed 10 cm below the tibial tuberosity and the leg maintained in a Thomas splint with Pearson attachment at the level of the fracture and flexed about 20° or on Bohler Braun Splint.10 to 15 kg of traction is applied, in line with the thigh segment. The patient must remain bed bound with maintenance of traction for 2 to 12 weeks, depending on the fracture.

SURGICAL MANAGEMENT

INTRODUCTION:

The combination of properly designed implant, a better understanding of fracture pattern, soft tissue handling, judicious use of antibiotics, and improved anaesthetic methods have made internal fixation safe and practical. Since 1970, all studies comparing the results of conservative and operative methods have favored operative stabilization of distal femur fractures.

The goals of operative treatment of distal femur fractures are

1. Anatomical realignment of fractures
2. Stable fixation of the fractures
3. Early mobilization of the knee joint
4. Early functional rehabilitation of joint by physiotherapy

Principles of internal fixation.

Sequences in the surgical management of supracondylar fracture includes

1. Restoration of articular surface
2. Metaphyseal alignment.
3. Impaction of fracture in osteoporotic patients.
4. Early mobilization of knee.

In Operative Treatment, Various Modalities Include

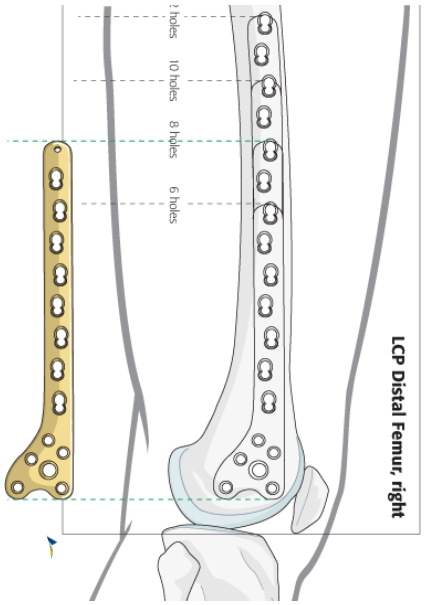
1. Open Reduction Internal Fixation with Dynamic Condylar screw
2. Open Reduction Internal Fixation with Condylar blade plate
3. Open Reduction Internal Fixation with Condylar Buttress plate
4. Open Reduction Internal Fixation with Cancellous screws
5. Closed reduction & internal fixation with ante grade locking nails.
6. Closed Reduction & Internal Fixation with supracondylar nail.
7. Closed Reduction & Internal Fixation with flexible intramedullary nail.

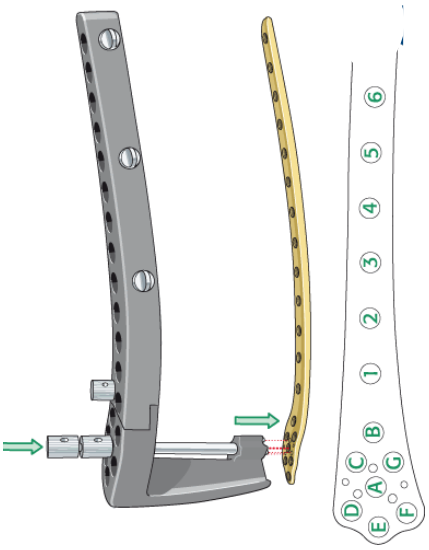
8. Ilizarov ring fixation

9. External fixation.

10. Open Reduction internal fixation with locking compression plate. (LCP)

LOCKING COMPRESSION PLATE





The plate system has many similarities to traditional plate fixation methods with few improvements such as Locking screws which provide fixed angle construct and improved fixation in osteoporotic bones

1. The screws do not rely on plate bone compression
2. Multiple screw fixation in distal femoral condyle allows improved fixation in Type C3 fractures
3. Anatomically shaped distal end is contoured to match the distal femur and hence intra-operative contouring is not required.
4. Combi - holes have additional dynamic compression holes providing

options for axial compression in addition to locking mechanism

5. Lateralisation of proximal femur is prevented by maintaining a gap between the proximal fragment and the plate until locking screw is applied after which the alignment is maintained
6. It combines the advantages of the dynamic compression plate principle with the locking screw head principle, giving the surgeons great flexibility of choice within a single implant. The screw holes in plate have been specially designed to accept either a standard cortical screw with a hemi spherical head or a locking screw with a threaded head.

A locked screw plate construct can be compared to an implanted external fixation device. When under load, the screws in the LCP plates distribute loading on cortical and cancellous bone. They form an angle stable construct. The plate is manufactured with a beveled edge, right and left separately because of larger posterior portion. The plate is pre contoured to the lateral surface of distal femur. It allows up to 3 screws in the condylar potion. It comes in various lengths-5, 7 & 9holed. It is anatomically pre contoured which reduces soft tissue problems and eliminates the need for plate contouring.

LCP combi-holes plates can be used when intraoperative choice between angular stability and compression to be decided. Guiding Jig enables easy and correct mounting of the plate and enable screw fixation

through guide and centering sleeves. Though there is no consensus on the best treatment of complex intra articular fractures and high energy diaphyseal fractures of the long bones. The new screw-plate systems seem to offer an excellent solution for the operative fixation in these cases.

BIOMECHANICS OF RETROGRADE NAILING

The axial stiffness and torsional stiffness of intramedullary nail were less than that provided by locking compression plates.Locking plates were significantly stiffer in valgus compression ,tension and lateral bending. The bending stiffness of both constructs were not significantly different in varus compression, medial bending and bending in flexion.

Although fixation stiffness and fracture site motion required for optimal fracture healing are not currently known, Intramedullary nail & side plate tested in this study were found to have significant different mechanical properties. Reported benefits of intramedullary nail include less extensive surgical exposure, no periosteal stripping, reduced peroperative blood loss , operating time and hospital stay. It remains unclear, under which circumstances these clinical factors favouring a retrograde Intramedullary supracondylar nail, might outweigh any biomechanical advantage offered by locking compression plate.

The supracondylar intramedullary nail was developed by Henry SL, Green. S, Seligson and manufactured by Smith & Nephew Richards ,Memphis, TN in 1988 . It is a cannulated closed section stainless steel intramedullary device designed specifically to provide fixation of supracondylar fractures of the distal femur including those with intra articular extension.

INDICATIONS

1. Supracondylar fractures of femur and mainly extra articular fractures
2. Fractures of middle and distal third in the femur.
3. Supracondylar fractures in total knee arthroplasty patients.
4. Distal femoral fracture with nonunion due to failed plate osteosynthesis
5. Supracondylar distal femur fracture in elderly.
6. Pathological fractures of distal femur
7. Patients with floating knee injuries (Ipsilateral fracture of femur &tibia)
8. In Polytrauma patients to decrease operative time by enabling to do simultaneous procedures for upper limbs &opposite lower limbs

ADVANTAGES

1. It reduces soft tissue dissection and periosteal stripping as it can be inserted via a closed technique.
2. Operating time is reduced.
3. Reduces overall blood loss.
4. Duration of hospital stay is decreased.
5. Advantages of an intramedullary position & biomechanical advantage over laterally placed conventional devices.

6. Medial parapatellar approach used ,permits direct visualization of the articular surface facilitating an anatomical reduction and allowing subsequent reconstructive procedure.
7. Simultaneous treatment of bilateral lower extremity injuries.
8. Treatment of supracondylar fractures and unilateral knee replacement at same surgery.

DISADVANTAGES:

1. Need for a an repeat arthrotomy in patients requiring nail removal
2. Patellofemoral arthrosis
3. Chronic knee stiffness secondary to intraarticular surgery
4. Anterior knee pain
5. Synovial metallosis resulting from nail fretting or breakage

CONTRA INDICATIONS

1. Femoral shaft fracture extending into intertrochanteric region.
2. Knee stiffness
3. High grade open fracture
4. Treatment of skeletally immature patients with open distal femoral physis.

DESIGN FEATURES

The standard multihole intramedullary supracondylar nails are fully cannulated closed section, stainless steel implants with an outer diameter of 12 mm or 13 mm. The IMSC five nail is available in 11 mm,12 mm or 13 mm outer diameters. Both nails available in length of upto 30cm. In the standard multihole nail, there are 7 – 12 holes for placement of 5.0. mm locking screws (depending on the length of the nail.) In the IMSC five nail, there are five holes in all length, two holes proximal and three holes distal which also accept 5.0mm locking screws.. It has 8 degree anterior bend. The nails are designed to permit the distal driving end to be countersunk below the level of the articular surface of the femur.

PREOPERATIVE PLANNING

Preoperative planning is essential to gain a thorough understanding of the fracture pattern. This will confirm the applicability of the supracondylar nail and determine the minimum possible surgical exposure necessary for its insertion. Preoperative radiographs must be adequate to determine whether or not a formal arthrotomy is necessary to reduce and stabilize displacement of the articular surface. Traction radiographs may help determine whether or not there is intraarticular extension. When the joint surface is intact (AO type) percutaneous nail

insertion can substantially reduce the invasiveness of the procedure. Fractures with articular or intercondylar displacement (AO type C fracture) are best approached though formal medial para patellar arthorotomy, which provides adequate exposure for open reduction of the articular surface. CT scan of the knee may be required to identify and accurately delineate condylar fracture especially in the coronal plane.

The geometry of the distal canal must be relatively normal without deformity from old fracture or metabolic bone disease. Overreaming by 1.5.or 2 mm facilitates locking when the 250 mm length nail is used ,by minimizing distortion of the nail with the intramedullary canal. Static locking is recommended for all fractures. The distal screws prevent the nail from protruding into the knee joint. Addition of proximal locking provides length and rotational stability.

DRILL GUIDE ASSEMBLY

The selected intramedullary nail is attached to the IMSC drill guide using the nail drill guide bolt and the wrench. The bend in the nail should face anterior to the patient unless the fracture configuration is such that placing it posterior would be more appropriate. The drill guide should extend to the lateral side of the patient if not the station for nail is reversed.

The IMSC guide bar is attached to either the inboard or outboard station of the drill guide using the guide bar bolt. The station is selected

based on the size of the patient and the amount of soft tissue surrounding the knee. It is preferable to use the inboard station, if possible. The apex of the guide bar must be oriented identical to the nail. The guide bar bolt is tightened with the wrench and the alignment rod is placed through the IMSC guide bar and through the nail.

EFFECT DUE TO ENTRY POINT

The most unique about retrograde supracondylar nailing of the femur is the intraarticular starting point. There continues to be concern regarding knee function after retrograde intramedullary nailing, despite recent clinical reports showing normal in effects. One of the concern is the potential for injury to the articular cartilage as a consequence of creation of the intracondylar entry portal.

In 1975, Insall & Aglietti et al, studied the normal patellofemoral contact area with the knee. In full extension, the patella is completely cephalad to the femoral articulaar surface. At 30 degrees of flexion, the inferior aspect of the patella is in contact with the most superior of the femoral condyes, with a contact area of 2.95 cm2. At 60 degrees; the femoral contact area is located at the femoral groove, slightly inferior to and encompassing a greater area (4.72 cm2) than at 30 degrees. At 90 degrees, the femoral contact area is somewhat larger (5.0 cm2) and is located at the femoral groove just above the notch. At 120 degrees, the patella is in contact with the femoral condyles on either side of the notch.

Morgan et.al. recently studied the effect of retrograde nail insertion on these contact forces by using cadaver knee specimens and pressure selective film.. Testing was performed at 90 degrees of knee flexion in intact normal knees and in knees, in which the nail was recessed 3mm below the articular cartilage, was flesh with the cartilage, or protruded 1 mm beyond the articular surface. The patellofemoral contact area was the same for all four groups, and patellofemoral contact pressure was adversely affected only in the protruding nail group. The authors concluded that with proper nail placement patellofemoral biomechanics should remain unaltered.

Studies by David b et al indicating entry portals are located in a tight cluster 6.21 mm mean (range 4 mm)anterior to posterior cruciate ligament attachment & 2.67 mm mean, (range 11mm) medial to centre of distal femoral condyles.

