DISSERTATION ON

Prospective Outcome Analysis of Various Methods of Management of Compound Supracondylar Fractures of Femur

SUBMITTED FOR
M.S. Degree Examination

BRANCH II – ORTHOPAEDIC SURGERY

INSTITUTE OF ORTHOPAEDICS AND TRAUMATOLOGY

MADRAS MEDICAL COLLEGE & GOVERNMENT GENERAL HOSPITAL, CHENNAI – 3

THE TAMILNADU DR. M.G.R MEDICAL UNIVERSITY

CHENNAI

APRIL – 2011

CERTIFICATE

This is to certify that this dissertation entitled **"Prospective Outcome Analysis of Various Methods of Management of Compound Supracondylar Fracture of Femur"** submitted by **Dr. BOOPATHI .K** appearing for Part II, M.S. Branch II - Orthopaedics degree examination in April 2011 is a bonafide record of work done by him under my direct guidance and supervision in partial fulfilment of regulations of The Tamil Nadu Dr. M.G.R. Medical University, Chennai.

I forward this to The Tamil Nadu Dr. M.G.R. Medical University, Chennai, Tamil Nadu, India.

Prof R.H.Govardhan M.S.Ortho; D.Ortho

Director, Institute of Orthopaedics and Traumatology
Madras Medical College &
Government General Hospital
Chennai- 600 003.

DEAN,
Madras Medical College,
Govt. General Hospital,
Chennai - 600 003.

ACKNOWLEDGEMENT

Any prospective study in a place as big as this institution requires the support and guidance of a lot of people. It would be appropriate if the efforts taken and the time put in are properly remembered and acknowledged.

My sincere thanks to **DR. MOHANASUNDARAM,** M.D Dean, Madras medical College, for permitting the utilization of resources and clinical material in this hospital.

I will forever be indebted to my beloved teacher and guide, **Prof. R.H. GOVARDHAN,** M.S.Ortho, D.Ortho, **Director, Institute of Orthopaedics and Traumatology,** Madras Medical College and Government General Hospital, Chennai, without whom the study would not have been possible. He has been a continuous source of inspiration and inputs, guiding me throughout this study.

I am grateful to **Prof. M.R. RAJASEKAR,** M.S Ortho, Professor for his inputs during the course of the study.

I express my profound thanks to **Prof. V.THULASIRAMAN,** M.S. Ortho, D. Ortho, Professor, for his continuous support during this study.

I express my sincere thanks to **Prof. S.SUBBAIAH** M.S. Ortho, D. Ortho, Professor, for his valuable guidance during this study.

I extend my thanks to **Prof. SUBRAMANIAM.,** M.S.Ortho, Professor for his valuable support during this study.

I am grateful to **Prof. R.SUBBAIAH,** M.S. Ortho, D. Ortho, Reader in Spine Surgery, for his valuable support during this study.

I also extend my sincere thanks to **Prof. NALLI R UVARAJ** M.S. Ortho, D. Ortho, DNB Ortho Reader in Spine Surgery, for his inputs and guidance.

My sincere thanks to **Dr. R. SELVARAJ,** M.S.Ortho, DNB Ortho for his constant encouragement and useful inputs in the completion of the study.

My special thanks to **Dr. S. KARUNAKARAN** for his valuable guidance and support during this study.

I am grateful to **Dr. RAMESH PANDIAN, Dr. ANTONY VIMALRAJ, Dr. SHANMUGASUNDARAM, Dr. VELMURUGAN, Dr. MANIMARAN, Dr. PRABHAKAR, Dr, SENTHIL SAILESH, Dr. P. KANNAN, Dr. KINGSLEY, Dr. PALANIKUMAR, Dr. SAMEER, Dr. MUTHALAGAN, Dr. NALLI. R. GOPINATH** who have guided me throughout the duration of the study.

I extend my grateful thanks to my fellow postgraduates, staff members, theatre staff who have extended their support during this period.

Last but not the least I am immeasurably indebted to all the patients who consented and co-operated with this study.

CONTENTS

KEY TO MASTER CHART

DCS	-	Dynamic condylar screw
ORIF	-	Open reduction and internal fixation
LCP	-	Locking compression plate
BG	-	Bone Graft
EXFIX	-	External fixator
MIF	-	Minimal Internal fixation
LLD	-	Limb length discrepancy
# BBLEG	-	Both Bone Leg
# BB FA	-	Both Bone forearm
WD	-	Wound debridement
UTPT	-	Upper tibial pin traction
ROM	-	Range of Motion

INTRODUCTION

Fractures of the distal femur are severe injuries that result in varying degrees of permanent disability.As the number of highways become more and high speed driving increases, the potential for devastating injuries like open fractures of the femur with polytrauma also increase substantially[2].

These injuries present with varied combination of bony and soft tissue loss.Bony injury could range from a simple supracondylar fracture pattern to a severely comminuted injury with intraarticular extension and bone loss.There is further understandable reluctance on the part of most Orthopaedic surgeons to primarily use bone graft for open injuries with bone loss.With changing expectations and rise in high velocity injuries,fracture fixation and rehabilitation in open distal femur fracture injuries however is still a challenge[2].

The Toronto experience with supracondylar fracture between the years 1967 and 1972 was the first review of results of operative treatment of supracondylar fractures achieved with AO methods by surgeons who were not the innovators of the technique. The outcome criteria for the surgically treated and conservatively treated were the same. They achieved good result in as many as 75% of their patients treated operatively, as against a mere 32%good result in those treated non operatively. SCHATZKER and colleagues concluded that if normal function is to be achieved, unquestionably ,if correctly employed ,open reduction and internal fixation ensures a very high rate of success.

Evidence from various studies indicates that the functional outcome of the degree of open supracondylar fractures largely is determined by the degree of their accompanying soft tissue injury ,while added articular component compounds to the stiffness by articular irregularities .In patients with such high velocity injuries ,the situation is often compounded by the presence of injuries to the head , chest, abdomen and injury to other appendicular skeleton,compromising the treatment outcome[(3)].

The timing of definitive fixation for these injuries is question of debate,some authors favour delayed bone grafting after the soft tissue settles,while some advocate early reconstruction of both osseous and soft tissue element. Conventional management with multiple operative procedures for open grade IIIB, and ,IIIC fractures often results in poor functional outcome and a high rate of late amputation.

These fractures present a very difficult problem in treatment since the patients do not stand long periods of immobilization well and operative methods are beset with complications.(American journal of surgery ,volume 97,issue 4,pages 419-522).

Fractures of the distal femur are complex injuries that can be difficult to manage. These serious injuries have the potential to produce significant long-term disability. This study reviews those fractures that involve the distal 15 cm of the femur including the distal femoral metaphysis (supracondylar) and the articular surface of the distal femur (intracondylar).

Distal femoral fractures are much less common than hip fractures and account for about 7% of all femoral fractures. If fractures of the hip are excluded, 31% of femoral fractures involve the distal portion . Various treatment options are available for the management of these injuries. Before the development of techniques and implants to provide stable fixation,most distal femur fractures were treated with skeletal traction. Studies done in the 1960s documented better outcomes for patients treated nonoperatively than for those treated operatively. However, complications of nonoperative treatment included angular deformity, joint incongruity, knee stiffness, and delayed patient mobilization. In the 1970s, the AO (Arbeitsgemeinschaft Osteosynthesefragen) principles and the use of the angled blade plate revolutionized the treatment of these injuries. Over the past 30 years, implants and techniques have improved. It is now recognized by most Orthopaedic surgeons that distal femoral fractures are best treated with reduction and surgical stabilization . Anatomic reduction of the articular surface, restoration of limb alignment, and early mobilization have been shown to be effective ways of managing most distal femoral fractures. Despite the advances in techniques and the improvements in surgical implants, treatment of distal femoral fractures remains a challenge in many situations. Long-term disability can still occur in patients with extensive articular cartilage damage, marked bone comminution, and severe soft tissue injury.

CHALLENGING INJURIES TO TREAT –WHY?

- Bimodal age distribution (young patients due to high velocity injury eg.Road traffic accidents, fire arm injuries, and sports injuries), while in elderly patients usually low velocity injury like fall during walking).
- Conservative methods at any age may be complicated by knee stiffness ,malunion,and non union.
- Osteoporosis ,severe comminution of the fracture ,involvement of the knee joint, and soft tissue injury in open fractures were associated with unsatisfactory results.
- The spectrum of injuries is so great that no single implant has been found to be suitable for every case.
- Metaphyseal fractures may extend into the joint and the diaphysis, increases the complexity of its management.
- In supracondylar fractures, there is usually a dead space behind the femur in the popliteal fossa. This dead space closes during anatomical reduction, and drainage from that space is blocked .The medial intermuscular septum, the biceps, the deep fascia may also contribute to blocking this opening. The resulting stasis may lead to infection.

- Intraarticular comminution and lack of postoperative physiotherapy adds to the complexity.
- When a distal femoral fractures involves the knee or quadriceps mechanism or both, some loss of motion of the knee seems to be inevitable in most patients, whether they are treated non operatively or by internal fixation.
- Intraarticular fractures lead to intraarticular stiffness,decreased range of motion and poor results and open fractures results in extraarticular stiffness.

AIM AND OBJECTIVES

AIM

The aim of the study is to analyze prospectively the results of outcomes of various methods of management of Compound Supracondylar fractures of femur.

OBJECTIVES

To evaluate the result of open Supracondylar fractures of femur in terms of, union, infection, range of motion of knee, complications and need for bone grafting.

This study also tries to bring insight into the unpublished area of literature to highlight the importance of need for further research in open supracondylar fractures of femur.

HISTORY

1933 MAHORNER and BRADBURN reported unsatisfactory results following Russel’s traction.

1937 TEES suggested skin traction for reduction immobilization.

1945 FUNSTEN AND LEE observed fractures of the distal third healed sooner 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 arthrofibrosis 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 and suggested posterolateral incision .
1967	NEER –classified the supracondylar fractures of femur and advised conservative management.
1971	BROWN & DARCY modified blade plate for use in osteoporotic supracondylar fractures.
1973	CONNOLY advocated closed reduction and early cast brace ambulation.
1974	SCHATZKAR reported superior results using operative methods .
1974	NEER –classified supracondylar /intercondylar fractures, used straight plate and screws and considered conservative treatment was superior to internal fixation.
1979	SCHATZKAR .J-Concluded that results of blade plate fixation.
1980	FRANK SEINSSHEIMER –classified distal femoral fractures advocated fixation for intraarticular fractures.
1990	MULLER –classified fracture of distal femur.
1997	MARSH JL-supracondylar fractures of femur treated by external fixation

2000 HUSTON JJ,ZYCH GA. Treament of comminuted intraarticular distal femur fractures with limited internal and external tensioned wire fixation.

2001 ARAZI M,MEMIK R,OGUN TC ,YEL M-illizarov external fixation for severely comminuted supracondylar and intercondylar fractures of distal femur.

ANATOMY

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

Medial condyle is longer and extends farther distally than the lateral femoral condyle .Outer surface of medial femoral condyle is convex ,and an epicondyle on the surface gives attachment to the medial collateral ligament.Adductor tubercle is present on the proximal medial surface of the medial condyle to which the adductor magnus is inserted .The medial head of gastronaemius arises from the back of femoral medial condyle.

Lateral condyle is stouter and stronger than the medial condyle.In the coronal plane lateral condyle is more anterior compared to the medial condyle.This prevents the lateral displacement of patella.Most prominent part of its lateral surface is the lateral epicondyle to which fibular collateral ligament is attached.

On axial view distal femur is trapezoidal with greatest dimension located posteriorly and narrowest dimension anteriorly.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 angulation of 9 degrees. In the saggital plane ,the shaft of femur lies with anterior two thirds of condyle.

Tibial articular surface is convex anteroposteriorly as well as from side to side .Lateral and medial meniscus creates greater conformity between the femur and tibia.Between the condylar surface, the plateau is elevated into the intercondylar eminence.

Capsule of knee joint is attached posterior to proximal margins of femoral condyles and the intercondylar fossa.Medially the capsule is attached proximal to the groove for popliteus tendon.Anteriorly the capsular attachment is deficient above the level of patella.