BIOMECHANICS OF LOCKING COMPRESSION PLATE

Locking compression plate are a hybrid of plate technology and percutaneous bridge plating using locked screws as a fixed angle device. Marti et al. showed that these devices allow much greater load bearing than regular plates. Locked plates also can be used in a hybrid fashion with locked and unlocked screws and are mechanically similar to pure locked constructs according to Gardner et al. They also provides adequate load-bearing strength to avoid medial and lateral plating in the distal femur. The features are

1. The screws do not rely on plate bone compression
2. Multiple screw fixation in distal femoral condyle allows improved fixation in Type C3 fractures
3. Anatomically shaped distal end is contoured to match the distal femur and hence intra-operative contouring is not required.
4. Combi - holes have additional dynamic compression holes providing options for axial compression in addition to locking mechanism
5. Lateralisation of proximal femur is prevented by maintaining a gap between the proximal fragment and the plate until locking screw is applied after which the alignment is maintained

It combines the advantages of the dynamic compression plate principle with the locking screw head principle, giving the surgeons great flexibility of choice within a single implant. The screw holes in plate have been specially designed to accept either a standard cortical screw with a hemi spherical head or a locking screw with a threaded head.

MATERIALS & METHODS

AIM:

To comparatively analyse the functional outcome in the management of extra articular distal femur fractures by retrograde intramedullary interlocking nailing vs distal femoral locking compression plate

OBJECTIVE:

- To compare the functional outcome in the management of extra articular distal femur fractures by retrograde intramedullary interlocking nailing vs locking compression plate
- Comparative analysis to be made on the time taken for surgery, blood loss,time to union,American knee society score, wound complications

DESIGN: prospective study

PERIOD: August 2016 to September 2018

This study is a prospective study with a sample of 28 patients with extra articular supracondylar femur fractures. Of this 14 were treated with Retrograde intramedullary interlocking nail and 14 treated with Distal femoral Locking Compression Plate fixation at Govt Rajaji hospital Madurai. Patients were selected from among the admissions to the trauma ward in the Department of orthopaedics surgery & traumaology and recruited into the study prospectively based on the following criteria.

INCLUSION CRITERIA:

1. Age from 18-80 years
2. Both sexes
3. Cases of supracondylar femur fractures –Simple, Comp Gr I,II,IIIA
4. Muller classification A1,A2,A3

EXCLUSION CRITERIA:

1. Comp Gr IIIB, IIIC fractures
2. Patient with associated patella fractures
3. Patients with severe OA knee
4. Age less than 18 years
5. Muller classification B,C types

METHODOLOGY :

A total of 28 patients with extra-articular supracondylar femur fractures were chosen and sampling based on the inclusion and exclusion criteria and included to the study. After admission and stabilization of the patient detailed examination of the patients was carried out. Then standard Antero – Posterior and Lateral view X – Rays are taken and the fracture configuration noted. Patients were initially managed with intra venous fluids, whole blood transfusion, & then limb rested in Thomas splint by either upper or lower tibial pin traction to immobilize and maintain the length & alignment of the fractures. Computerized Tomography is also

taken when needed to assess the exact alignment of the fragments. The fractures are classified according to Muller classification.

PRE OPERATIVE ASSESMENT:

All routine basic investigations include complete haemogram, Blood Grouping and Viral markers were done .If patients aged more than 50years both cardiologist and Thoracic physician opinion obtained to know cardiac and pulmonary reserve of the patient to withstand surgical procedure.

Informed & written consent obtained from all patients. Preoperative hemoglobin levels and also amount of blood loss during surgery, based on which Blood Transfusion planned for all patients. Test dose of antibiotics and test dose of xylocaine was done. Both lower limbs prepared up to hip level & bladder, bowel preparations done .

SUPRACONDYLAR NAILING TECHNIQUE:

PATIENT POSITIONING

Under spinal anaesthesia the patient is placed supine on a radioluscent table. The leg should be draped free and knee should flexed 45 degrees to 55 degrees with a leg roll. Knee flexion allows proper access to the entry portal, as well as reduction and fixation of inter condylar fractures. A tourniquet is not necessary. Fracture can be reduced either with a tibial traction pin or with manual traction applied by gripping the gastrocnemius muscle at the level of proximal tibial border. Occasionally, a femoral distractor is useful to maintain length and rotation.

OPERATIVE TECHNIQUE

Extra articular fractures can be approached through a limited incision using a variety of techniques. An infrapatellar incision 4 to 5 cm long is made either directly over the patellar tendon or at its medial edge. The patellar tendon is correspondingly then either split longitudinally or retracted laterally (as for tibial nailing, hence the ability to fix a floating knee with minimal dissection) .The entry point is 5mm anterior to the attachment of posterior cruciate ligament and it lies slightly medial to the center of the distal femoral condyles. Direct visualization of the entry site in the intercondylar notch can be accomplished by excision of the fat pad. C -arm guidance confirms that the entry site is along the axis of the distal fragment in both the AP and lateral planes. Either of the two intrapatellar incisions can easily be extended to a formal medial para patellar arthrotomy if necessary. A ¼ - inch twist drill or Steinman pain is used to perforate the subchondral cortex. The subsequent path created in the distal fragment by passage of hand-held reamers is the most crucial reduction maneuver of the entire procedure. C-arm must confirm that the reduction is in perfect alignment along the longitudinal axis of the distal fragment, because the varus/valgus and sagittal alignment of the fracture will be determined by this.

A guide wire is then passed into the distal fragment, the fracture is reduced by manual traction and , the guide wire will be passed into the proximal canal. If difficulty is encountered, a femoral distraction can be applied to achieve reduction but it must be positioned where it will not interfere with either the nail or its lateral targeting device. Length and alignment are maintained manually or with a femoral distractor while the canal is reamed incrementally to at least 1 mm greater than the anticipated

nail diameter. Over reaming by up to 2 mm may be necessary when the 250 mm length nail is used to minimize the distortion within the canal, which can complicate proximal interlocking. The reamers must be passed far enough proximally to accommodate the length of the nail being used.The distal end of the nail should be at least 1 mm deep to the subchondral bone. Length and alignment are confirmed on the image intensifier prior to interlocking. The nail should be statically locked in all cases. At least two screws should achieve secure bicortical purchase in the distal fragment. The same is true proximally unless using a nail long enough to gain at least approximately 10 mm of secure circumferential intramedullary purchase in which case a single proximal interlocking screw may suffice.

REDUCTION:

Proper alignment and reduction must be completed using traction or manual manipulation to reduce the fracture. The primary intent is to restore anatomic alignment between the condyles and the structural integrity of the shaft. Both A-P and lateral radiographs should be taken intraoperatively for the confirmation of proper reduction and alignment.

NAIL INSERTION

After removal of the alignment rod from the nail/drill guide assembly, the nail is advanced by hand through the intercondylar notch into the

medullary canal. Usually the apex of the angle is directed anteriorly. The distal nail tip should be counter sunk 1-2 mm below the surface of the intercondylar notch. There is a notch on the drill guide to aid in visualizing the connection with the nail on the image intensifier.

LOCKING COMPRESSION PLATE TECNHIQUE:

Position of The patient :

For Locking compression plating patients were positioned in supine positions with both lower limbs extended and a small triangular bolster placed below the thigh in operative limb to make hip in neutral rotation and also make knee flex to aid in posterior vessels falls away from operative area.

Incision and surgical approaches

Lateral approach for distal femur

Procedure:

Under spinal/General Anaesthesia patient positioned supine on the radiolucent table. A triangular bolster kept under the operating knee to allow 30- $60^0$of flexion to relax Gastrocnemius muscle. A 10-15cm long skin incision is made, Sub cutaneous tissue, , tensor fascia lata,vastus lateralis is incised till the lateral condyle is reached, reduction of the condyles done using point reduction clamp and image intensifier. Reduction held temporarily using two K wires by avoiding disturbance to plate

positioning. The plate along with jig assembly is slid along the shaft using the bevel. The jig plate assembly is held with distal condylar portion with a temporary K wire. The condylar fragment is aligned with metaphyseal fragment by appropriate manipulation (traction and rotation) under image control.

The reduction is held temporarily with k wire, after aligning the plate along the shaft. After confirming the reduction and plate position parallel to the condyles the second K wire passed into the jig, plate and condyle. In this position the anatomically pre bent implant matches the distal femur. The condyles were fixed to the plate using 6.5mm cannulated locking head cancellous screws without disturbing the reduction.The reduction and the position of the plate were controlled clinically and by image intensifier help (axis, length, and rotation).The locking head screws inserted using jig sleeve assembly with image intensifier in accordance with pre op planning. The insertion guide is removed and wound is closed over a suction drain. Sterile non bulky dressing applied.

POST OPERATIVE PROTOCOL

POST OPERATIVE CARE AND REHABILITATION

Postoperative rehabilitation plays a major role in recovery of range of movement and improving the quadriceps mechanism and functions of joint. If fracture fixation is stable, early rehabilitation can be started.

Increased and useful useful range of motion can be achieved, in the first few weeks of postoperative period.

Early Phase (1-3 Weeks)

The primary goal is full range of motion, started on 2nd day, if fixation is stable. Static & dynamic Quadriceps strengthening and hamstring stretching exercises are encouraged. Hip and ankle mobilization exercises are continued.

Continuous passive motion – when started in 1st week has following advantages

1. Improves early range of motion of knee.
2. Decreases incidence of deep vein thrombosis and pulmonary embolus.
3. Pain relief and Early discharge.
4. Better results when used at a rate of 1 cycle/ min, with 40-50 degrees of maximum flexion for first 3 days.
5. Non – weight bearing with walker support started in 1st week, if fixation is stable. Sutures are removed between 10th - 12th postoperative days.

Late Phase (After 3weeks)

Continue isometric quadriceps setting exercises, Active and passive Range motion exercises.

Partial weight bearing is allowed after 3rd week.

Full weight bearing is allowed after radiological evidence of healing.

FOLLOW UP:

All the patients were advised to review for regular follow up in regular interval.Initial 6 weeks they were advised to review every 2 weeks then every month for first 3 months and every 3 months for two years. In each visit their functional outcome analyzed and also good quality digital x ray of the knee with lower thigh taken to assess the union of fractures and see the signs of fracture union,

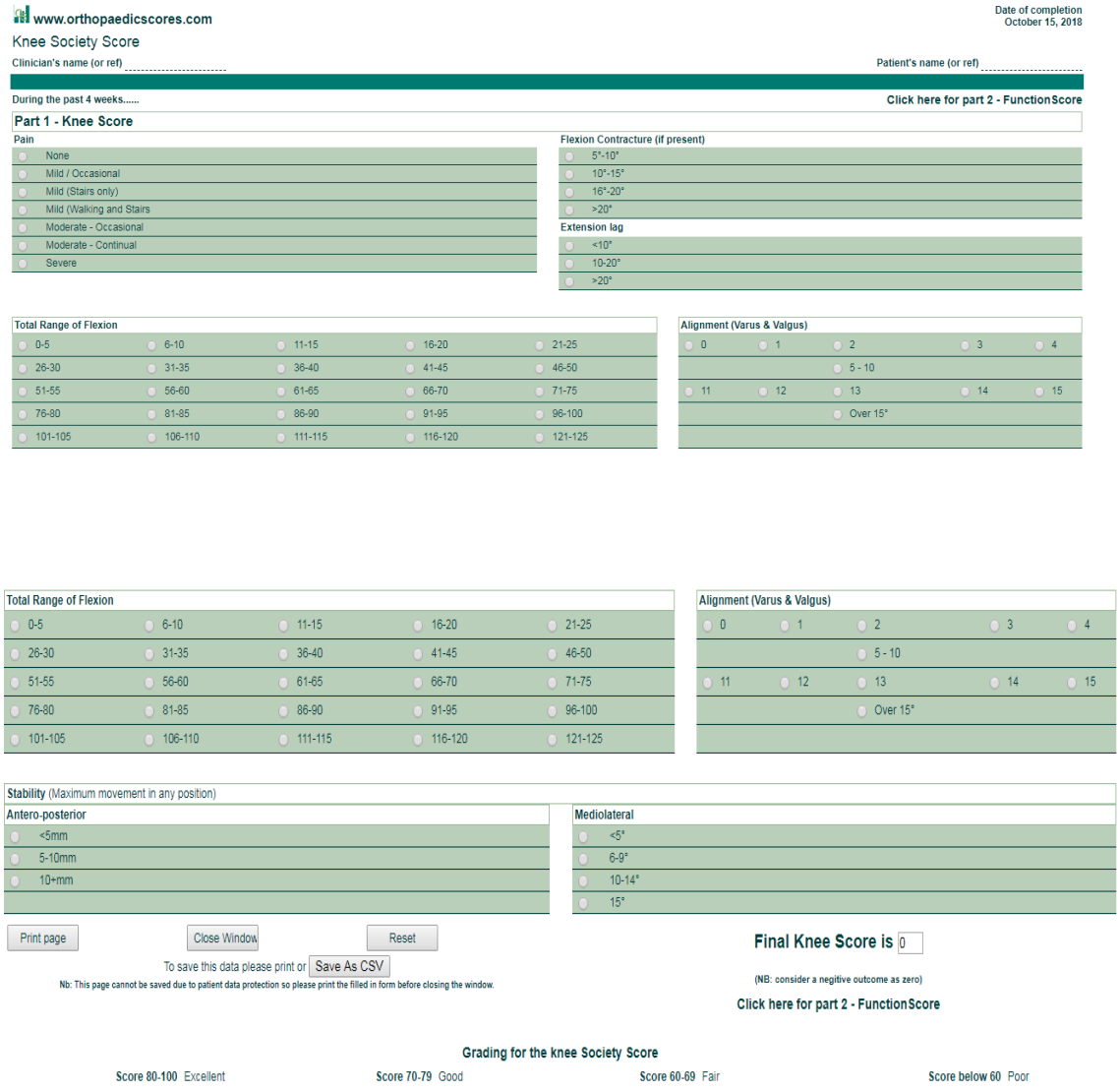
Functional outcome of all patients analyzed using AKSS American Knee Society Score

It has six variables positive points for three variables Pain, Range of movements, Stability(both antero-posterior & medio- lateral stability) substraction points for three variables Flexion contracture, Extensor lag and varus valgus alignment. All patients functional outcome analyzed in each visit & the final 1 year follow up results were included for comparison.