The tibial collateral ligament is a flat triangular band attached above to the medial femoral epicondyle and below to the upper part of medial surface of tibia.The fibular collateral ligament is cord like and is attached proximally to lateral epicondyle below the attachment of lateral head of gastronaemius and above that of popliteus tendon.Its distal attachment is to head of fibula.

The cruciate ligaments are a pair of very strong ligaments connecting to tibia to femur.They are intracapsular and extrasynovial .Anterior cruciate ligament is attached to anterior part of tibial plateau between the attachments of anterior horn of medial and lateral menisci.It ascends posterolaterally and is attached to posteromedial aspect of lateral femoral condyle.Posterior cruciate ligament is stronger, shorter and is attached to smooth impression on posterior part of tibial intercondylar area.It ascends anteromedially and is attached to anterolateral aspect of medial femoral condyle. Medial menisci is almost a semicircle and is broader posteriorly .Its anterior horn is attached to intercondylar area in front of the anterior cruciate ligament ,while the posterior horn is similarly attached in front of the posterior cruciate ligament. The lateral meniscus is about four fifths of a circle. Anterior horn is attached to front of intercondylar eminence of the tibia, while the posterior horn is attached in front of the posterior horn of the medial meniscus.

BLOOD SUPPLY

Knee joint has an abundant blood supply supplied from the anastomoses around the knee. The chief contributors are the five genicular branches of the popliteal artery.

In the anterior approach to the knee ,subcutaneous dissection should not be superficial to the facial layer because devitalization of the skin can occur.

NERVE SUPPLY

The joint is supplied from the femoral nerve through its branches to the three vasti, from the sciatic nerve by genicular branches of the tibial and common peroneal components and from the obturator nerve by the twig from its posterior division.

MECHANISM OF INJURY

Most supracondylar fractures are the result of a severe varus, valgus or rotational force with axial loading. In young patients this amount of force is typically the result of high energy trauma such as motor vehicle accidents and falls on a flexed knee may be sufficient to produce these fractures.

After fracture, the deformities observed are usually those of femoral shortening with apex posterior angulations, and posterior displacement of the distal fragment. These deforming forces are produced by the quadriceps, hamstring, and gastronaemius muscles. Varus deformity may result from the pull of adductor muscles. If an intercondylar fracture is present, there will be rotational misalignment of the condyles (with resulting joint incongruity) because of the separate attachments of the gastronaemius muscles to each condyle.

The axial bending loads applied to the femur in the production of a supracondylar fracture may produce additional injuries to the same extremity.Physical examination and radiographic assessment must assess the possible presence of a fracture to the acetabulam ,femoral neck and the femoral shaft. Varus or valgus force applied to the knee may result in associated ligament injury to the knee.Alternatively the same force may produce fractures of tibial plateau or shaft.

Open fractures occur in 5-10percent of all supracondylar fractures.Most common site for the open wound is over the anterior thigh, proximal to the patella and as a result patients have some damage to the distal quadriceps muscle or tendon. Although femoral and popliteal arteries are at risk of injury because of their close proximity to the site of fracture, the incidence of associated injury to these vessels is low. The popliteal artery is more commonly at risk of injury when an associated posterior dislocation of knee occurs.

The greater the quantity of damaged or necrotic tissue, the longer the time required for its removal and the more delayed the healing. Therefore, with musculoskeletal injury, short-term management techniques that limit the quantity of damaged tissue are highly desirable.[6].

CLASSIFICATION

A classification for supracondylar fractures of the distal femur should distinguish possible injuries to this area, including extraarticular, intraarticular and isolated condylar lesions.

1) Allow different surgeons consistently &reliably to grade a fracture pattern into one of the classification patterns.

2) Assist in deciding the method of treatment.

3) Correlate with findings of outcome analysis.

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

NEER CLASSIFICATION

Neer classified these injuries into

1) Minimal displacement

2) Displacement of condyles

   a. Medial

   b. Lateral

3) Concomitant supracondylar and shaft fractures

It is an anatomical classification and does not correlate with the severity of the injury.

SEINSHIMER CLASSIFICATION

He classified these injuries into

Non displaced fracture

Any fracture with less than 2mm of displacement of fractured fragments.

Fractures involving only the distal metaphysis without extension into the intercondylar region .

TWO PART FRACTURE

Comminuted fractures

Fractures involving the intercondylar notch in which one or both condyles are separate fragments.

1) Medial condyle is a separate fragment ,lateral condyle remains attached to the femoral shaft.

2) The lateral condyle is a separate fragment ,medial condyle is intact.

3) Both condyles are separated from the femoral shaft and from each other.

Fractures extending through the articular surface of the femoral condyles

A fracture through the medial condyle (two parts are comminuted)

A fracture through the lateral condyle (two parts are comminuted)

This classification is exhaustive and is no longer used .

AO/ASIF CLASSIFICATION

AO classification based on MULLER et al is as follows:

EXTRAARTICULR FRACTURE

A1 Extraarticular fracture ,simple

A2 Extraarticular fracture metaphyseal wedge

A3 Extraarticular fracture metaphyseal complex

PARTIAL ARTICULAR FRACTURE

B1 Partial articular fracture, lateral condyle, saggital

B2 Partial articular fracture, medial condyle, saggital

B3 Partial articular fracture, frontal

C. COMPLETE ARTICULAR FRACTURE

C1 Complete articular fracture ,articular simple, metaphyseal simple

C2 Complete articular fracture ,articular simple, metaphyseal multifragmentary

C3 Complete articular fracture multifragmentary

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

OPEN FRACTURES CLASSIFICATION

Classification of open fractures is important because it allows comparison of results between surgeons and in scientific publications.The optimal time to classify the open fracture is at the time of debridement of the traumatic wound.

Open fracture classification gives the surgeon guidelines for prognosis and permits us to make some statements about methods of treatment.

In North America and most of the world, the wound classification system of Gustilo and Anderson and the subsequent modification by Gustilo et al is the most widely accepted and quoted. There is wide variation in the interpretation and use of the Gustilo-

Anderson classification and, in general, there is too much emphasis on wound size. The critical factors in their classification system are (a) the degree of soft-tissue injury and (b) the degree of contamination.

GUSTILO ANDERSON'S CLASSIFICATION

GRADE I: Clean skin opening of <1 cm, usually from inside to outside; minimal muscle contusion; simple transverse or short oblique fractures.

GRADE II: Laceration >1 cm long, with extensive soft tissue damage; minimal to moderate crushing component; simple transverse or short oblique fractures with minimal comminution.

GRADE III: Extensive soft tissue damage, including muscles, skin, and neurovascular structures; often a high-energy injury with a severe crushing component.

IIIA: Extensive soft tissue laceration, adequate bone coverage; segmental fractures, gunshot injuries, minimal periosteal stripping.

IIIB: Extensive soft tissue injury with periosteal stripping and bone exposure requiring soft tissue flap closure; usually associated with massive contamination.

IIIC: Vascular injury requiring repair.

BIOMECHANISM OF INTERNAL AND EXTERNAL FIXATION METHODS

The accepted fixation targets are anatomic rigid fixation of the intra articular fragments and biological stable fixation of the articular component to the diaphyseal component .This can be achieved any of the following implants that includes dynamic condylar screw ,locking plates,fixed angle blade plate,cancellous screws and for open fractures external fixation alone or in combination with cancellous screws can be used .

IMPLANT SELECTION:(HARDER Y .INJURY J,30,:A31)

TYPE OF FRACTURE	PREFERRED FIXATION DEVICE
TYPE A	DYNAMIC CONDYLAR SCREW, LOCKING PLATES.
TYPE B	CANCELLOUS SCREWS
TYPE C	LOCKING PLATE

SCREWS

Screws are an integral component of surgical stabilization of distal femoral fractures. In most cases, they are used in addition to other fixation devices. There are, however, situations in which screws alone can be used for definitive fracture stabilization. In uncomminuted type B fractures in young patients with good bone stock, screws alone can provide adequate fixation. Screws are used in two modes: interfragmental compression and buttress. In a unicondylar fracture, after anatomic reduction, transverse interfragmental screws (perpendicular to the fracture plane) can be used to secure the reduction. With an angular load, there is a tendency for shearing at the fracture. This tendency can by countered by the placement of a buttress screw. This is a screw, with a washer, placed in the intact proximal fragment at the apex of the fracture with the washer overlying the proximal tip of the fractured fragment . This screw prevents proximal migration of the fractured fragment and, therefore, shear at the fracture surface. It depends on fracture pattern and good quality bone. Failing these conditions, a buttress plate should be used rather than a screw.

In complete articular fractures (type C), the initial anatomic articular reconstruction usually depends on screws. In most cases, transverse interfragmental compression screws are used to reconnect the split condyles. In patients with comminution of the intercondylar region, noncompressing position screws may be required to avoid narrowing of the distal femur. The position of these screws should be planned so as not to interfere with the placement of the subsequent hardware (blade plate, DCS, intramedullary nail) and to avoid penetration of the patellar groove or the intercondylar notch. This usually results in placement of the screws in a convergent fashion from lateral to medial in the transverse plane . With planned blade plate or DCS fixation, these screws need to be placed proximal to the site of planned blade or lag screw placement to avoid interference. In patients with coronal split of the condyle (fortunately lateral, most commonly) a cerclage wire can be placed around the heads of these screws to help to stabilize this fracture . This fixation is then augmented with a sagittal countersunk interfragmental screw, again avoiding the course of other planned fixation devices.

PLATES

To control alignment (particularly varus and valgus) of the relatively short distal articular segment a fixed-angle implant is frequently necessary. The blade plate and the dynamic condylar screw are the standard fixed-angle implants used for the distal femur. Recently plates with fixed-angle screws have been developed for fixation of distal femur fractures.

DYNAMIC CONDYLAR SCREW (DCS)

The DCS evolved from the sliding hip screw in an attempt to simplify the technique of fixed-angle device fixation of distal femoral fractures. Like the sliding hip screw, the DCS is a modular system comprising large, keyed lag screws of various lengths, barreled side plates of varied lengths, and a compression screw to link the two . The plate-barrel (screw) angle is 95 degrees, as in the blade plate. The advantages of this device are the easier and more familiar technique of insertion. The lag screw is a cannulated system, so once a guide wire is appropriately positioned, screw placement easily follows. Intercondylar compression can be obtained with the lag screw in the case of an intercondylar fracture. Furthermore, once the screw is placed, flexion and extension can still be adjusted, unlike with the blade plate, in which once the blade is inserted, fracture flexion and extension cannot be adjusted. Finally, separation of the plate from the screw allows the potential of percutaneous techniques of plate insertion.

Disadvantages

The disadvantages of the DCS are the increased bulk of the device and the lack of rotational control with the lag screw alone. The plate bulk distally is greater than that of the blade plate because it has to accommodate the barrel. Clinically, this does not prove to be much of a problem. The amount of bone removed to accommodate the screw and barrel is more than for a blade, and this may a problem for extremely distal fractures. Despite the keyed design (the lag screw is round), it does not afford good rotational control about a transverse axis because the bone may spin around the screw. To provide rotational stability, it is obligatory that at least one screw in the side plate engage the distal fragment to provide rotational stability. There may, therefore, be some limitations to the applicability of this device in extremely distal fractures.