	Point
Pain	
None	50
Mild or occasional	45
Stairs only	40
Walking and stairs	30
Moderate	
Occasional	20
Continual	10
Sever	0
Range of motion	
5°=1 point	25
Stability	
Anteroposterior	
<5 mm	10
5–10 mm	5
10 mm	0
Mediolateral	
<5°	15
6–9°	10
10–14°	5
>15°	0
Subtotal	[–]
Deductions points (minus)	
Flexion contracture	
5–10°	2
10–15°	5
16–20°	10
>20°	15
Extension lag	
<10°	5
10–20°	10
>20°	15
Alignment	
5–10°	0
0–4°	3 points each degree
11–15°	3 points each degree
Other	20
Total deductions	[–]
Total knee score	[–]

< 60	Poor
61-70	Fair
71-80	Good
> 81	Excellent

AMERICAN KNEE SOCIETY SCORE



www.orthopaedicscores.com

Knee Society Score

Date of completion
October 15, 2018

Clinician's name (or ref) .....

Patient's name (or ref) .....

During the past 4 weeks.....

Click here for part 2 - FunctionScore

Part 1 - Knee Score

Pain

- None
- Mild / Occasional
- Mild (Stairs only)
- Mild (Walking and Stairs
- Moderate - Occasional
- Moderate - Continual
- Severe

Flexion Contracture (if present)

- 5°-10°
- 10°-15°
- 16°-20°
- >20°

Extension lag

- <10°
- 10-20°
- >20°

Total Range of Flexion

0-5	6-10	11-15	16-20	21-25
26-30	31-35	36-40	41-45	46-50
51-55	56-60	61-65	66-70	71-75
76-80	81-85	86-90	91-95	96-100
101-105	106-110	111-115	116-120	121-125

Alignment (Varus & Valgus)

0	1	2	3	4
		5 - 10		
11	12	13	14	15
		Over 15°		

Total Range of Flexion

0-5	6-10	11-15	16-20	21-25
26-30	31-35	36-40	41-45	46-50
51-55	56-60	61-65	66-70	71-75
76-80	81-85	86-90	91-95	96-100
101-105	106-110	111-115	116-120	121-125

Alignment (Varus & Valgus)

0	1	2	3	4
		5 - 10		
11	12	13	14	15
		Over 15°		

Stability (Maximum movement in any position)

Antero-posterior

- <5mm
- 5-10mm
- 10+mm

Mediolateral

- <5°
- 6-9°
- 10-14°
- 15°

Print page | Close Window | Reset

To save this data please print or Save As CSV

Nb: This page cannot be saved due to patient data protection so please print the filled in form before closing the window.

Final Knee Score is 0

(NB: consider a negitive outcome as zero)

Click here for part 2 - FunctionScore

Grading for the knee Society Score

Score 80-100 Excellent | Score 70-79 Good | Score 60-69 Fair | Score below 60 Poor

OBSERVATION

The Patients included in study were evaluated & instructed to review as advised and comparative analysis were made as per the following criteria based on their all variables.

1.Age distribution

2.Sex distribution

3.Side of injury

4.Mode of injury

5.Grading of injury

6.Subtype of fracture

7.associated injuries

8.Open fractures

9.Union in weeks

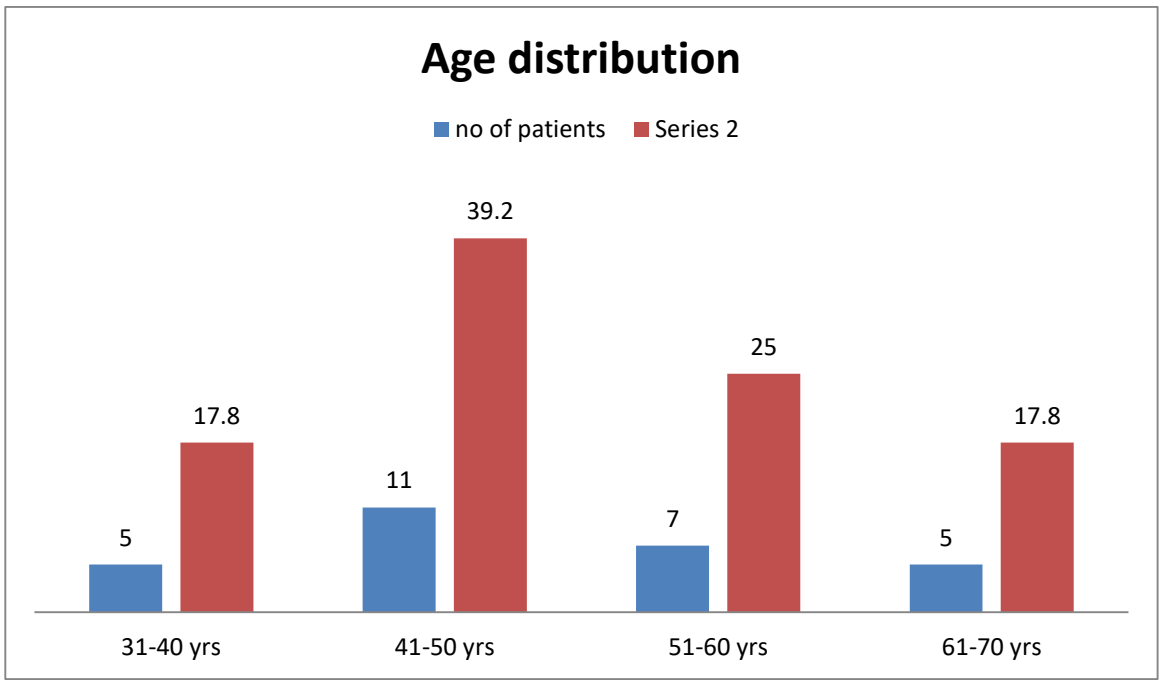
10.Time taken for surgery

1.AGE DISTRIBUTION

The age groups varied from 18 years to 80 years with the mean age of 48.7 years. Incidence of fracture was observed maximum between 40 – 60 years of age.

More clusters found in 41-50years.

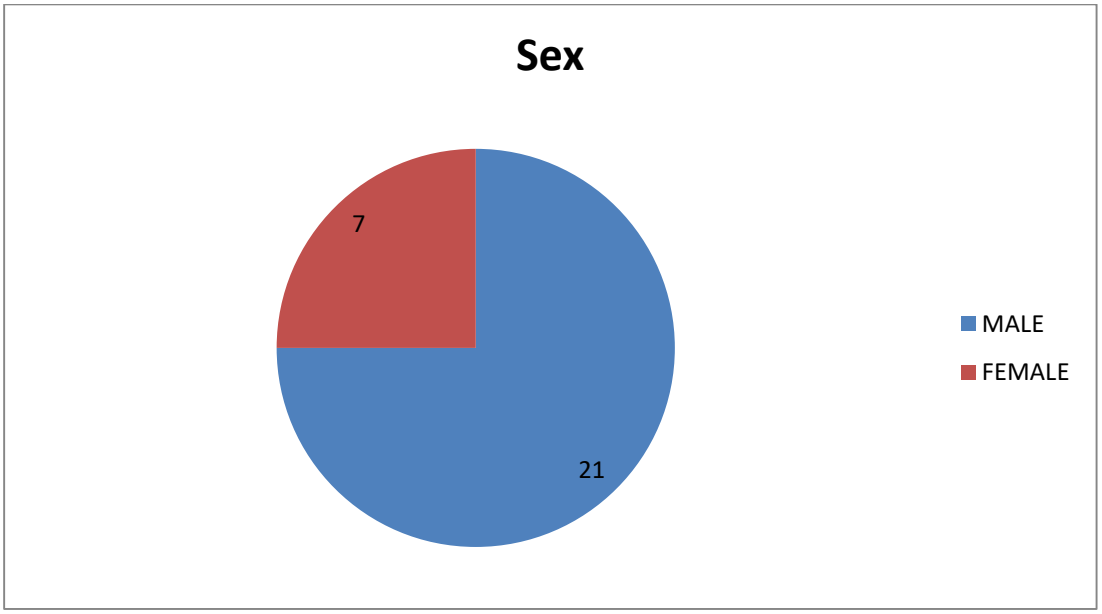
Age Group	Number of cases	Percentage
31 – 40 years	5	17.8%
41 – 50 years	11	39.2%
51 – 60 years	7	25%
61 – 70 years	5	17.8%



2.SEX DISTRIBUTION

Among the 28 cases, males were predominant than female.males were 21 (78.6%) than females (21.4%)

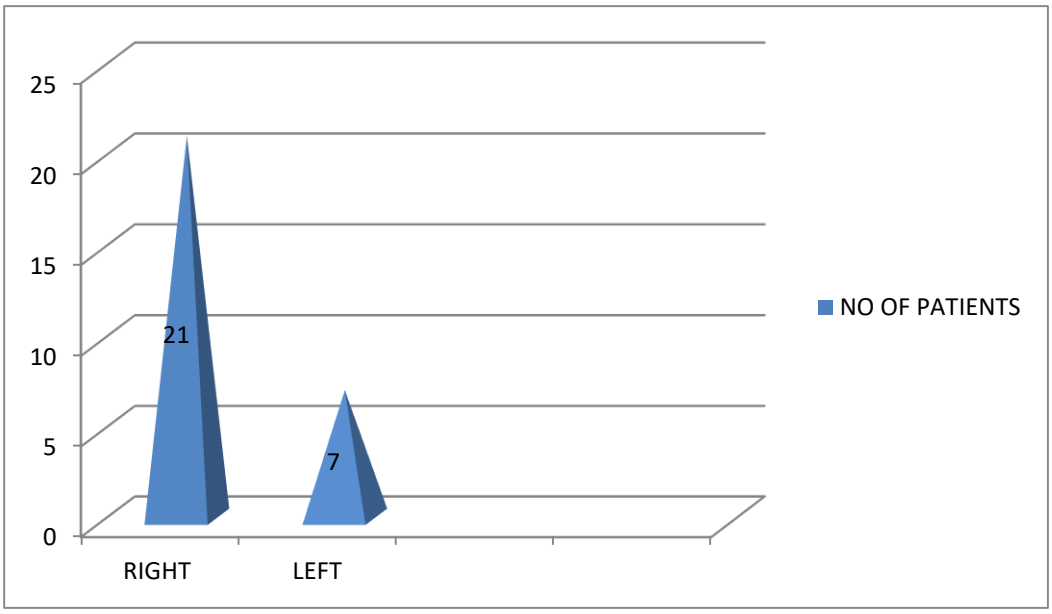
Sex	Number of cases	Percentage
Male	21	78.6%
Female	7	21.4%



3.SIDE OF INJURY:

Right side was common in our series

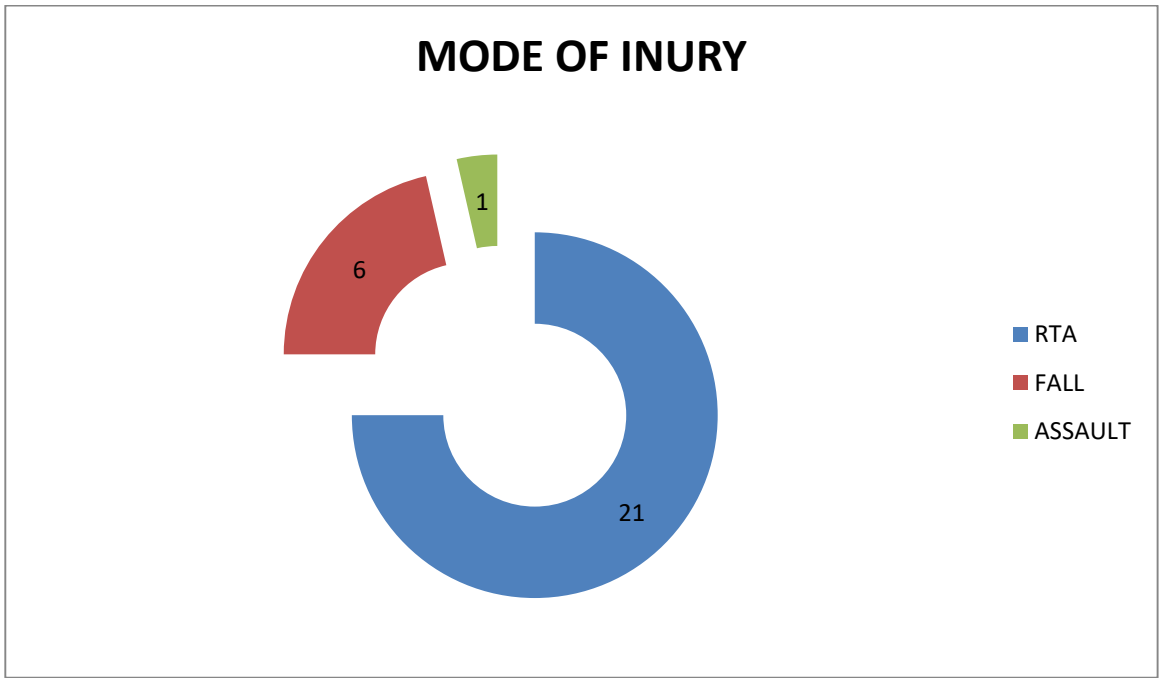
Sex	Right	Left	Total
Male	14	7	21
Female	3	4	7
Total	17	11	28



4.MODE OF INJURY :

Among 28 cases , 21 cases were due to road traffic accidents and 6 cases due to accidental fall & 1 case was assault injury .

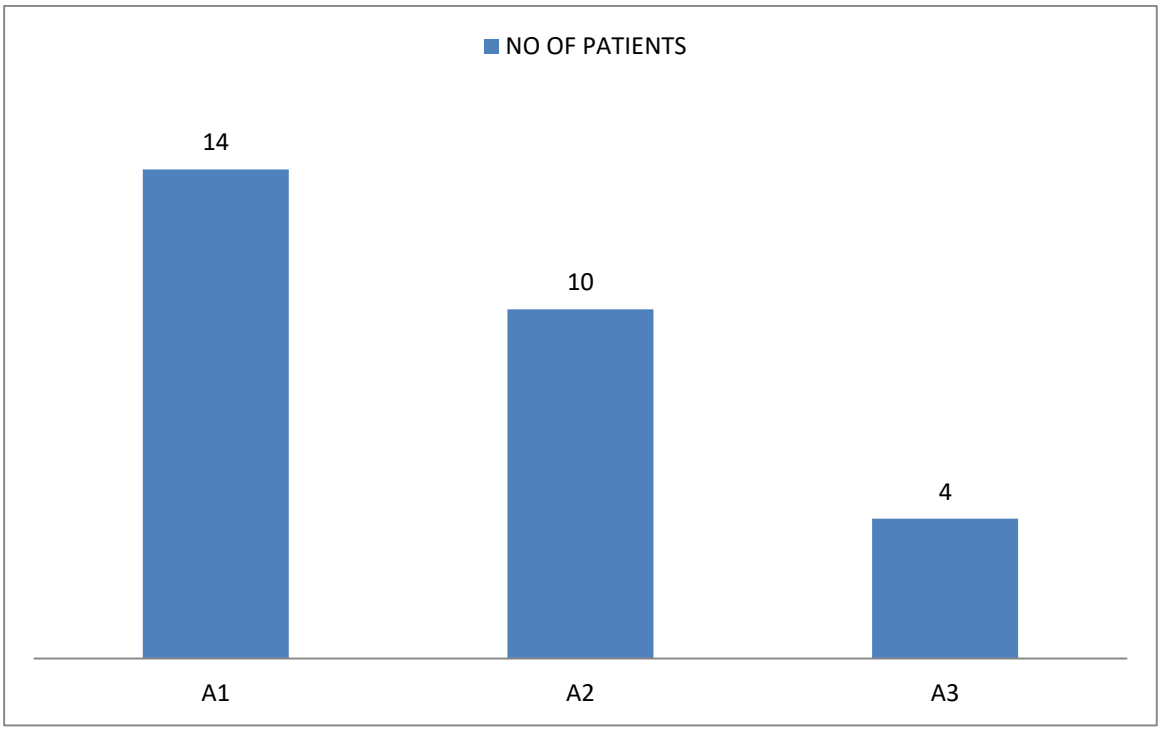
Mode of Injury	Number of cases	Percentage
RTA	21	75.5%
Fall	6	21.5%
Assault	1	3.5%



5.MULLER SUBTYPE OF FRACTURE

Among 28 extra articular distal femur fractures,subtype A1 was more common

Muller sub type	Number	Percentage
A1	14	50%
A2	10	35.7%
A3	4	14.2%



6.ASSOCIATED INJURIES

Associated injuries mostly involves ipsilateral limb injuries since most cases are due to motor vehicle accidents.

Many poly trauma patients had associated multisystem involvement like multiple rib fractures hemothorax and head injury.

Distal radius fracture-2

Fracture Both bone leg – 2

Pubic rami fracture-1

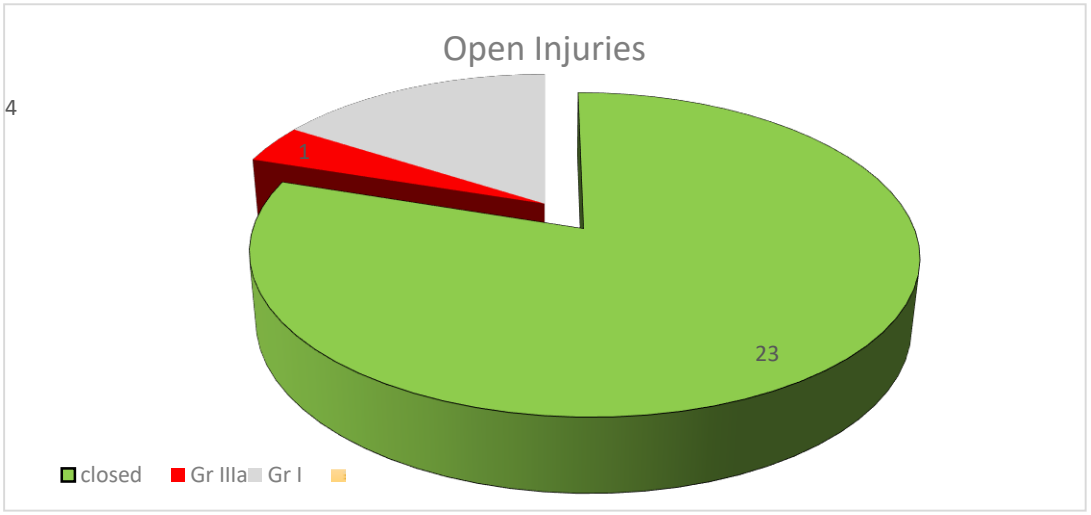
Clavicle fracture-4

Opposite femur fracture -3

7.OPEN FRACTURES

Among 28 cases of distal femur in this study, closed fractures were more common

Gustilo –Anderson Classification	Number of Cases
Closed	23
Grade I	4
Grade IIIA	1



8.UNION IN WEEKS

Among 28 supracondylar patients , tab 8.1 shows those who were operated with LCP, the average no of weeks for union is 12.14 weeks and tab 8.2 shows average no of weeks of union those who were operated with SCN is 10.50 weeks

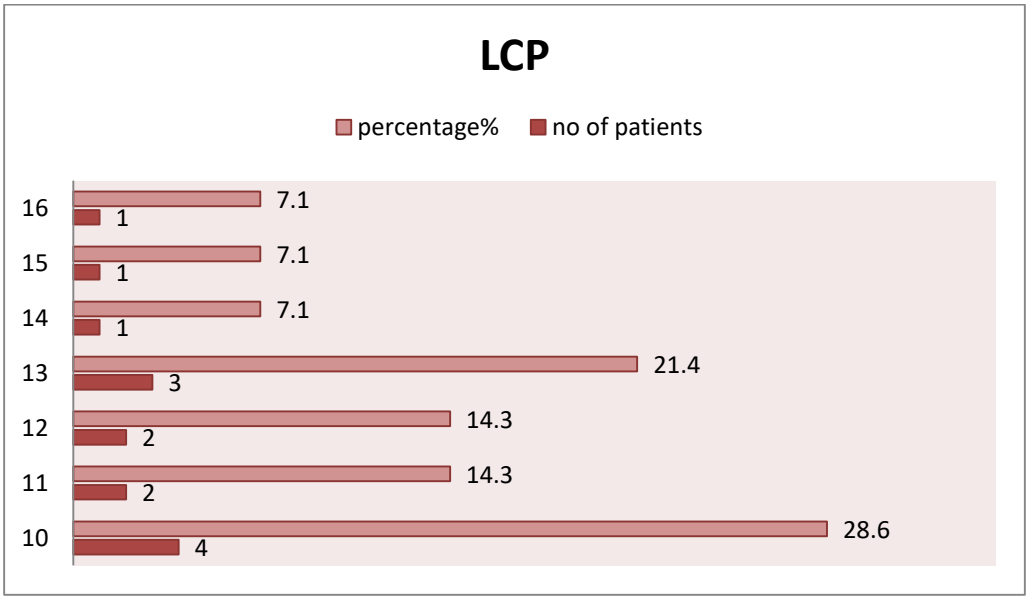
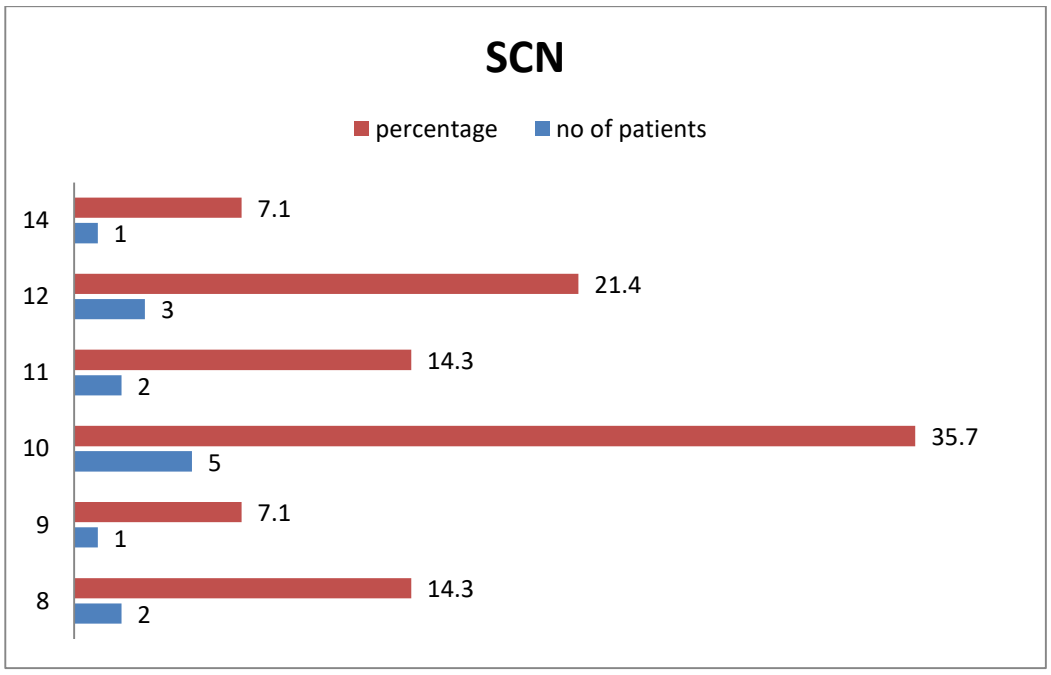