Technique of Insertion

The first step in the use of this device is to reconstruct the articular surface, with care taken to ensure that the interfragmentary screws do not lie in the projected path of the lag screw or the side plate. The screws must therefore be placed proximal to the site of lag screw insertion, and the heads must be far enough apart to allow seating of the plate. Because the lag screw can be used to apply interfragmental compression, one can consider using only a posterior interfragmentary screw outside of the plate. If an anterior interfragmentary screw is used, the surgeon should consider not using a washer since there is usually insufficient space for it between the anterior edge of the plate and the anterior edge of the lateral condyle. The DCS is a cannulated system, designed to be inserted over a guiding K-wire. The insertion point of the wire is similar to that of the center of the blade of the blade plate, but it is slightly more proximal (2 cm from the joint surface at the junction of the anterior one-third and posterior two-thirds of the longest AP dimension of the lateral femoral condyle or in the middle of the anterior half of the lateral femoral condyle). The K-wire needs to be parallel to the distal articular surface in the frontal plane. This can be controlled fluoroscopically or by placing a K-wire along the distal articular surface as a guide. In the transverse plane, the wire should be perpendicular to the lateral surface of the lateral femoral condyle. This ensures that the screw will lie between the patellar groove and the intercondylar notch and is the longest dimension available for good screw purchase. A contoured wire guide, matching the side plate contour, is available to facilitate guide wire placement. Carefully measure the correct lateral insertion point of the condylar screw. Placement of the screw too posterior is a very common error, and always results in medialization of the distal femur relative to the femur shaft. During placement of all guide wires in the distal femur, make sure that fluoroscopy shows a true AP view of the distal femur. Deforming forces will typically force the distal segment into extension making it difficult to obtain a true AP of the distal segment, resulting in inaccurate placement of guide wires and, ultimately, placement of the condylar screw itself.

The guide wire, having been advanced to the medial cortical surface and its position having been verified radiologically, is measured with the appropriate depth gauge to determine the depth of reaming and the length of screw required . Because of the trapezoidal shape of the distal femur, care needs to be taken to ensure that the guide wire does not penetrate the medial cortex. The depth of reaming is 10 mm less than the imbedded wire length, and the screw selected is 5 to 10 mm less than the reamer. This technique ensures that the screw is countersunk in the distal segment to allow for interfragmentary compression if desired. The cannulated reamer is then set to the depth required, and the wire is overreamed, preferably under fluoroscopic control. In bone of good quality, the cannulated tap should be used to prior to screw insertion. The screw of the appropriate length is then inserted over the guide wire to the full depth of the prepared hole. The insertion handle of the lag screw should end in a position parallel to the longitudinal axis of the distal segment, so when the side plate is applied, it will have the correct alignment, given that it is a keyed device.

Once the lag screw has been inserted, the appropriate side plate is selected and applied. The length of the side plate, should be such to allow at least eight points of cortical purchase in the proximal fragment. The plate must line up with the beveled surfaces of the end of the lag screw to allow the barrel to engage. The rotational alignment of the plate, in relation to the distal fragment, can be refined, and then the plate is impacted on the lateral femoral condyle. In more extensive fractures requiring extremely long side plates, the plate needs to lie somewhat more posteriorly on the distal fragment to accommodate the anterior bow of the femur; otherwise, the proximal end of the plate will ultimately project from the femur anteriorly. It should then be secured by the compression screw, which runs down the barrel and connects the plate to the screw and can provide further interfragmental compression in the case of intercondylar fracture. To ensure adequate rotational control, at least one screw is required in the plate that further engages the distal fragment. This is usually a 6.5-mm cancellous screw.Once the plate is secured in the correct anatomic relation to the distal fragment, reduction of the metaphyseal component of the fracture is undertaken, as described in the blade plate section earlier . Proper length and rotational alignment must be obtained before the plate is fixed to the diaphysis or metaphysis. Clinical and x-ray verification of this situation should be obtained.

LOCKING PLATES (WITH FIXED-ANGLE SCREWS)

As are the DCS and the blade plate, locking plates are fixed-angle devices. The screws lock to the plate and therefore provide angular stability to the construct that conventional screws do not. For the distal femur, angular stability of the distal screws will help to prevent varus collapse. The locking screws may also provide stronger fixation of the plate in the proximal fragment by eliminating any potential for toggle and sequential screw loosening. This could have particular advantage in osteoporotic bone.

Plates with locking screws function as internal fixators and have a possible biological advantage over conventional plates. The plate is not compressed against a cortex and therefore periosteal blood supply may be preserved. These types of devices cannot be used to aid the reduction of the nonarticular component of the fracture as conventional fixed-angle devices can. The fracture must be reduced and provisionally fixed prior to plate placement.

Another disadvantage of locking plate fixation is that the surgeon has no tactile feedback as to the quality of the bone when tightening the screws. The screws stop abruptly when the threads are completely seated into the plate regardless of the bone quality.

Devices that combine locking screw technology with conventional screw capacity allow the surgeon to utilize the mechanical advantages of both systems.

LOCKING CONDYLAR PLATE

The locking condylar plate is an example of a device that combines fixed-angle locking screw technology with the option for conventional screw utilization. Experience with this device is still very limited and more study is required to define its place in the management of distal femur fractures. The advantage of combining conventional screw capacity with fixed-angle technology is that the fixed-angle screws provide stable fixation in the small articular block (protecting against collapse and loss of alignment) while the conventional screws can provide interfragmentary compression and make it possible to use the device as an aid in reduction of the nonarticular portion of the fracture.

Application of these devices, by present technology, requires extensive use of image intensification to control fracture alignment and hardware placement. Operating table selection and patient positioning must be predicated on this. Intraoperative verification of rotational and axial alignment requires radiological and clinical access to the entire lower limb.

As with all devices designed for fixation of fractures of the distal femur, the principles of application of this device are: anatomic reduction and rigid stabilization of the articular surface, relatively stable fixation of the metaphyseal component of the fracture in anatomic alignment, rotation and length, while minimizing the biological insult. Like devices such as the blade plate and DCS, the device can be used as a reduction tool, for the extraarticular component of the fracture. The precontoured plate must be perfectly applied to the distal fragment and then by using conventional screws in the proximal portion the extraarticular reduction can be completed. The locking plate, which is first provisionally applied to the lateral surface of the distal fragment, dictates the screw position, such that the plate bone relationship needs to be anatomical prior to the insertion of any screws.

The first step in the stabilization of a distal femoral fracture is to address the articular component of the fracture if there is one. These fractures need to be anatomically reduced and provisionally stabilized with K-wires. Definitive stabilization of the articular surface is then undertaken with interfragmentary screws. The placement of these screws must not impede the subsequent placement of the plate. Two alternatives exist for the management of the frequently associated sagittal split between the condyles: percutaneous placement of screws from the medial side or placement of lateral to medial screws peripheral to where the plate will come to lie. Even with medial to lateral screws, one needs to anticipate the ultimate placement of the plate and locking screws to avoid obstructing the trajectory of the locking screws which is not adjustable but is determined by the plate. For lateral to medial screws, either the plate guide or an actual plate can be used to direct the starting point of these screws to avoid the screw heads from obstructing the plate application .

The articular segment having been reconstructed, attention is now directed to reduction of the metaphyseal component and provisional stabilization. Reduction is often aided by an angular bolster providing a fulcrum under the distal thigh. Traction, under two plane fluoroscopy, is used to reduce the fracture and provisional stabilization is undertaken with crossed stout K-wires (percutaneous if necessary). Joy sticks in the articular segment may be helpful in the manipulation of difficult to reduce distal fractures. Alternatively, the plate can be secured to the perfectly reduced articular segment and then used as an aid for the reduction of the metaphyseal component.

The provisional reduction having been achieved, attention is now directed to applying the plate. The wire guide for the primary condylar screw is threaded into the appropriate hole in the plate. This screw is to be oriented as to be parallel to the knee joint on a frontal projection and parallel to the patellar joint on the axial projection . Other threaded wire guide(s) can be attached to the plate to aid in plate handling. The length of plate selected is similar to that for a blade plate or DCS procedure, sufficient length to allow 4 or 5 holes in the proximal, metadiaphyseal segment.

The plate is then applied to the lateral surface of the distal femur. The plate should fit the contour of the bone and, again, must be aligned so that a wire passed through the primary screw wire guide is parallel to the distal articular segment and the patellar articulation, on the AP and axial views, respectively . This wire is inserted to provisionally secure the plate to the reconstructed distal segment. Minor rotational adjustments of the plate are then made to ensure that the anterior edge of the plate parallels the anterior distal femur contour. Further wires can be inserted to maintain this relationship. If the metadiaphyseal component of the fracture is well aligned the plate will come to align with the femoral shaft proximally. If the fracture is not well aligned, adjustments to the reduction can be made. The plate can then be secured to the proximal segment with a k-wire through a threaded wire guide or with a reduction forceps. This is best done in one of the more proximal, if not the most proximal of the holes.

The provisional fixation now being complete, careful radiological assessment should be undertaken to confirm the reduction and plate positioning. If satisfactory, one can now begin to secure the plate. The first screw to be placed is the primary distal locking screw. A cannulated drill is used to over drill the wire passing through this hole, a wire based depth gauge having determined the length of screw required. The appropriate cannulated screw is then inserted over the guide wire. It is critical that the plate is fully applied to the bone as, unlike conventional screws, locking screws will not aid in the apposition of the plate to the bone, but will rather fix the plate in whatever relationship it held at the time of screw insertion. For fractures with a sagittal intercondylar component, a medial screw nut can be applied by passing the wire out the medial condyle and skin and using this as a guide to cut down and apply the nut.

The relationship of the plate to the distal segment is now again critically evaluated clinically and radiologically. Minor rotational (flexion and extension) adjustments can still be made. Further locking screws are now placed into the distal segment to finish the distal fragment fixation. Each of these needs to be inserted with first predrilling through a guide threaded into the plate to ensure proper alignment and locking of the screw.

The distal fixation now being complete, attention is directed to applying the plate to the proximal segment. The fixation used depends on the fracture pattern and the bone quality. Regular screws, in neutral or compression mode, locking screws or a combination of these can be used . In the situation of a simple transverse metaphyseal component fracture in good bone, once the axial and rotational alignment is verified clinically and radiologically, a screw in compression mode is placed followed by three or four screws placed in neutral position. These screws need to be placed in the appropriate dynamic compression holes in the plate, using the appropriate drill guides to ensure accurate drill hole positioning. In the face of poor bone quality, the use of locking screws in the proximal segment may be preferred. It may still be beneficial to use one or two conventional screws to ensure satisfactory plate bone apposition and, in appropriate fracture patterns, allow for fracture compression. Alternatively, the external compression device can by used to provide fracture compression. Once the plate has been provisionally applied to the proximal segment and length, rotation and alignment has been checked, locking screws can be placed. It is essential that the plate is properly centered on the shaft for secure locking screw insertion. Again, it is critical to predrill through the appropriate, plate mounted drill sleeve in the locking screw holes, to be sure of the correct alignment. This is vital to screw plate locking. The length of screw required is measured with a depth gauge and the screw placed and locked with a screw driver. If a combination of conventional and locking screws is to be used, the conventional screws must be inserted before the locking screws are . At the completion of the procedure a final clinical and radiological evaluation of the reduction and fixation should be undertaken. Postoperative management is the same as with other forms of internal fixation.

EXTERNAL FIXATION

Unlike the tibia and the wrist, the thigh does not tolerate external fixation well. However, external fixation has been used for both temporary stabilization and definitive stabilization of distal femur fractures in some situations.

In patients whose instability requires rapid fracture stabilization or in patients with major soft tissue lesions, spanning external fixation allows for rapid fracture stabilization while still allowing access to the limb and patient mobilization. With a view to subsequent definitive treatment, the pin sites should be placed remote from the site of planned surgical intervention. This usually means lateral or anterolateral pins in the proximal femur and anterior pins in the tibia.

A simple anterior frame is all that is required for temporary splintage. Gross restoration of length, rotation, and alignment is the goal. Two 5-mm half-pins in each of the proximal and distal segments are all that is required. Pins should be placed with a predrilling technique to lower the incidence of pin site complications such as infections.[30, 32]

Definitive external fixation, although rarely used, can be in the form of a unilateral half-pin fixator or a hybrid frame. In both instances, if there is an intraarticular component, it should be reduced and secured. In the instance of an undisplaced articular fracture, this may be accomplished with a percutaneously placed screw or, in the case of the hybrid-type frames, with crossed olive wires . For articular fractures that are displaced and are not readily reduced closed, a limited open approach is required to achieve reduction and provisional fixation. The external fixator can then be applied.

For unilateral frames, half-pins are placed in the distal and proximal fragments. A minimum of two pins, 5 or 6 mm in diameter, should be placed in each. The pins are placed through a lateral approach with a percutaneous, predrilling technique. The pins should be placed perpendicular to the mechanical axis of the femur. Their spread in each fragment should be as wide as reasonably possible to improve the frame mechanics. With the application of the frame, the length, rotation, translation, and angular alignment are corrected.

OPERATIVE TECHNIQUES

EMERGENCY ROOM MANAGEMENT

The management of compound distal femur fractures follows the same principles as for any other compound fractures.the modality of skeletal stabilization will always be a spanning fixator with or without minimum internal fixation in order to restore the articular surface. We have debrided the all the 20 cases on day 1 and grade III fractures were stabilized with spanning external fixator as well. During the planned joint lavage we have retained the all major fragments regardless of the wound type retained.(1,3,4,5)

SURGICAL APPROACHES

Surgical approaches for management will vary from percutaneous to extensile approaches depending upon the philosophy of fracture fixation adopted .The standard approach for distal femur is the lateral approach with its extension to the knee joint.SWASBUCKLER approach (9,10),a commonly used approach for type C fractures ,an extension of the lateral approach ending at the level of tibial tuberosity to facilitate the medial subluxation of patella. Surgical approaches for type B needs to be individualized depending upon the fracture pattern.(6,5,22).

LATERAL APPROACH: STANDARD TECHNIQUE

INTRODUCTION

A lateral approach to the distal femoral shaft and supracondylar region of the femur is the most commonly used exposure for open reduction and internal fixation (ORIF) of fractures in this area. Most supracondylar fractures (with the exception of fractures limited to the medial condyle), when treated with ORIF, can be managed with this approach.

POSITIONING

A radiolucent operating table facilitates use of an image intensifier during the procedure, and it is recommended because it allows rapid intraoperative evaluation of reduction and implant placement for this technically demanding procedure. A fracture table (and traction) should not be used, because the resulting muscle tension will make exposure and reduction more difficult. The patient is positioned supine with the ipsilateral hip elevated to allow slight internal rotation of the leg. Alternatively, the patient may be placed in the lateral position. The leg should be draped free; the iliac crest will need to be left exposed if bone graft is going to be required for the reconstruction. With the patient in the supine position, a sterile bolster can be placed under the knee to facilitate exposure and reduction. When proximal extension of the fracture precludes use of a standard tourniquet, a sterile tourniquet can be used for part or all of the procedure.

PROCEDURE

A single straight lateral incision is made along the thigh. The incision should start as proximal as necessary; distally, it should extend across the midpoint of the lateral condyle anterior to the fibular collateral ligament, across the knee joint, and then gently curve anteriorly to end distal and lateral to the tibial tubercle. The fascia lata is incised in line with the skin incision. At the knee, the iliotibial tract will need to be incised, and the incision will continue down through the joint capsule and synovium to expose the lateral femoral condyle. The superior geniculate artery will need to be identified and ligated. Care must be taken not to incise the lateral meniscus at the lateral joint margin. The vastus lateralis muscle is carefully elevated from the intermuscular septum and is retracted anteriorly and medially. The perforating vessels will need to be identified, ligated, and then cut. Stripping of soft tissues from the anterior, medial, and posterior surfaces of the femoral shaft and supracondylar regions is unnecessary and should be avoided, to prevent devitalization of bone fragments.

MATERIALS AND METHODS

This is a prospective study of 20 patients with open supracondylar and distal femoral fractures treated with rigid internal fixation using locking compression plate,dynamic condylar screw fixation and knee spanning external fixator and minimal internal fixation with cancellous screws and k wires at INSTITUTE OF ORTHOPAEDICS AND TRAUMATOLOGY,MADRAS MEDICAL COLLEGE&GOVERNMENT GENERAL HOSPITAL,CHENNAI FROM MAY 2008 TO SEPTEMBER 2010.

The patients were selected based on the inclusion and exclusion criteria as given below.

INCLUSION CRITERIA

All patients above 18 years with open supracondylar femur fractures extending upto 15 cm from the articular surface.

1) Compound grade I,II,IIIA,IIIB (Gustilo anderson's classification) of supracondylar fracture of femur.

2) TYPE A1, A2, A3, B1, B2, B3, AND C1,C2,C3 (MULLER'S CLASSIFICATION)

3) REPORTING WITHIN 12 HOURS AFTER INJURY.

EXCLUSION CRITERIA

1) ASSOCIATED MULTIPLE COMORBID CONDITIONS

2) ASSOCIATED TIBIAL PLATEAU FRACTURES

3) ASSOCIATED VASCULAR INJURIES

4) PATHOLOGICAL FRACTURE

This case series study grouped the patients into three and outcomes were analysed .Three groups were given below:

Group 1: wound debridement and delayed stable internal fixation

Group 2: Minimal internal fixation and external fixation

Group 3: Minimal internal fixation alone

Group 4: External fixation alone

Group 1 treatment were applied to the open wound grade I and II of Gustilo's type and fracture types included were Muller's A1,A2,A3 and C1,C2,C3.Group 2 treatment were applied to open grade IIIA,and IIIB of gustilo's and fracture types were Muller's C1,C2 and C3.Group 3 treatment were applied to open grade I,II and III of gustilo's type and fracture types were Muller's B1,B2 and B3.Group 4 treatment were applied to the A3 and C3 types with compound Grade I,II,and III .

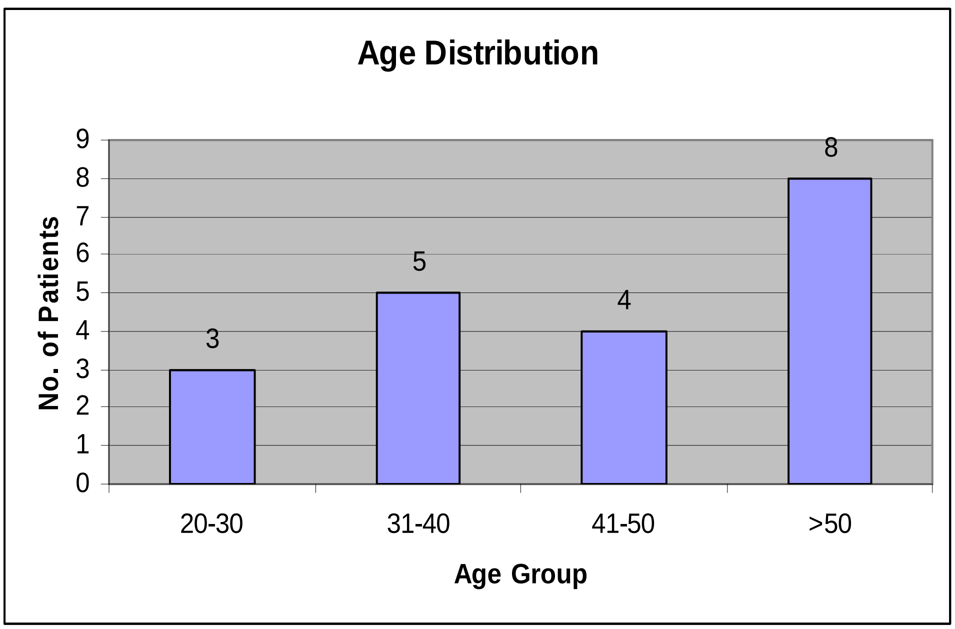
According to the above indigenous methods of selection criteria we have treated seven(35%) patients with wound debridement and delayed internal fixation with either dynamic condylar screw fixation or locking compression plating.11 patients(55%) were treated with minimal internal fixation or external fixation alone .Among them seven patients were later converted into plate osteosynthesis.Two patients were (10%)treated with combination of minimal internal fixation and external fixation .For minimal internal fixation we have used 6.5mm cancellous screw alone or with K wires of 3mm size.

AGE DISTRIBUTION

The age of occurrence of these fractures varied from 30-60 years.The number of patients in different age group is as follows.

AGE GROUP IN YEARS	***NO.OF PATIENTS***
20-30	3
31-40	5
41-50	4
>50	8
TOTAL	20

AGE DISTRIBUTION

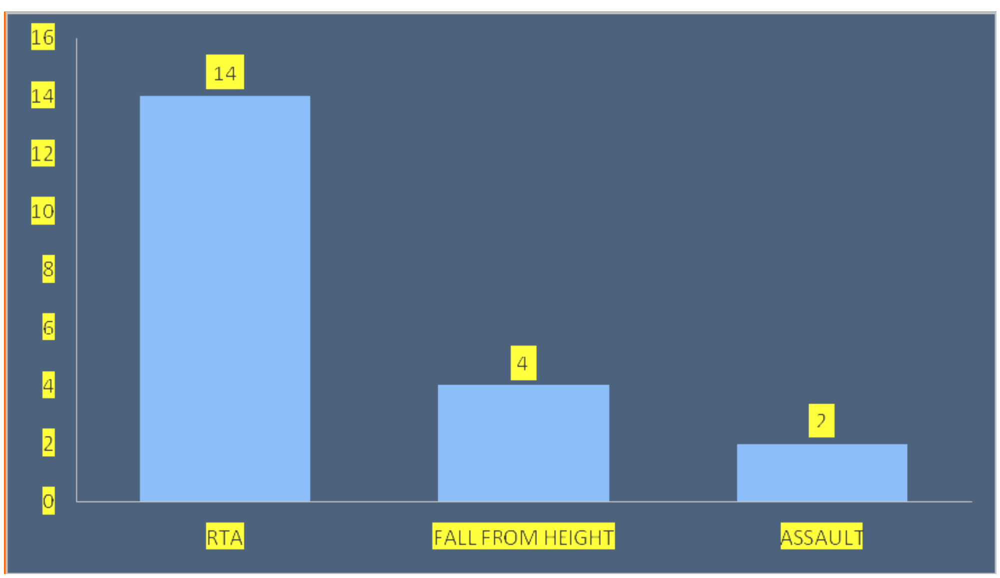


MODE OF INJURY

The mode of injury was mainly due to ROAD TRAFFIC ACCIDENT (70%)