TABLE 8.1



9.TIME TAKEN FOR SURGERY

For the time taken for surgery among 14 cases in LCP operated patients 110mins and among those who operated with SCN the average was 89.64 mins from tab 9.1 & 9.2

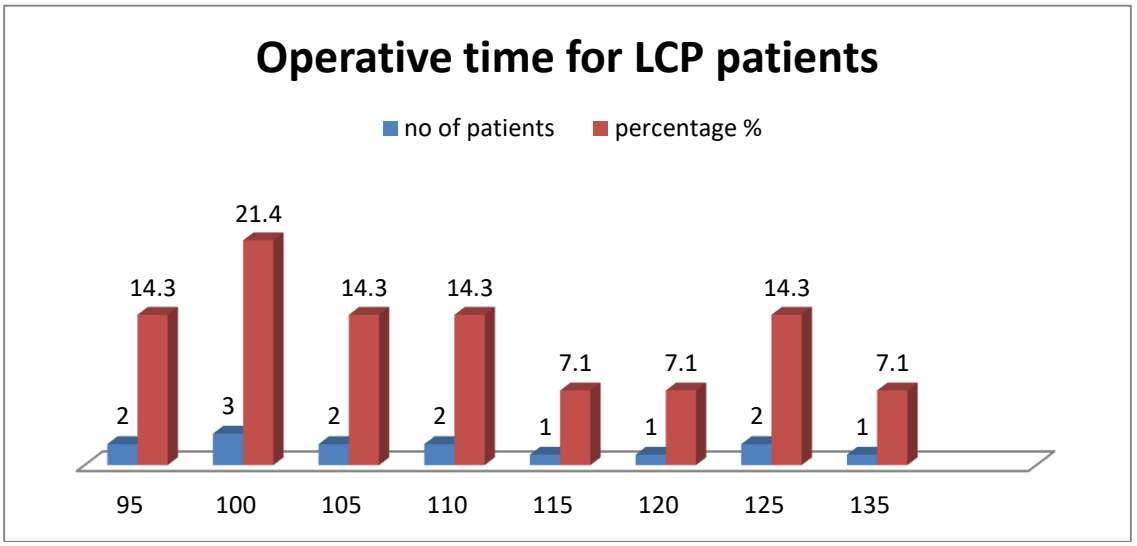


TABLE 9.1

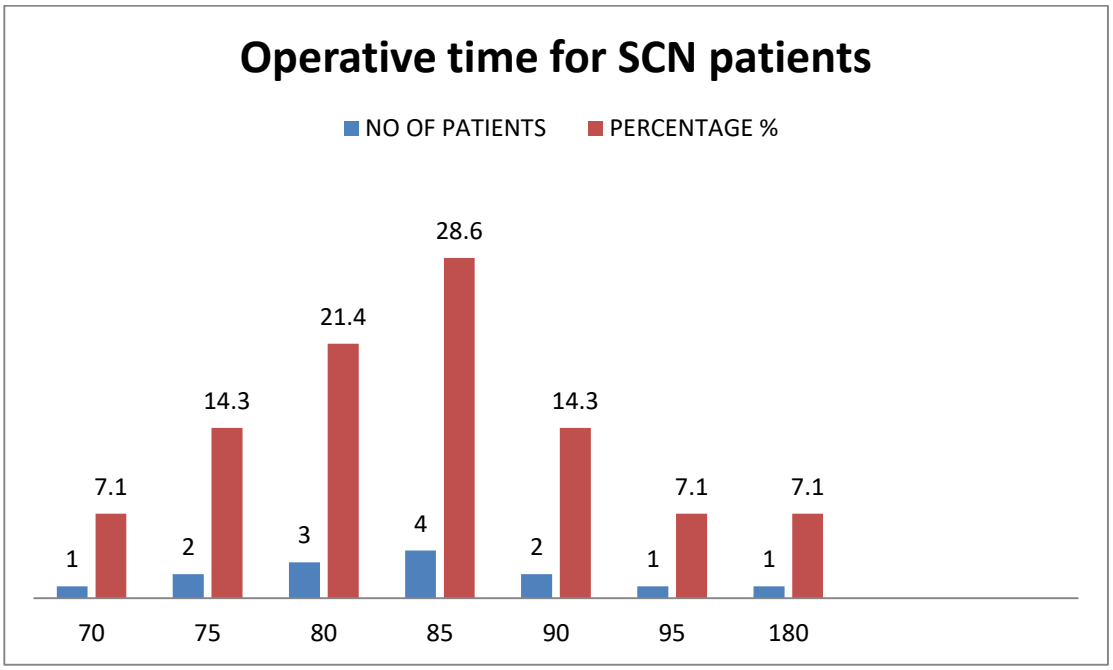


TABLE 9.2

10.BLOOD LOSS

In calculating the blood loss among those patients, who had operated with LCP had average blood loss of about 357.50 ml and average blood loss for SCN patients were 224.29 ml from tab 10.1 & 10.2

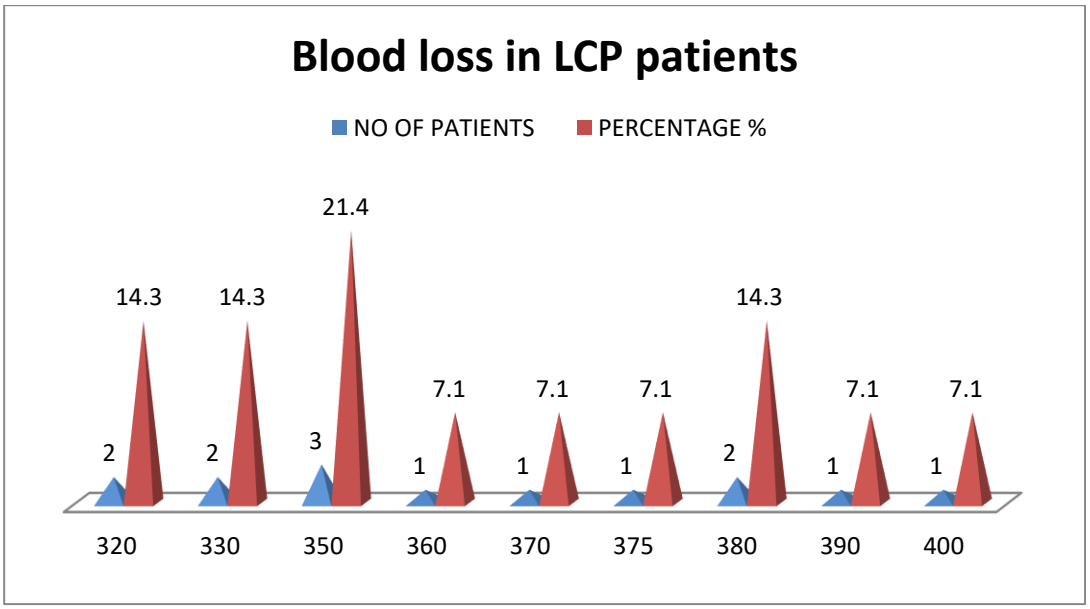


FIG 10.1

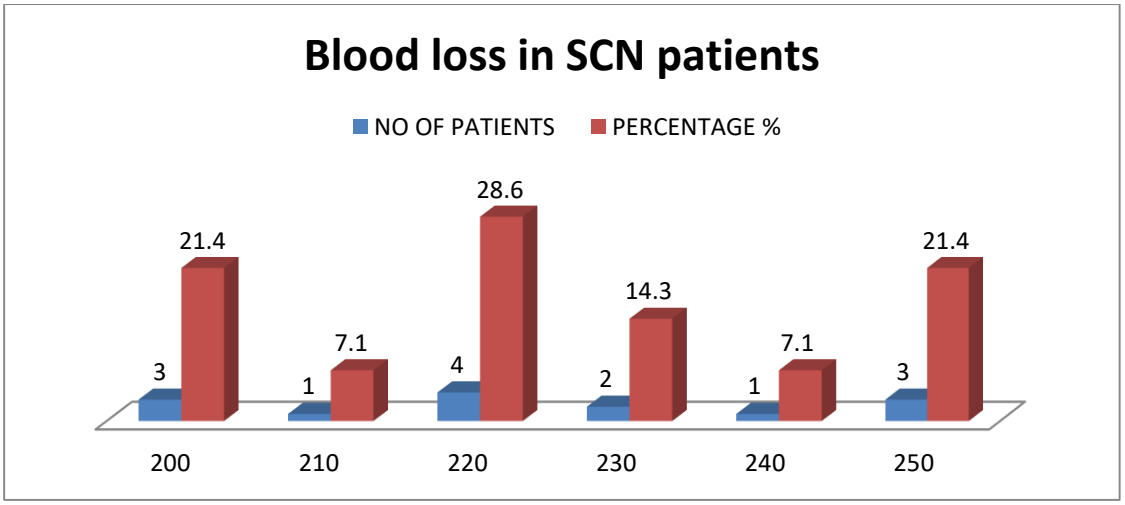
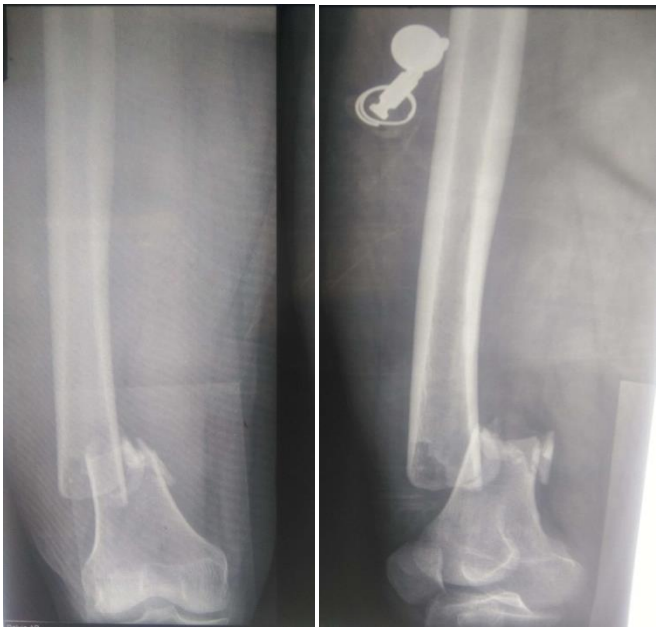


FIG 10.2

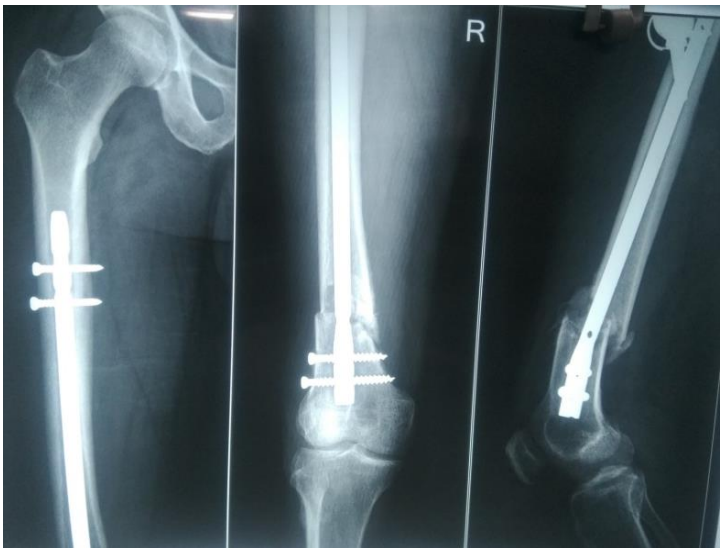
CASE ILLUSTRATION: CASE NO-1

1.Patient :	Mr. Alagumani
2.Age /Sex:	41/M
3.IP No:	5321
4.Mode of Injury:	RTA
5. Muller Type:	A1-Right side-Closed
6. Initial Treatment :	Upper Tibial Pin traction
7.Management:	Supracondylar nail
8.Anesthesia:	Spinal
9.Union in Weeks:	10 weeks
10.Range of Movements:	10-95*
11.Complications:	-
12.Functional Outcome Score (AKSS) :	70
13.Outcome:	Good