ROAD TRAFFIC ACCIDENT	14
FALL FROM HEIGHT	4
ASSAULT	2

MODE OF INJURY

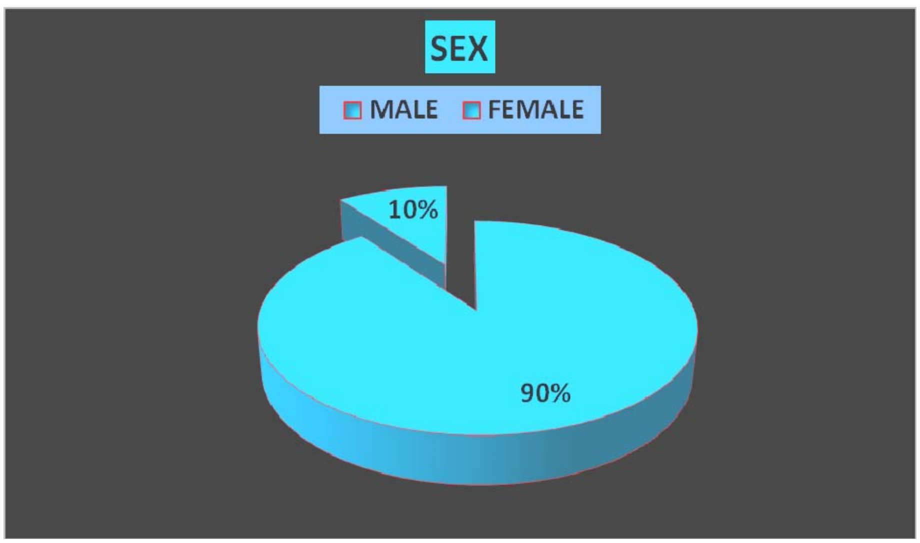


SEX

The male to female ratio was 9:1

MALE	18
FEMALE	2

SEX DISTRIBUTION

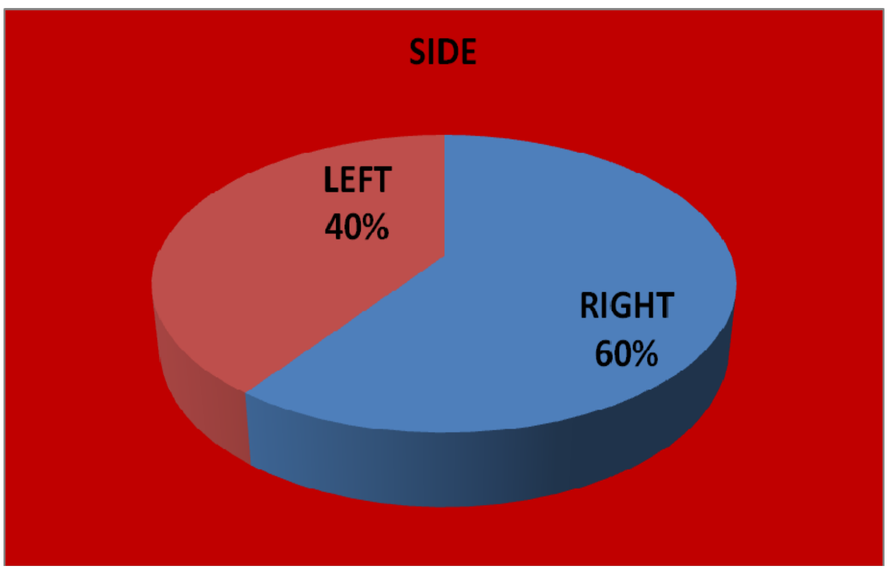


SIDE

The side of occurrence of fracture in our patients was as follows

RIGHT	12
LEFT	8

SIDE INVOLVEMENT

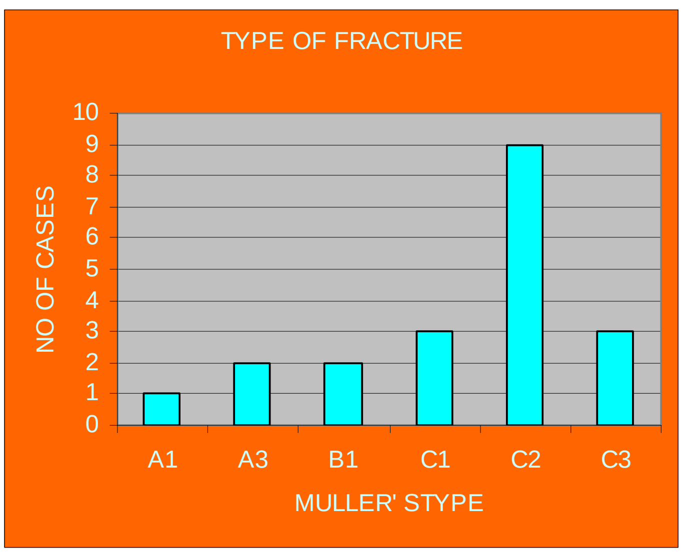


FRACTURE TYPES

Among the 20 cases of supracondylar fractures of femur split up of no of cases according to the MULLER'S CLASSIFICATION SYSTEM:

MULLER'S TYPE	NO OF CASES
A1	1
A3	2
B1	2
C1	3
C2	9
C3	3

TYPE OF FRACTURE

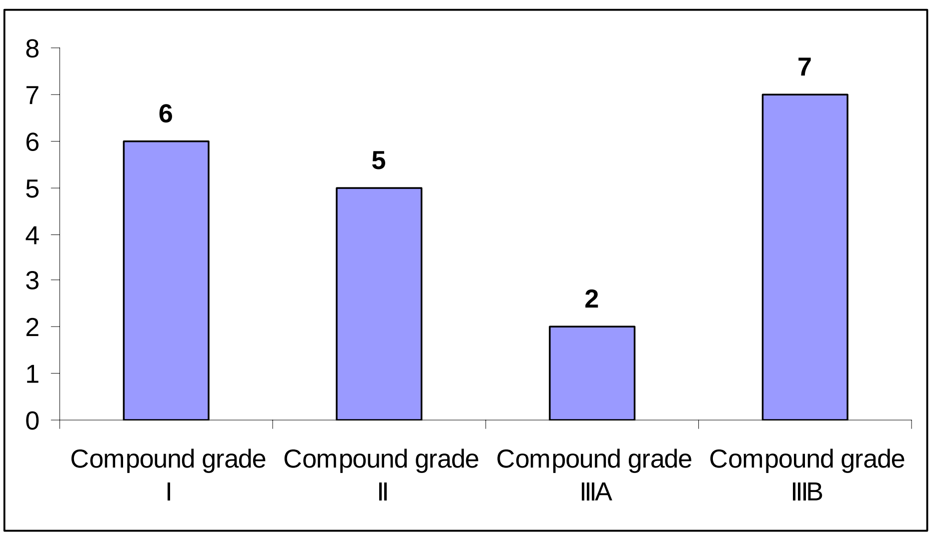


TYPE OF INJURY

Of the 20 patients, the number of patients in each compound grade is as follows,

Compound grade I	6
Compound grade II	5
Compound grade IIIA	2
Compound grade IIIB	7

TYPE OF INJURY



ASSOCIATED INJURIES

The associated injuries in this study include

Head injury	2
Patella fracture	2
Both bone leg fracture	2
Fracture of both bone forearm	1
Fracture of metatarsals	1
TOTAL	8

TIME INTERVAL BETWEEN INJURY AND SURGERY

The time interval between injury and surgery varied from less than 1 week to more than 5 weeks.

TIME INTERVAL	NUMBER OF CASES
BELOW ONE WEEK	4
BELOW 2 WEEKS	6
BETWEEN 2 WEEKS -3 WEEKS	6
BETWEEN 3 WEEKS -4 WEEKS	2
BETWEEN 4WEEKS -5 WEEKS	1
>5 WEEKS	1

The reasons for the delay in taking up for surgery were due to non availability of theatre days, compound nature of the wound or the associated injuries, and persistently elevated C – Reactive Protein levels.

BONE GRAFTING

Eleven patients had bone grafting during their definitive procedure. No of patients and their Muller's grade were given below.

MULLER'S GRADE	NO OF PATIENTS
C2	6
C3	1
C1	2
A3	2

FOLLOW UP PERIOD

The follow up period ranged from 6-18 months. The mean follow up period was 8.6 months.

WOUND DEBRIDEMENT

All cases were undergone initial wound debridement irrespective of compound grade.

All cases undergone minimum of two surgical procedures and two cases of compound grade IIIB undergone more than two surgical procedures. One patient undergone primary wound debridement and skin cover with split skin graft to reduce the raw area and to reduce the period of soft tissue healing.

OBSERVATIONS AND RESULTS

Based on our study, we have made the following observations.

1) The mean age of patients was 45.25 years.In 40% of the patients fracture occurred above 50 years.

2) There was a definite male preponderance with 90% occurring in males.

3) The side occurrence was ,60 % in the right, and 40 % in the left.

4) Road traffic accidents was the main mode of injury(70%).

5) Associated injuries was present in 30% of the patients.

6) Grade 1 compound constitutes 30%,Grade II compound 35% and Grade III compound wound constitutes 35%.

7) AO MULLER’S type C2 FRACTURE type predominates and constitutes about 45%.

8) Bone grafting necessitates in 40 % of the patients.

9) The time interval between injury and definitive surgery averaged about three weeks.

RESULTS

20 cases (four groups) results were studied. Group 1treated with initial wound debridement and followed by either internal fixation with dynamic condylar screw fixation or locking compression plating with an average period of gap between the initial debridement, skeletal traction and definitive fixation was about 3 weeks. Group 2 of patients were treated with initial wound debridement and external fixator with minimal internal fixation for maintaining the articular surface as well as to prevent the flexion of the distal fragment. Group 3 was treated with minimal internal fixation alone. Group 4 was treated with external fixation alone.

Post Operative Protocol

Patients were followed up once they got discharged from the hospital for every 3 weeks till the fracture united and there after at 3 months, 5 months, and 1 year. The minimum follow up period in our study was 6 months and maximum follow up period was 18 months.

Clinically, tenderness at fracture site, knee pain, limb length discrepancy, range of movements, 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 united if callus was seen in atleast three cortices in anteroposterior and lateral views. The functional outcomes were analyzed using KNEE RATING SYSTEM BY THE HOSPITAL FOR SPECIAL SURGERY.

KNEE RATING SYSTEM BY THE HOSPITAL FOR SPECIAL SURGERY

PAIN - 30 POINTS

Walking	**NO OF POINTS**
NONE	15
MILD	10
MODERATE	05
SEVERE	00
AT REST	
NONE	15
MILD	10
MODERATE	05
SEVERE	00

FUNCTION -22 POINTS

WALKING	**NO OF POINTS**
WALKING AND STANDING UNLIMITED	12
5-10 BLOCKS STANDING >30 MINUTES	10
1-5 BLOCKS STANDING >30 MINUTES	8
<1 BLOCK	4
CANNOT WALK	0
STAIRS	
NORMAL	5
WITH SUPPORT	2
TRANSFER	
NORMAL	5
WITH SUPPORT	2

RANGE OF MOTION-15 POINTS

80 DEGREES	10
90 DEGREES	11
100 DEGREES	12
110 DEGREES	14
120 DEGREES	15

MUSCLE STRENGTH-15 POINTS

GRADE -5	15
GRADE -4	12
GRADE -3	09
GRADE -2	06
GRADE -1	03
GRADE -0	00

FLEXION DEFORMITY-10 POINTS

NONE	10
0-10 DEGREES	08
10-20 DEGREES	05
>20 DEGREES	00

INSTABILITY - 5 POINTS

NONE	05
O-5 DEGREES	04
6-15 DEGREES	02
>15 DEGREES	00

SUBTRACTION

ONE CANE	1
ONE CRUTCH	2
TWO CRUTCHES	3
EXTENSOR LAG	
5-DEGREES	2
10 –DEGREES	3
15 –DEGREES	5
DEFORMITY (5 DEG = 1 POINT)	
VARUS	
VALGUS	
TOTAL SUBTRACTION	

Knee score = Total Points – Total Subtractions

EXCELLENT	**85 POINTS OR MORE**
GOOD	70-84 POINTS
FAIR	60 – 69 POINTS
POOR	<60 POINTS

OVERALL RESULTS

Analysis of functional outcome of this study had a few drawbacks. One of the obstacles is that frequency of associated injuries and multiple fracture patterns makes functional outcome studies difficult to quantify. Also presence of preexisting degenerative joint disease confounds the outcome .Another problem encountered when attempting to evaluate long term functional outcome is inadequate follow up and shorter period of study.

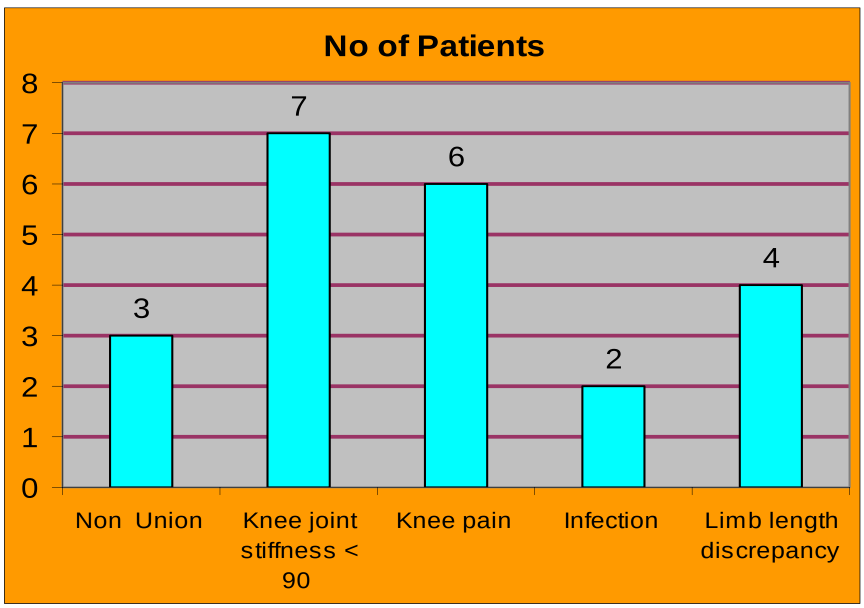
Of the twenty cases with the available follow up the functional outcome was good to excellent in twelve patients(60%),fair in three patients (15%),and poor in 4 patients (20%).