Pre op AP & LAT



11 month follow up



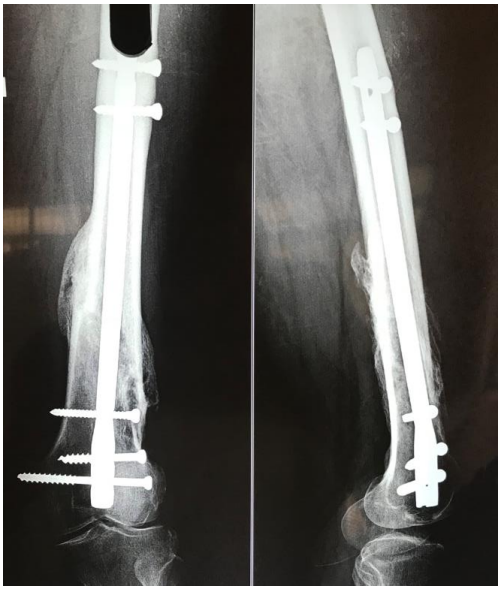
CASE ILLUSTRATION : CASE NO-2

1.Patient :	Mr.Shankar
2.Age /Sex:	43/M
3.IP No:	9831
4.Mode of Injury:	Assault
5. Muller Type:	A1 Left side Comp Gr IIIA
6. Initial Treatment :	Upper Tibial Pin traction
7.Management:	SCN
8.Anesthesia:	Spinal
9.Union in Weeks:	8 weeks
10.Range of Movements:	10 – 105 degrees
11.Complications:	-
12.Functional Outcome Score (AKSS) :	83
13.Outcome:	Excellent

Pre op xray : AP & LAT view

Post op X ray: 8 weeks follow up

Post op 1 yearx ray:

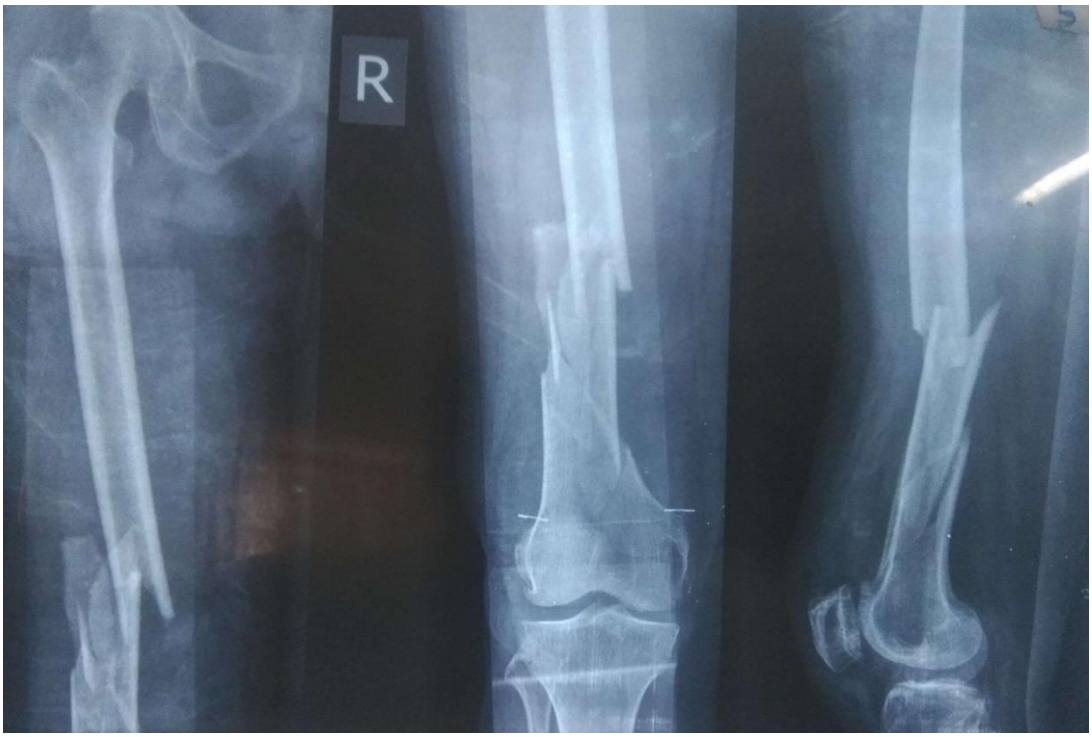


Clinical picture:

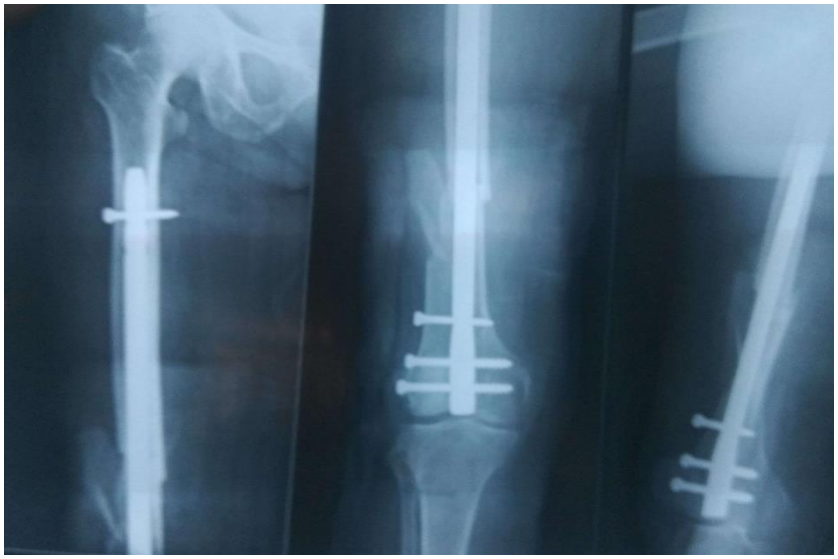
CASE ILLUSTRATION: CASE NO-3

1.Patient :	Mrs.Irulayee
2.Age /Sex:	62 /F
3.IP No:	3741
4.Mode of Injury:	Road Traffic Accident
5. Muller Type:	A1-Right side-Closed
6. Initial Treatment :	High AK Slab
7.Management:	SCN
8.Anesthesia:	Spinal
9.Union in Weeks:	12 weeks
10.Range of Movements:	10-105 degrees
11.Complications:	-
12.Functional Outcome Score (AKSS) :	72
13.Outcome:	Good

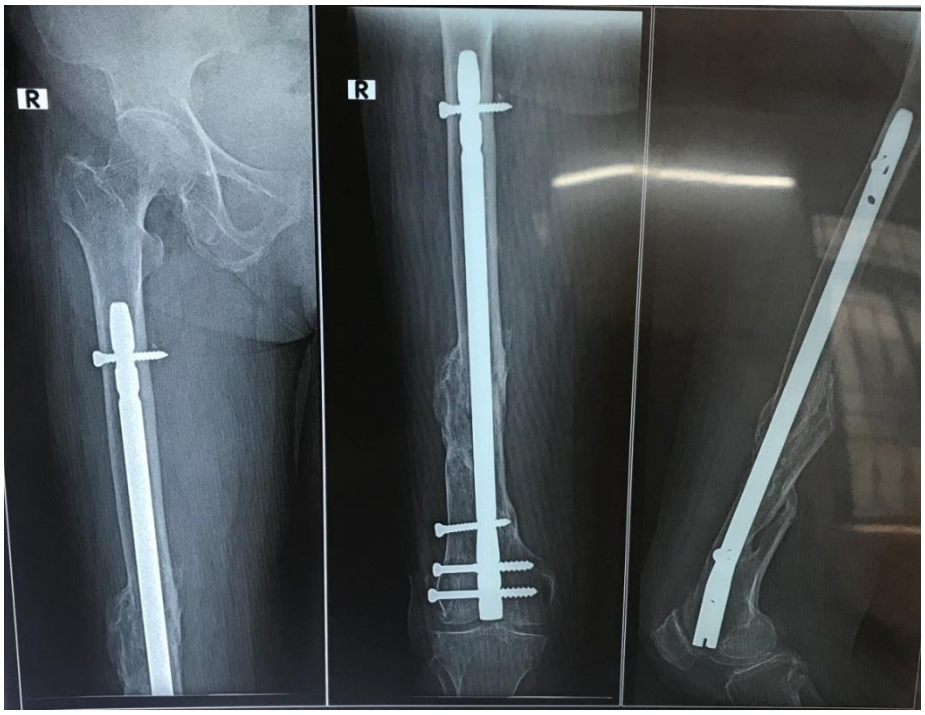
Pre op



Post op : 4 weeks follow up



1 year follow up



Clinical picture

CASE ILLUSTRATION: CASE NO-4

1.Patient :	Mrs. Allirani
2.Age /Sex:	59/F
3.IP No:	8598
4.Mode of Injury:	Accidental fall
5. Muller Type:	A1-Right side-Closed
6. Initial Treatment :	Upper tibial pin traction
7.Management:	SCN
8.Anesthesia:	Spinal
9.Union in Weeks:	9 weeks
10.Range of Movements:	10-100degrees
11.Complications:	-
12.Functional Outcome Score (AKSS) :	80
13.Outcome:	Excellent

Pre op X ray:

Post op X ray & Clinical picture:

CASE ILLUSTRATION: CASE NO-5

1.Patient :	Mrs. Karupayee
2.Age /Sex:	58/F
3.IP No:	33654
4.Mode of Injury:	Accidental fall
5. Muller Type:	A2-Right side-Closed
6. Initial Treatment :	Upper tibial pin traction
7.Management:	LCP
8.Anesthesia:	Spinal
9.Union in Weeks:	11 weeks
10.Range of Movements:	10-105degrees
11.Complications:	-
12.Functional Outcome Score (AKSS) :	80
13.Outcome:	Excellent

Pre op x ray

Post op 1 year

CASE ILLUSTRATION: CASE NO-6

1.Patient :	Mr. Gunasekaran
2.Age /Sex:	50/M
3.IP No:	3341
4.Mode of Injury:	RTA
5. Muller Type:	A2-Right side-comp GR I
6. Initial Treatment :	Upper tibial pin traction
7.Management:	LCP
8.Anesthesia:	Spinal
9.Union in Weeks:	13 weeks
10.Range of Movements:	10-60degrees
11.Complications:	Stiff knee
12.Functional Outcome Score (AKSS) :	61
13.Outcome:	Fair

Pre op

Post op & clinical picture

COMPLICATION

A Patient operated with SCN who had knee stiffness , infection & discharge at the locking sites. X ray showed generalized infectious changes. Finally implant removal done.

A Patient operated with LCP developed infection

LCP infected

RESULTS AND STATISTICS

In this study, 28 cases of distal femur fracture were included. Of these 14 patients of distal femur fractures operated with Retrograde intramedullary interlocking nailing and 14 patients were operated with Distal femoral locking compression plate. Patients were followed up every 3 weeks till fracture united and thereafter at 6 months, 8 months and 1 year. Clinically, tenderness at fracture site, knee pain, limb length discrepancy, range of movements, alignment any varus or valgus deformity were assessed at each follow up. The results were analyzed with standard anteroposterior and lateral radiographs. Clinical and radiological signs of union were analyzed at each follow up. The fracture was said to be radiologically united if callus was seen in at least 3 cortices in anteroposterior and lateral views. The functional outcomes were analyzed using scoring system of **AMERICAN KNEE SOCIETY SCORE**

Majority of injured patients were male indicates that males are more involved in outdoor activities and highest number of patients were in their 4th decade (39%),Road traffic accident was the most common mode of injury (76%) 2 patients had associated distal radius fracture, one patient had ipsilateral clavicle and one patient had pubic rami fracture, and 2 patients had ipsilateral tibial shaft fracture and 3 patients had opposite femur fracture making a total of 9 patients (43%) with associated fractures

Most of the patients, reported within first 7-10 days of injury to the hospital. 23 out of 28 patients had closed injury. Type A1 is more common among the 28 patients 14 out of 28 cases (50%).The average range of knee flexion achieved was about 0 to 84° among LCP patients.Maximum gain in knee flexion was 105° and minimum gain about 50°. The average range of knee flexion achieved was about 0 to 81° among SCN patients.Maximum gain in knee flexion was 105° and minimum gain about 40°. The amount of intraoperative blood loss that was compared with the both groups showed that average bloos loss among the LCP operated patients was 357.50 ml of blood loss with maximum of 400 ml in a case and minimum of about 320ml in a case among 14 cases. While the bloos loss among the retrograde intramedullary interlocking nailing patients were about 224.29 ml out of which maximum of 250 ml in a patient and minimum of 200 ml in a patient among 14 cases. Among 14 cases in supracondylar retrograde nailing cases average time taken was 89.64 mins with maximum of 180 mins for a case but that case had ipsilateral tibial plateau time was also included and minimum of 70 mins in a case. Among 14 LCP patients average time taken was 110 mins with maximum of 135 mins and minimum of 95mins. The time taken for union among retrograde intramedullary nailing was 10.50 weeks and 12.14 weeks among the LCP patients. The average American knee score 67.64% among LCP operated patients & 70.36% among the SCN treated patients. Early complications

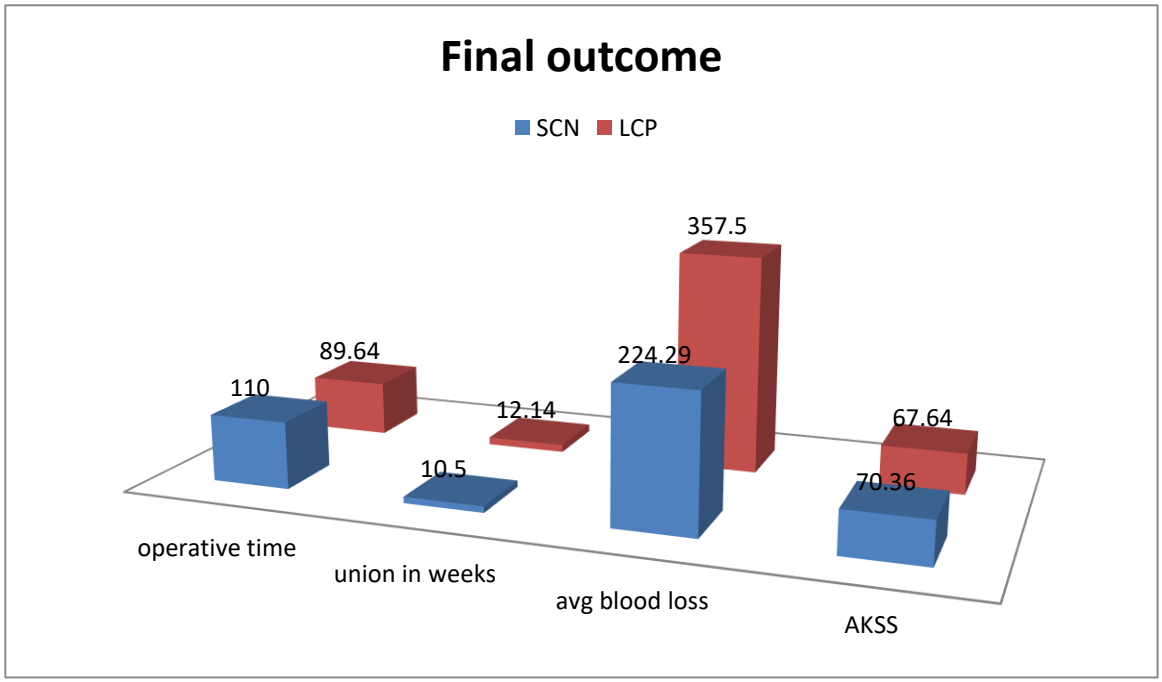
were encountered in 4 patients and these were superficial wound infection, wound gaping, pin site infection and mild transfusion reaction. Late complications were observed among SCN patients such as shortening of about 2 cms in two patients, knee pain persistent in two patients, infection was there in one patient and stiff knee among two patients totally 7 patients had late complications among SCN patients. Among LCP operated patients similar late complications such as infection in two patients and shortening in one patient,knee pain in one patient and stiff knee among three patients totally 7 had late complications. The average knee flexion in our series was 84 degrees ranging from 15°-105 degrees, the knee flexion varied according to the subtype of the fracture. Shortening less than 1 cm was recorded in 8 cases and shortening of 2 cm and more was recorded in 3 cases. All the patients remained painless in the postoperative period, except for 2 cases which had wound infection. Functionally all the patients discarded walking aid by 16 weeks and one patient was using heel and sole rise.

Among 14 cases in SCN operated patients three patients had excellent outcome ,3 patients had fair outcome,6 had good outcome & 2 patients had poor outcome. Among the poor outcome patients one had infection on 3rd month follow up and patient was started i.v antibiotics for 3 weeks and oral antibiotics for 3 weeks according to pus culture sensitivity. The patient had not improved with persistent discharge and knee flexion

upto 15 degree and extensor lag of 20 degree, hence implant exit was done at 6 months, the fracture had united by that time. Another patient with poor outcome had severe knee stiffness with shortening,because that patient had ipsilateral tibial plateau fracture. The patient was immobilized for 6 weeks post operatively which lead to severe stiffness. The patient also had shortening of more than 2cms.Another patient had varus deformity of the operated limb and FFD of 30 and knee stiffness. Among 14 cases in LCP operated patients three patients had excellent outcome ,3 patients had fair outcome,6 had good outcome & 2 patients had poor outcome.Among the poor outcome patients one had severe infection at 4^{th} month follow up with sprouting granules and eventually end up in implant exit. Another patient had severe knee stiffness besides CPM and physiotherapy he could not achieve more than 30 degree of knee bending. Among 14 patients treated with SCN 57.1% had no complications, knee pain was seen among 14.3% and stiff knee was seen in 7.1%,shortening was seen in 14.2% and infection in 7.1%. and Among 14 patients treated with LCP , 50% had no complications, 14.3 % had infection, 7.1% had shortening, stiff knee was seen in 21.4% and knee pain among 7.1%.

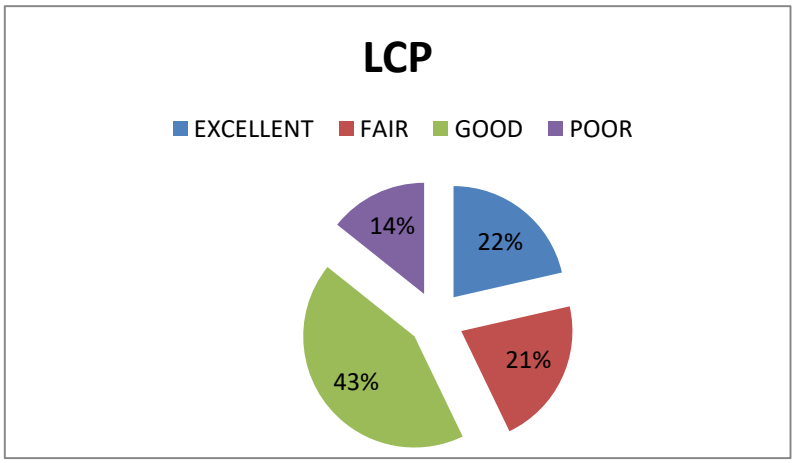
Final results of comparison between two groups

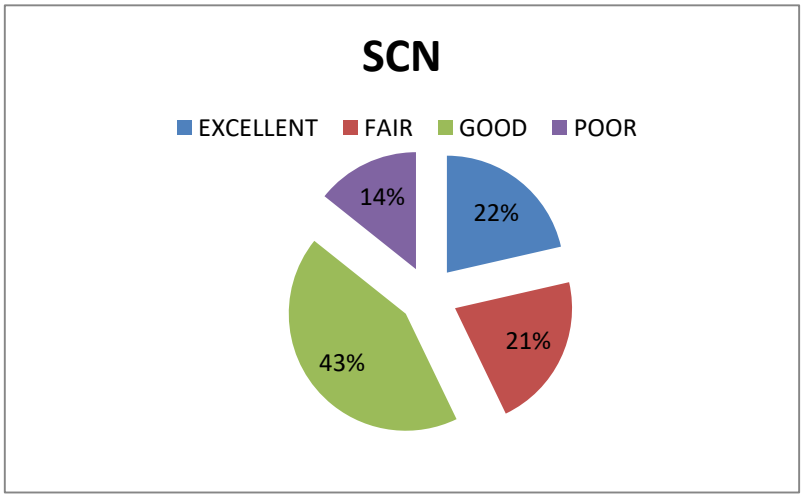
	Group	N	Mean
Operativetime	LCP	14	110.00
	SCN	14	89.64
UnionInweeks	LCP	14	12.14
	SCN	14	10.50
Bloodlossml	LCP	14	357.50
	SCN	14	224.29
AKSS	LCP	14	67.64
	SCN	14	70.36



Out come

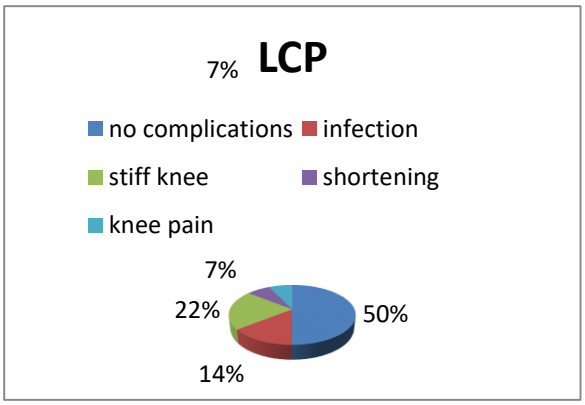
DefinitiveTreatment			Frequency	Percent
LCP	Valid	Excellent	3	21.4
		Fair	3	21.4
		Good	6	42.9
		Poor	2	14.3
		Total	14	100.0
SCN	Valid	Excellent	3	21.4
		Fair	3	21.4
		Good	6	42.9
		Poor	2	14.3
		Total	14	100.0

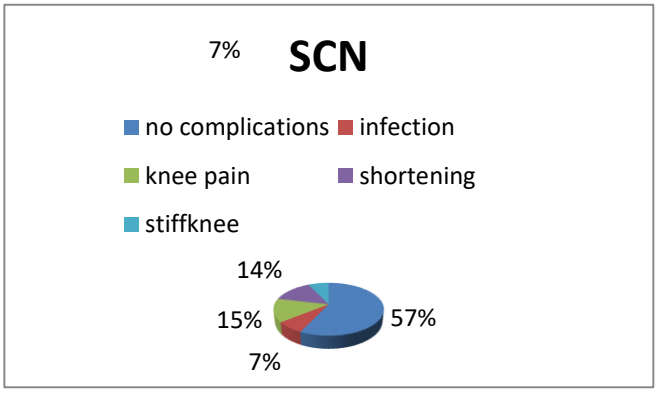




Complications

Definitive Treatment		Frequency	Percent
LCP	Infection	2	14.3
	Knee pain	1	7.1
	No	7	50.0
	Shortening	1	7.1
	Stiff knee	3	21.4
	Total	14	100.0
SCN	Infection	1	7.1
	Knee pain	2	14.3
	No	8	57.1
	Shortening	2	14.3
	Stiff knee	1	7.1
	Total	14	100.0





t-Test of significance:

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
Operativetime	Equal variances assumed	.355	.557	2.575	26	.016
	Equal variances not assumed			2.575	18.306	.019
UnionInweeks	Equal variances assumed	.641	.431	2.401	26	.024
	Equal variances not assumed			2.401	25.296	.024
Bloodlossml	Equal variances assumed	2.518	.125	15.654	26	.000
	Equal variances not assumed			15.654	23.291	.000
AKSS	Equal variances assumed	2.619	.118	-.598	26	.555
	Equal variances not assumed			-.598	20.435	.556

P value for blood loss was <0.05(0.00) and p value for union in weeks was 0.024 which is also significant. P value for operative time was 0.016 which shows significance. The AKSS score was not found to be significant.

DISCUSSION

Treatment of the distal femoral fractures is a cumbersome subject over the decade . There have been changing principles towards surgical treatment of supra condylar fractures of femur. Closed management of these fractures was the treatment of choice until 1970. This was due to lack of proper techniques and scarcity in availability of appropriate implants . Conservative methods at any age may be complicated by knee stiffness, mal union and nonunion.

Early surgical stabilization can facilitate care of the soft tissue, permit early mobility and reduces the complexity of nursing care. Open reduction and internal fixation has been advocated, using implants, including angled blade plate, fickle devices, Rush rods, Ender nails, Dynamic condylar screw, condylar buttress plate and interlocking nails, locking compression plate.A locking plate decreases the screw-plate toggle and motion at the bone- screw interface and provides more rigid fixation. Rigid fixation is felt to be one key to the successful treatment of these fractures .The conventional plates are associated with their own demerits such as screw pullout, implant failure and unstable fixation needing postoperative immobilization.