Results	**No. of patients**	**Percentage**
Excellent	6	30
Good	6	30
Fair	3	15
Poor	4	20

COMPLICATIONS

S. No	Complications	No of Patients
1.	Non Union	3
2.	Knee joint stiffness < 90	7
3.	Knee pain	6
4.	Infection	2
5.	Limb length discrepancy	4

COMPLICATIONS



KNEE STIFFNESS

It was the most common complication in our study .Average knee flexion was 70 degrees. The reasons for knee stiffness were delaying in taking up for surgery, fracture patterns, infection, stability of the fixation and non compliance to multiple surgical procedure and aggressive physiotherapy.

CASE ILLUSTRATIONS

CASE - I

55 year old male, MR.MANOKARAN I.P.NO.15763 brought with alleged history of assault with known person and sustained head injury, open supracondylar fracture of femur ,GRADE I compound on left side, MULLER'S A3 TYPE. After the clearance from neurosurgeon for head injury, patient was taken up for immediate wound debridement and upper tibial pin traction given at the same time.

After 2 weeks time wound healed and there was no evidence of local infection and blood parameters were normal. He underwent open reduction and internal fixation with ten hole locking compression plate with bone grafting. Immediately following surgery he gained only 0-40 degree of knee flexion .He was followed up regularly for every month and advised non weight bearing walking ,and advised to mobilize the knee and ankle.after 12 weeks fracture got well united and evident on both ap and lateral views.At 6 month follow up patient had excellent range of (0-100)movement of knee and there was no other complications .He was returned to his previous job as a driver and leading an active life.

CASE - 2

48 Year old male, MR.BALARAMAN ,IP NO 58707,admitted with alleged history of road traffic accident and sustained injury to his left thigh and diagnosed to have open GRADE IIIA SUPRACONDYLAR FRACTURE OF FEMUR Muller's type C2 .Initially wound was thoroughly debrided and primary closure was possible hence sutured and UTPT applied. After two 2 weeks time wound was healed well and we proceed with internal fixation using dynamic condylar screw fixation. Intra operatively we found that distal fragment was gone into varus and metaphyseal comminution was more and bone grafting was not done.

Due to inadequate stable fixation and severe comminution not showing any signs of healing at 3 month .Hence we have planned to revise with locking plate with bone grafting. After this procedure at 6 month follow up fracture got united with excellent callus formation. Knee motion was encouraged from the suture removal (12th day). At 6 month follow up had 0-90 degree of motion without any infection and knee pain.

CASE - 3

45 year old male, MR.VENKATESAN IP NO 51213,admitted with alleged history of road traffic accident and diagnosed to have open GRADE IIIB supracondylar fracture femur treated with initial external fixator and then revised with open reduction and internal fixation with locking plate and bone grafting done. Time interval between the primary and definitive surgery was 5 weeks.

Total hospital stay exceeds 7 weeks and knee movements were started on the 2nd week onwards under supervision. Follow ups were at 1, 3, 6, 8,12 months after the discharge, knee movements at 12th month follow up was 0-90 degree and patient leading an active pain free life.

CASE -4

55 year old male MR, MURUGAN IP.NO.66670 got admitted with the alleged history of fall from height in the working place and sustained injury to his right thigh and diagnosed to have open grade I supracondylar fracture of femur with communited proximal third both bone leg on the same side. The patient was initially treated with wound debridement and calcaneal pin traction.

After 3 weeks both the supracondylar and tibia was planned to fix at the same time.open reduction and internal fixation with locking plate and bone grafting for supracondylar fracture and illizarov fixation for tibia done at the same time.

At 6 month follow up fracture got united and knee movements obtained was o-90 tibial fracture not yet united in the study period.

DISCUSSION

The presence of open fractures requires thorough evaluation of the soft tissues to assess their viability in light of the additional trauma of major surgery.Meticulous wound debridement is mandatory and is the cornerstone of open supracondylar fracture treatment.

In our study of 20 patients of supracondylar fractures of femur the mean age of occurrence of fracture in our study was 45.25 years as compared to 47.2years reported by JM SILISKI,et al ,50 years reported in a study done by Gellman etal and 32.4 years in a study done by HERSCOVICI and WHITEMAN. According to our study ,the incidence of fracture was high in the age group of more than 50 years . The most common mode of injury was road traffic accidents in our study similar to other studies.(12,6,1).

There was a definitive male preponderance 90% in our study. OSTRUM reported 75% in his study. The open wounds were always anterior through the extensor mechanism. This finding was comparable with other studies. (FAZAL ALI,MICHAEL SALEH,INJURY JOURNAL,2000,139-146).

The average time interval between injury and definitive fixation was higher in our study (ranged from 1 weeks to 10 weeks) which is attributed to the non availability of theatre days and consistently elevated C-Reactive protein level. Bone grafting was done in fracture with gross comminution and fractures with severe osteoporosis. No clear cut recommendations given in the literature regarding the timing for bone grafting in compound supracondylar fractures of femur .Edward and colleagues recommended bone grafting two to three weeks after successful wound coverage. In our study bone grafting done two to nine weeks after the soft tissue healing.

In our study we had dynamic condylar screw implant failure in one patient which was identified to be due to significant medial comminution. This problem was managed with locking plate fixation and bone grafting .This finding is comparable with SCHATZKER J STUDY of fractures of distal femur. clin orthop 1998, Feb ,43-56 .

We had major complication of variable degrees of knee stiffness in 35% of patients instead of infection in 10% of patients. Several factors may play a role in the development of extension contracture includes open nature(grade IIIA,IIIB),severity of the fracture pattern (C2,C3), long injury and operative time interval ,long duration of surgery,soft tissue envelope over the fracture is often contused and patients non compliance to multiple procedures including quadriceps plasty and early aggressive physical therapy.(2,5,17,22,24,26).

ROY SANDERS AND M.SWIONTKOWSKI highlighted the importance of muscular and capsular injury and the occurrence of extensive quadriceps adhesions .They concluded that despite satisfactory union and alignment functional results remained to be poor due to limitation of flexion .This contributory effect of soft tissue injury is not clearly understood.It believed to be due to cytokines and nitric oxide mediated neutrophil recruitment.Recent studies have begun to explore the relationship between inflammatory cell function and skeletal muscle injury and repair by using genetically modified animal models, antibody depletions of specific inflammatory cell populations,or expression profiling of inflamed muscle after injury.This could explain the knee stiffness occurred in this study inspite of satisfactory bony union.Rehabilitation protocol and delay in fixation in our cases could have also contributed to the variable results in range of movements. Hence amount of soft tissue damage and intraarticular comminution correlates with limited range of motion.

In our study we have used external fixators in 35% patients either alone or with cancellous screws .Among them 10%were treated with external fixator alone resulted in poor functional outcome and 25% of patients were treated with external fixator as a temporary method of fixation resulted in good functional outcome.In review of all the published articles on this subject we have found that most centers have used external fixators as a temporary device for the initial management of fractures and soft tissues in open fractures .It has also been used in the multiply injured patient when the overall condition does not permit early definitive fixation.(21,STEWART et al)

The use of external fixator has many theoretical advantages for helping to promote union.In the distal femur the cortex is thin and there is a widened medullary cavity with cancellous bone.In addition the distal fragment is usually short. All these features makes the stable fixation difficult to achieve .Also ,because the fracture site is so close to the knee joint movement of the knee allows movements at the fracture site.By using the external fixator and especially by crossing the knee joint we are able to achieve a more stable fracture fixation. The concept of cross joint fixation is not new. Compared to open methods of treatment negligible soft tissue dissection or periosteal stripping is performed . The periosteal blood supply and the soft tissue envelope is thereby undisturbed.(FAZAL ALI,MICHAEL SALEH,INJURY,INT,CARE INJURED 31 (2000) 139-146.).In our study we observed that in patients were treated with external fixators alone after 3 weeks to 5weeks developed pin tract infection in the distal fragment pin and got loosened leading to removal of the pin and subsequent flexion of the distal fragment lead on to non union and poor functional results.

We attributed the favorable results(60% of good to excellent results) in this series to adherence to the principles of stabilization with rigid internal fixation and early functional rehabilitation .In elderly patients ,bone grafting of supracondylar defects and impaction of comminuted metaphyseal fractures were considered critical for rapid union of these fractures(12,23.24,25).

In our case series we had loss of fixation in three patients attributed to early weight bearing and initial minimal internal fixation methods using k wires and cancellous screws comparable to the JM

SILISKI ,M. MAHRING study with twenty open supracondylar fractures of femur treated with only rigid internal fixation .

Elderly patients did not have a poorer outcome ,and age does not pose any special problems in this series(13,26).The incidence of mal reduction was low in our series only four patients had 5 to 10 degrees of mal alignment in the saggital plane and hyper extension was not evident in any of these four patients ,this finding are comparable with other studies(26).

Of the two infection one had developed osteomyelitis and undergoing treatment .He is on external fixator and initial open wound grade was IIIB, fracture pattern was C3.Another patient is on higher antibiotics according to the culture and sensitivity.

We had anterior knee pain in 6 patients without any localized tenderness and made one patient less comfort in daily activities.Due to severe metaphyseal comminution 4 patients got limb length discrepancy of 1-3 cm (4,6,7). Residual pain was rarely significant and then only when secondary arthritic changes had developed .Most patients were satisfied so long as they had strong extensor power and could flex the knee 70 degrees .This enabled them to walk on stairs normally while a lesser range of flexion forced them to climb stairs sideways.(S.NEER ,GRANTHAM,-A STUDY OF HUNDRED AND TEN CASES OF SUPRACONDYLAR FRACTURE OF FEMUR J B J S ,1967,491-497.)

CONCLUSION

Though we are able to achieve satisfactory union in compound supracondylar fractures of femur, the functional outcome still remains to be poor in severe (Grade IIIB) cases.

External fixation can only be used as a temporary modality and not as a definitive fixation and we found better results when external fixation was converted early to definitive stable internal fixation.

Amount of soft tissue injury correlates with poor results. Grade of compound wound influences more than the fracture pattern in the final outcome.

Delay in stable fixation and non compliance to the early Rehabilitation physical therapy also influences the final functional outcome.

BIBLIOGRAPHY

1) ANTOUN.R. AND GAUDREAU,M,J.comparative study of treatment of supracondylar fractures of femur. In proceedings of the canadian orthopaedic association .J.bone and Joint surgery.63-b:456,1981.

2) SCHATZKAR J:fractures of distal femur revisited :clin orthop 1998 feb(347):43-56.

3) MIZE RD,BUCHOLZ RW,GROGAN DP:surgical treatment of displaced, comminuted fractures of distal end of femur.J.bone and joint surgery am 1982 july:64(6):871-914.

4) R.SANDERS AND M.SWIONTKOWSKI:double plating for complex supracondylar fractures of femur.J.bone and Joint surgery 1991 jan 73-341-346.

5) P.V GIANNOUDIS ,review article on management of open injuries of lower limb.j bone and joint surgery 2006:88-b:281-289.

6) S.RAJASEKARAN,J.DHEENADHAYALAN,A.P.SHETT,.R.SUNDARARAJAN,S, AJASABAPATHY.A score for predicting salvage and outcome in gustilo type-IIIA and type –IIIB open tibial fractures j. bone and joint surgery 2006:88-b:1351-60.

7) YASAR, SUKRU M.D:LIN,CHIH-HUNG M.D:one stage reconstruction of composite bone and soft tissue defects in traumatic lower extremities.plastic &reconstructive surgery.114 (6):1457-1466.2004.

8) JAMES G. TIDBALL:inflammatory processes in muscle injury and repair american journal of regulatory &integrative physiology 288:345-353,2005.

9) BORGEN ,DANIEL AND SPRAGUE ,B.L treatment of distal femur fractures with early weight bearing .a preliminary report .clin orthop.iii.156-162.1975.

10) CHIRON H.S TREMOULET JEAN MULLER :fractures of distal third femur treated by internal fixation .

11) CONNOLY .closed reduction and early cast bracing and mobilization in the treatment of femur fractures.j.bone and joint surgery 55-a 1581-1599.dec 1973.

12) GILES, J .B DELEE ,J.C HECKMAN J.D AND KEEVER.J.E supracondylar –intercondylar fractures of femur treated with supracondylar plate and screw.j.bone and joint surgery 64.a864-870.1982.

13) HEALY W.L BROOKER .A.F JR distal femural fractures clin orthop 174 ,166-171,1983.

14) INSALL J.N RANAWAT .C.S AGLIETTI, PAOLO:AND SHINE JOHN :supracondylar fractures of femur j .bone and joint surgery 58-a 754-758.1986

15) MOORE .T.J. WATSON TIMOTHY GREEN S.A GARLAND. Complications of surgically treated supracondylar fractures of femur.

16) MULLER M.E ALLGOWAR AND WILLENEGAR. Anual of internal fixation technique recommended by AO group.

17) NEER C.S, GRANTHAM S.A SHELTON M.L. supracondylar fractures of adult femur . a study of one hundred and ten cases.j bone and joint surgery 49-a:591-613.1967.

18) OLEREUD, SVEN .operative treatment of supracondylar fractures of femur .technique and results in fifteen cases.j. bone and joint surgery.54-a,1015-1032.1972 july.

19) SEINSHIMER ,FRANK,III :fractures of the distal femur. Clin orthop .153:169-179.1980.

20) SHELBOURNE ,K.D BREUKMANN .F.R rush pin fixation of supracondylar –intercondylar fractures of femur .j.bone and joint surgery .,64-a,161-169, feb 1982.

21) STEWART ,M.J SISK T.D AND WALLACE .S.L fractures of distal third of femur .a comparison of methods of treatment .j bone and joint surgery 48-a.784-807.

22) SLATIS ,P RYOPPY S. AND HUITTINEN .V.M AOI osteosynthesis of fractures of distal third of femur .acta orthop scadinavia 42.162-167,1971.

23) TSCHERNE ,H. OESTERN ,H.J. AND TRENTZ O. the problem of supracondylar fractures of femur in aged person AM. j. sur 97:499-512. 1959.

24) WINTERS .C. AND DABEZIES .E.J. supracondylar fractures of femur .orthopaedics ,7. 1051-1054,1984.

25) ZIMMERMANN A.J:intraarticular fractures of the distal femur orthop.clin .north america.10:75-80,1979.

26) JM SILISKI, .MAHRING AND HP HOFER. Supracondylar fractures of femur treated by internal fixation ,j bone and joint surgery am 1989:71:95-104.

27) 27.JOHNSON KD ,HICKEN G.distal femoral fractures .orthop clinic north am 1987 :18(1):115-32

28) 28.JOHNSON KD.internal fixation of distal femoral fractures. instructional course lecture 1989:38:437-48

29) WISS DA .IN. ROCKWOOD JR.CA,GREEN DP, EDITORS. FRACTURES IN ADULTS. LIPPINCOTT- RAVEN, 1996.P.1972-99.

30) RONEN GM.MICHALSON M,WAISBROD K.external fixation in war injuries.injury 1974:6(2):94-8.

31) SELIGSON D,KRIDTAINSON TK.use of the wagner apparatus in complicated fractures of femur.j trauma 1978:18(12):795-9.

32) VAN DER WERKEN C,MEEUWIS JD,ET AL.treatment of femoral fractures with the illizarov fixator. 1992: 95(11): 534-6.

33) NOER HH,CHRISTENSON N.distal femoral fractures treated by orthofix.1993:155(35):2699-702.

34) STEWART MJ,SISK TD, WALLACE JR.SL. FRACRURES OF DISTAL FEMUR .a comparison of methods of treatment. J.B J S.1966:48 a:784-807.

35) FOSTER TE, HEALY WL .operative management of distal femoral fractures.orthop rev 1991:20(11):962-9.

36) MARTINET O,CORDY J,HARDER Y ,MAIER A,BUALER M,BARRAUD GE, the epidemiology of the distal femur. Injury 2003:31(Suppl3):C62-c63.

37) KOREGOR PJ.distal femur fracture with complex articular involvement.management by articular exposure and sub muscular fixation .orthop clin north Am 2002:33:153-75.

38) STOVER M.DISTAL FEMUR FRACTURE:current treatment results and problems.injury 2001:32(supplem)sc3-sc13.

39) HEALY WI,BROOKER AF,distal femur fractures: comparison of open and closed methods of treatment.clin orthop 1983:174:166-71.

40) 40.INSAL JN .fracture of distal femur .in insal jn ed,surgery of the knee. Churchil Livingstone New York, Edinburg, London, Malburne 1984:413-48.

41) SCHEWRING DJ.MEGGIT BF. Fracture of the distal femur treated with AO DYNAMIC CONDYLAR SCREW. JB JS 1992,74,122-5.

42) TRABULSY PP,KERLEY SM,HOFFMAN WY.A prospective study of early soft tissue coverage of fractures.J TRAUMA 1994:36:661-8

43) BLICK SS,BRUMBACK RJ,LAKATOS R,POKA A,BURGESS AR. Early prophylactic bone grafting of fractures.CLIN ORTHOP RELAT RES.1989:240:21-41.

44) BROWN JUPITAR text book of trauma vol.2.page 112-114.

45) CAMPBELL OPERATIVE ORTHOPAEDICS,VOL 3,PAGES 2805-2825.

46) CHARNLEY J.THE CLOSED TREATMENT OF COMMON FRACTURES, 3RD EDITION, EDINBURG, E AND S LIVINGSTONE ,1961.

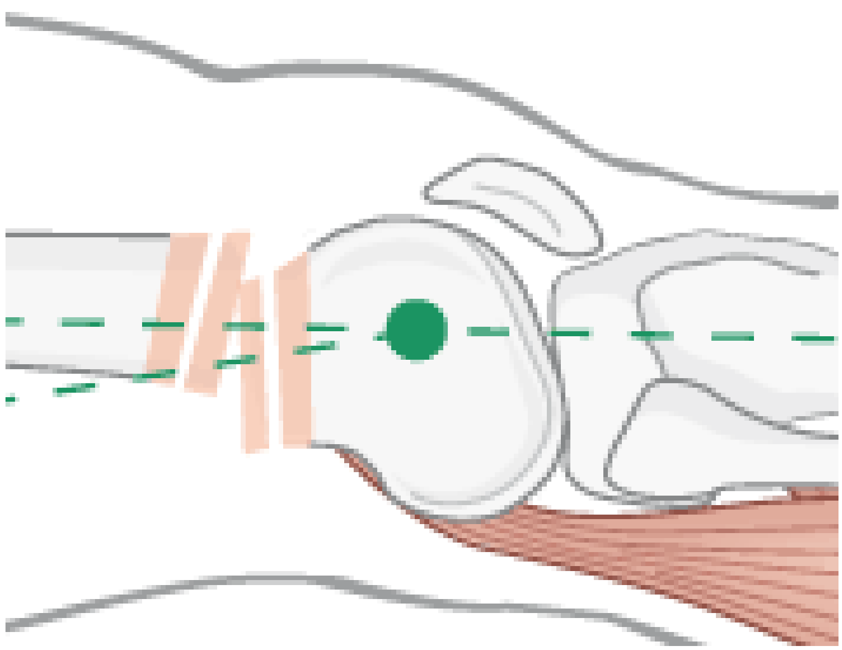
47) KULKARNI G S TEXT BOOK OF ORTHOPAEDICS, VOL 2.

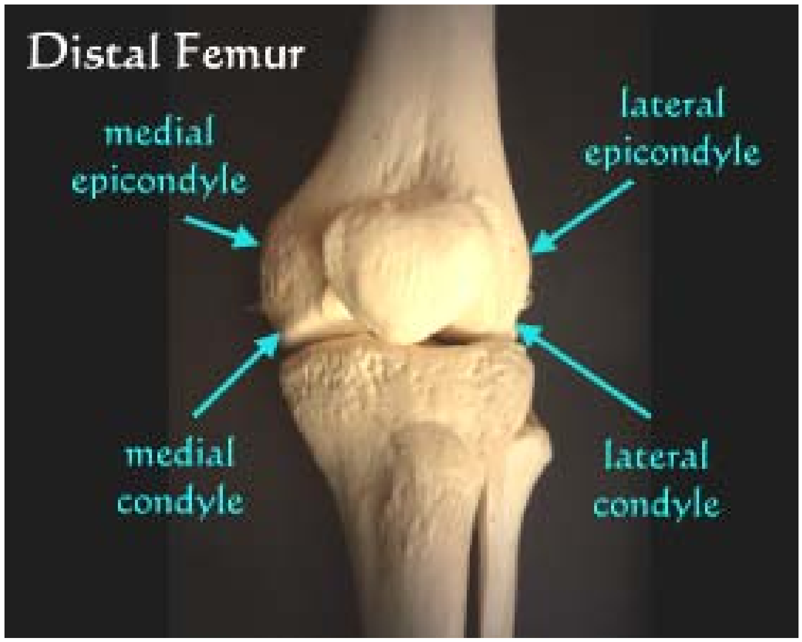
48) SHATZKER J, TILES TEXT BOOK OF OPERATIVE SURGERY.

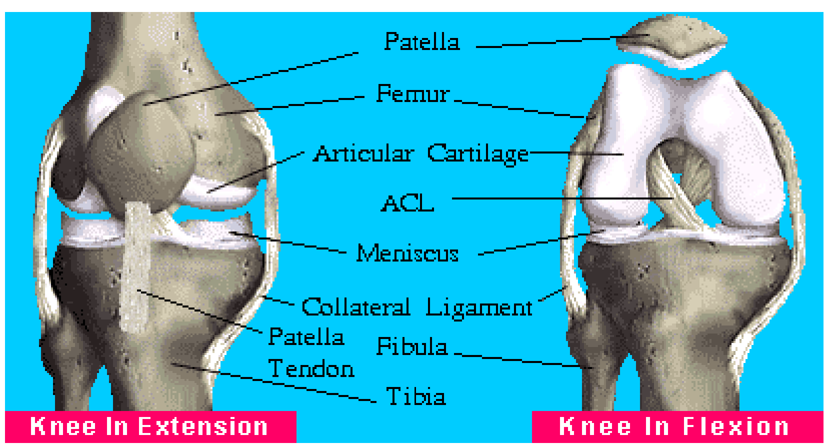
49) PRITCHETT JW.SUPRACONDYLAR FRACTURES OF FEMUR .CLIN ORTHOP 1984:184:173-177.

50) SCOTT W,KENNETH FRACTURE AND DISLOCATIONS, A MANUAL OF ORTHOPAEDIC TRAUMA.VOL 2,PAGE 376-390.