In the management of extra articular distal femur fractures, as the articular congruity is maintained and there is no involvement of articular cartilage damage fixation and early mobilization and rehabilitation can lead to excellent outcome for patients. Though distal femur fracture are managed recently by locking compression plate, as far as extra articular distal femur fracture is concerned retrograde intramedullary nailing can also be an option. In intra medullary nailing as it is load sharing device and by applying closed means without disturbing the fracture hematoma biological fixation is a main advantage. Also the time taken for surgery is compared in both technique in our study. The significant average time taken for SCN being 89.64 mins which is less time consuming than LCP technique which is average of 110 mins. Regarding blood loss , SCN operated patients had significantly less blood loss comparing LCP operated patients in our study. Average blood loss in SCN patients was found to be 224.29 ml and those with LCP was found to be 357.50ml. Blood transfusions rate were decreased while using nailing. Regarding union of fracture, the fracture united well earlier among those who were operated with SCN at an average of about 10.50 weeks which is earlier than the LCP group which was 12.15 weeks. The complications rate there was not much significant difference between the two groups. Knee pain (14.3%) and shortening (14.3%) was more common among those operated with SCN technique. Infection rate (14.3%) and stiff knee (21.4%) was more common

among the LCP patients. Implant exit was done in one patient in SCN group and one patient in LCP group. The final outcome based on AKSS was not significantly different among these two groups. In LCP excellent outcome was seen among 21.9% of the sample and fair results was seen among 21.9 %,good outcome was seen in 42.9 % and poor outcome was among 14.3%. In SCN patients the final outcome was excellent among 21.9% and fair results were seen among 21.9%, good outcome was found to be an average of 42.9% and poor outcome in 14.9% which is similar in both groups and no statistical significant difference was seen in the final outcome of the patients.

CONCLUSION

Fractures of distal femur are more common in high velocity injuries and occur in middle aged men and old age women. In extra articular fractures, SCN also showed good outcome compared with LCP which is recently in use Soft tissue damage control,early union, reduced operative time and reduced blood loss are the advantages of SCN over LCP . Both retrograde IM nailing and LCP plating may be adequate treatment options for distal femur fractures.

No significant differences in outcome between implants regarding fracture healing, non-union were found for both the techniques. Both procedures need correct preoperative planning and adequate surgical experience so as to avoid revision surgery.

However, large study sample and long term follow up needed for accurate analysis of functional outcome

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MASTER CHART

S.no	Name	Age	Sex	ipno	Mode Of Injury	type	Open Closed Injury	Affected Side	Definitive Treatment	Operative time (min)	Union In weeks	Bloodlossml	Rom Flexion	AKSS	Complication	Outcome
1.	Palanisamy	56	M	8001	RTA	A2	Simple	Lt	LCP	125	10	320	10°-110°	82	Knee pain	Excellent
2.	Palanikumar	45	M	6658	RTA	A1	Simple	Rt	LCP	115	12	350	10°-95°	75	Shortening	Good
3.	Parmasivan	62	M	5841	Fall	A1	GR I	Rt	LCP	95	13	380	10°-60°	65	no	Fair
4.	Karupayee	58	F	33654	Fall	A2	Simple	Lt	LCP	100	11	400	10°-105°	80	no	Excellent
5.	Arjunan	48	M	18795	RTA	A2	Simple	Rt	LCP	105	12	370	10°-110°	83	no	Excellent
6.	Parameshwari	62	F	9995	Fall	A1	Simple	Lt	LCP	120	13	330	10°-50°	62	Stiff knee	Fair
7.	Radhakrishnan	32	M	154	RTA	A3	Simple	Lt	LCP	135	10	360	10°-85°	72	no	Good
8.	Ramamoorthy	44	M	3300	RTA	A1	GR I	Rt	LCP	110	15	350	30°-50°	37	Infection	Poor
9.	Sarath kumar	47	M	8047	RTA	A1	Simple	Rt	LCP	95	16	330	20°-40°	36	Infection	Poor
10	Muthu	52	M	4454	RTA	A2	Simple	Lt	LCP	100	10	380	10°-80°	74	no	Good
11.	Gunasekaran	50	M	3544	RTA	A1	Gr I	Rt	LCP	125	13	320	10°-60°	61	Stiff knee	Fair
12.	Kannama	45	F	4053	RTA	A2	Simple	Lt	LCP	110	10	375	10°-80°	71	no	Good
13.	Sarojini	40	M	7852	RTA	A1	Simple	Rt	LCP	105	14	350	10°-95°	77	no	Good
14.	Jeya	53	M	2005	RTA	A2	Simple	Rt	LCP	100	11	390	10°-85°	72	Stiff knee	Good
1.	Alagumani	41	M	5321	RTA	A1	Simple	Rt	SCN	90	10	250	10°-95°	70	Knee pain	Good
2.	Shankar	43	M	9831	RTA	A1	Simple	Lt	SCN	85	8	220	10°-105°	83	Shortening	Excellent
3.	Muruganantham	35	M	5469	Assault	A1	IIIA	Lt	SCN	85	10	230	10°-90°	82	no	Excellent
4.	Allirani	59	F	8598	Fall	A1	Simple	Rt	SCN	95	9	200	10°-100°	80	no	Excellent
5.	Thangavel	42	M	6524	RTA	A2	Simple	Rt	SCN	70	10	200	10°- 95°	71	no	Good
6.	Irulayee	62	F	3741	Fall	A3	Simple	Rt	SCN	80	12	250	10° -105°	72	no	Good
7.	Irulaye	62	F	5214	RTA	A2	Simple	Lt	SCN	75	10	220	10°-100°	74	no	Good
8.	Nagamani	32	M	1142	RTA	A3	Simple	Rt	SCN	180	12	200	20°-30°	57	Shoertening	Poor
9.	Mahalingam	44	M	6047	RTA	A1	Simple	Rt	SCN	80	8	220	20°-50°	57	Infection	Poor
10.	Naainar	47	M	3321	RTA	A2	Gr I	Lt	SCN	85	14	240	20°-40°	62	Stiff knee	Fair
11.	Kasi	54	M	7542	RTA	A3	Simple	Rt	SCN	80	12	230	10°-70°	65	no	Fair
12.	Lakshmi	50	F	8856	RTA	A2	Simple	Rt	SCN	90	11	210	10°-60°	66	Knee pain	Fair
13.	Kannayan	64	M	7459	Fall	A1	Simple	Lt	SCN	85	10	250	10°-105°	72	no	Good
14.	Karthik	35	M	11285	RTA	A1	Simple	Rt	SCN	75	11	220	10°-100°	74	no	Good

PROFORMA

- **Name :** **Hospital No:**
- **Age / Sex:**
- **Address:**
- **Date of admission:**
- **Date of discharge:**

HISTORY:

PHYSICAL EXAMINATION :

HIP:

KNEE :

RADIOLOGICAL INVESTIGATIONS:

X RAY PELVIS WITH BOTH HIPS

X RAY THIGH WITH KNEE AP & LATERAL VIEWS:

CT KNEE (IF NEEDED)

Diagnosis :

Treatment :

Complications :

Blood loss:

Intra operative time:

Union in weeks:

FOLLOW UP BASED KNEE SOCIETY SCORE- 100 POINTS

- **Pain**
- **Felxion contracture**
- **Extensor lag**
- **Range of movements**
- **Stability**
- **alignment**

PAIN

None = 50

Mild / Occasional=45

Mild (Stairs only)= 40

Mild (Walking and Stairs=30

Moderate Occasional= 20

Moderate continual= 10

Severe =0

flexion contracture:

5-10* = -5

10-15* = -10

16-20* = -15

>20*= -20

Extensor lag:

<10* = -5

10-20* = -10

>20*= -15

Total range of flexion (1-25 points)

0-5*	**25-30***	**50-55***	**75-80***	**100-105***
5-10*	**30-35***	**55-60***	**80-85***	**105-110***
10-15*	**35-40***	**60-65***	**85-90***	**110-115***
15-20*	**40-45***	**65-70***	**90-95***	**115-120***
20-25*	**45-50***	**70-75***	**95-100***	**120-125***

STABILITY:(maximum movement in any position)

Anteroposterior		**Mediolateral:**
<5 mm	**=0**	**<5* = 15**
5-10 mm	**= -5**	**6-9* = 10**
>10mm	**= -10**	**10-14* =5**
		15* = 0

Score 80-100 Excellent

Score 70-79 Good

Score 60-69 Fair

Score below 60 Poor

PATIENT CONSENT FORM

Study Detail	:	**A COMPARITIVE STUDY ON FUNCTIONAL OUTCOME IN MANAGEMENT OF EXTRA ARTICULAR DISTAL FEMUR FRACTURES BY RETROGRADE INTRAMEDULLARY INTERLOCKING NAILING VS DISTAL FEMORAL LOCKING PLATE**
Study Centre	:	Govt Rajaji hospital, Madurai
Patient's Name	:	
Patient's Age	:	
Identification Number	:	

Patient may check (√) these boxes

a) I confirm that I have understood the purpose of procedure for the above study. I have the opportunity to ask question and all my questions and doubts have been answered to my complete satisfaction. ☐

b) I understand that my participation in the study is voluntary and that I am free to withdraw at any time without giving reason, without my legal rights being affected. ☐

c) I understand that sponsor of the clinical study, others working on the sponsor's behalf, the ethical committee and the regulatory authorities will not need my permission to look at my health records, both in respect of current study and any further research that may be conducted in relation to it, even if I withdraw from the study I agree to this access. However, 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 this study. ☐

d) I agree to take part in the above study and to comply with the instructions given during the study and faithfully cooperate with the study team and to immediately inform the study staff ☐

MADURAI MEDICAL COLLEGE
MADURAI, TAMILNADU, INDIA -625 020
(Affiliated to The Tamilnadu Dr.MGR Medical University, Chennai, Tamil Nadu)

ETHICS COMMITTEE CERTIFICATE

Name of the Candidate : Dr.Muralidharan R

Course : PG in MS., Orthopedic

Period of Study : 2016-2019

College : MADURAI MEDICAL COLLEGE

Research Topic :

A comparative study on functional outcome in management of extra articular distal femur fractures by retrograde intramedullary interlocking nailing VS distal femoral locking plate

Ethical Committee as on : 21.11.2017

The Ethics Committee, Madurai Medical College has decided to inform that your Research proposal is accepted.

Member Secretary | Chairman | Dean / Convenor

Prof Dr V Nagaraajan
M.D., MNAMS, D.M., Dsc.,(Neuro), Dsc (Hon)
CHAIRMAN
IEC - Madurai Medical College
Madurai

DEAN
Madurai Medical Coll
Madurai-20

27 NOV 2017

URKUND

Urkund Analysis Result

Analysed Document:	comparative analysis of supracondylar femur fractures.docx (D42216461)
Submitted:	10/7/2018 7:56:00 AM
Submitted By:	drmurali90@gmail.com
Significance:	15 %

Sources included in the report:

thesis parasu plagarism.docx (D31238502)
FUNCTIONAL AND RADIOLOGICAL OUTCOME OF POSTERIOR PLATE OSTEOSYNTHESIS FOR DISPLACED TIBIAL PLATEAU FRACTURES.docx (D31692647)
dissertation.docx (D30941404)
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https://walkingquad.files.wordpress.com/2013/09/distal-femur-fractures.pdf
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https://www.researchgate.net/publication/224822354_Calcaneal_plate_fixation_of_distal_femoral_fractures

Instances where selected sources appear:

26

ANTI PLIAGRISM CERTFICATE

CERTIFICATE II

This is to certify that this dissertation work titled **"A COMPARATIVE STUDY ON FUNCTIONAL OUTCOME IN MANAGEMENT OF EXTRA ARTICULAR DISTAL FEMUR FRACTURES BY RETROGRADE INTRAMEDULLARY INTERLOCKING NAILING VS DISTAL FEMORAL LOCKING PLATE"** of the candidate **Dr. R. MURALIDHARAN** with **Registration Number 221612102** for the award of **MASTER DEGREE** in the branch of **ORTHOPAEDICS.** I have personally verified the urkund.com website for the purpose of plagiarism check. I found that the uploaded thesis file contains from introduction to conclusion pages and result shows **15%** of plagiarism in the dissertation.

Guide & Supervisor sign with Seal

ABBREVIATIONS

AO – Albeitgemeinschaft fur Osteosynthesefragen

ASIF - Association for the Study of Internal Fixation

SCN- supracondylar nail

CBP – Condylar Blade Plate

ORIF – Open Reduction and Internal Fixation

DCS – Dynamic Condylar Screw

GSH – Green Seligson Henry

LCP-Locking Compression Plate

LISS-Less Invasive Skeletal Stabilization

ORIF-Open Reduction Internal Fixation

ROM-Range Of Movements

AP-Antero Posterior