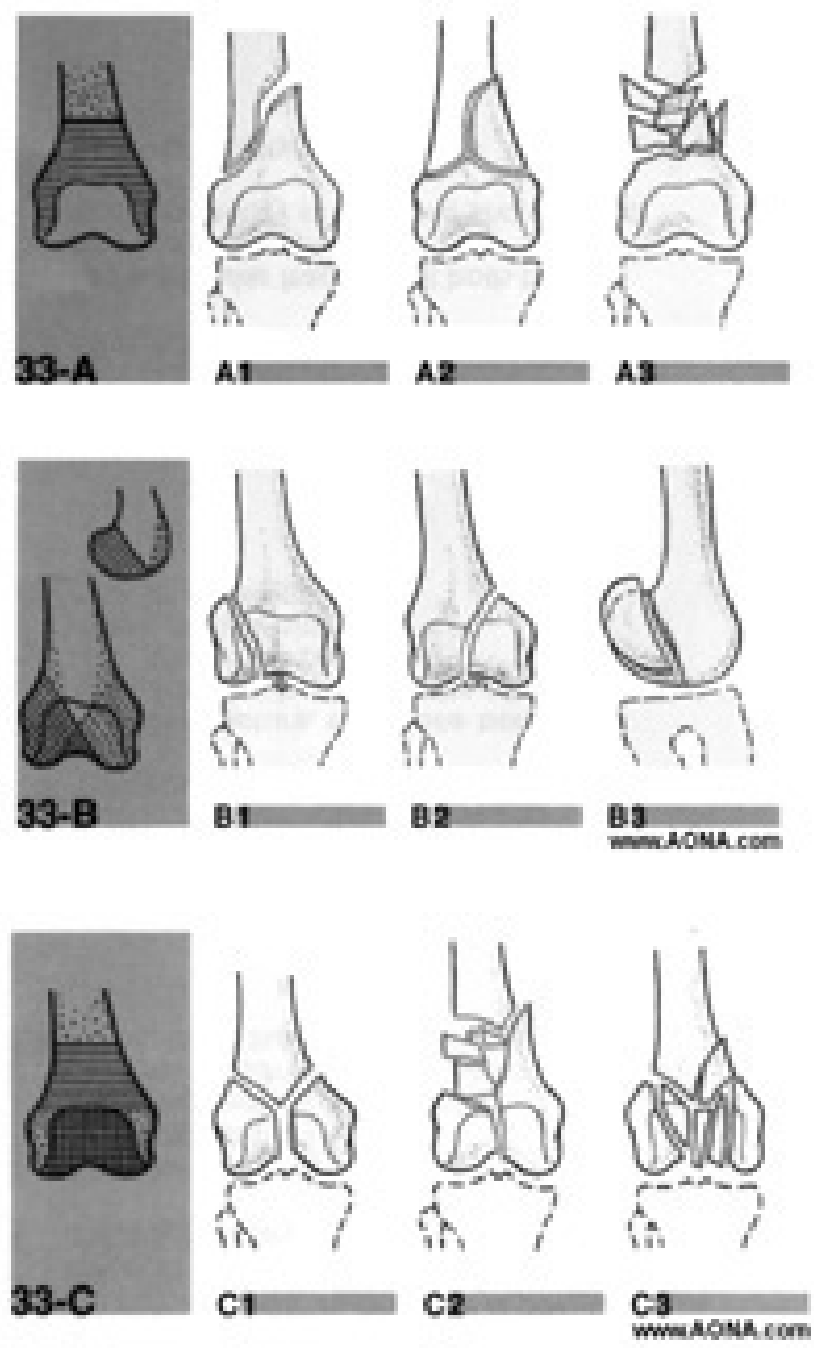
POSTERIOR ANGULATION DUE TO GASTRONAEMIUS PULL



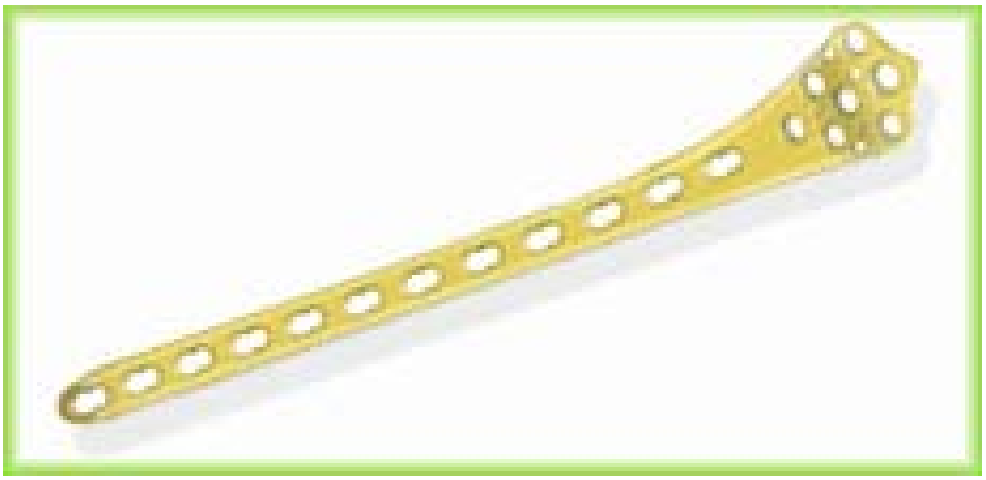

Distal Femur
medial
epicondyle
lateral
epicondyle
medial
condyle
lateral
condyle


Patella
Femur
Articular Cartilage
ACL
Meniscus
Collateral Ligament
Patella
Tendon
Fibula
Tibia
Knee In Extension
Knee In Flexion

AO /OTA CLASSIFICATION OF SUPRACONDYLAR FRACTURES OF FEMUR



DISTAL FEMUR LOCKING PLATE



DYNAMIC CONDYLAR SCREW

INTRA OPERATIVE PICTURES

Healed open wound

Positioning

Fixed with locking plate

CASE ILLUSTRATIONS

CASE - 1

Preop Skeletal Traction

Pre OP AP and lateral Views

Immediate Post OP X-Rays

5 Month follow up X- Rays

Healed Open WOund

Functional Outcome

CASE - 2

Pre Op Open Wound

Pre OP X-Rays

Immediate Post OP X-rays with DCS

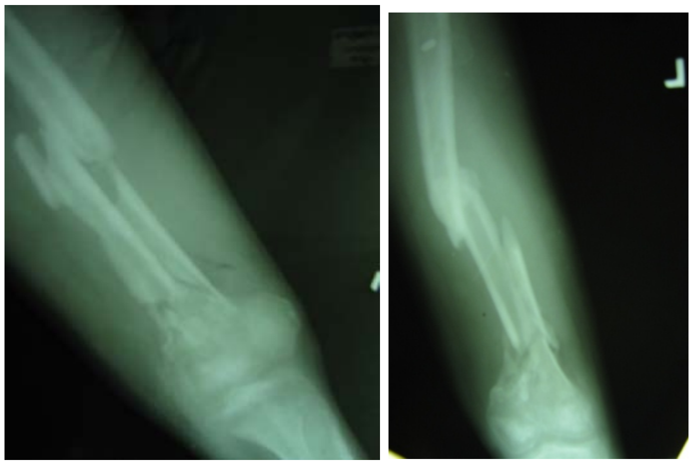
Revised with locking plate and bone graft

8 Month follow up X-rays

Flexion

Extension

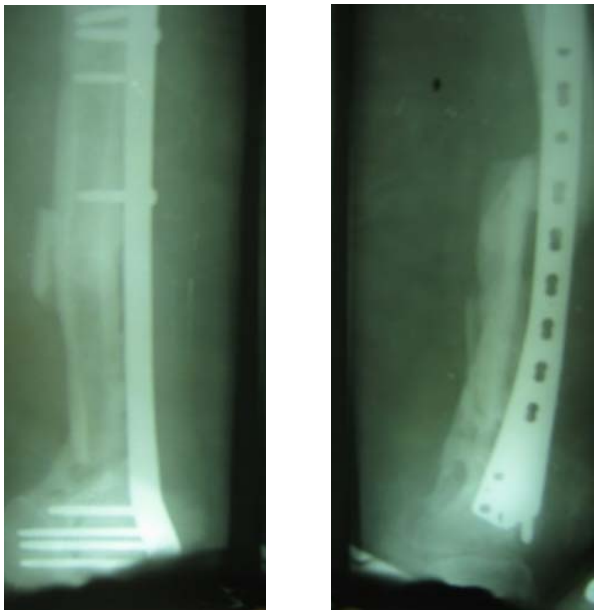
CASE – 3



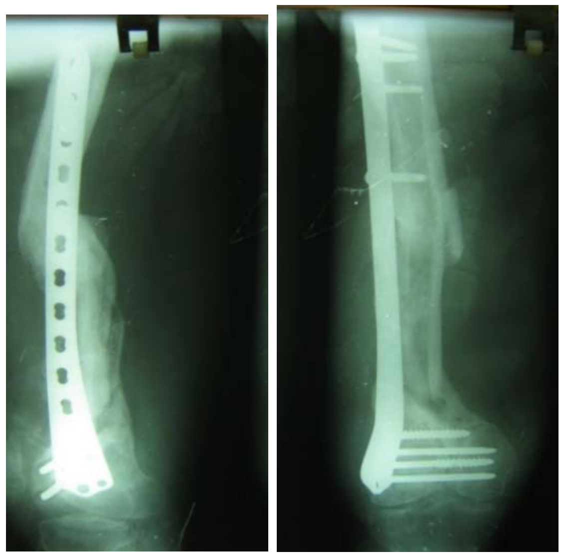
Preop AP and LATERAL Xrays

Initial external fixation

Immediate Post op X-ray after locking plate with bone grafting



6 Months follow up



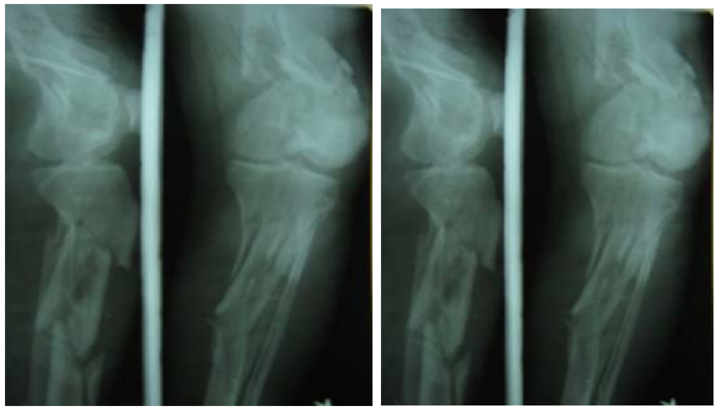
1 Year follow up X – Rays

Standing

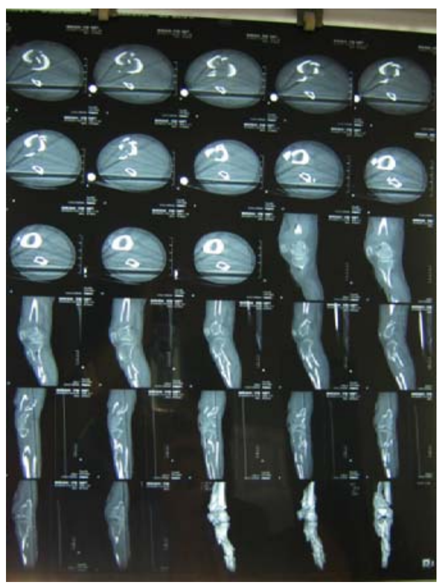
Flexion

Extension

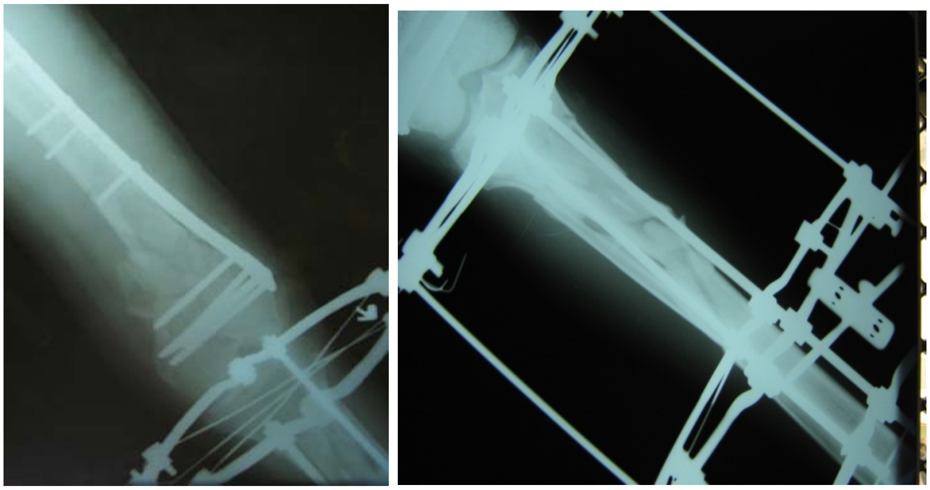
CASE - 4



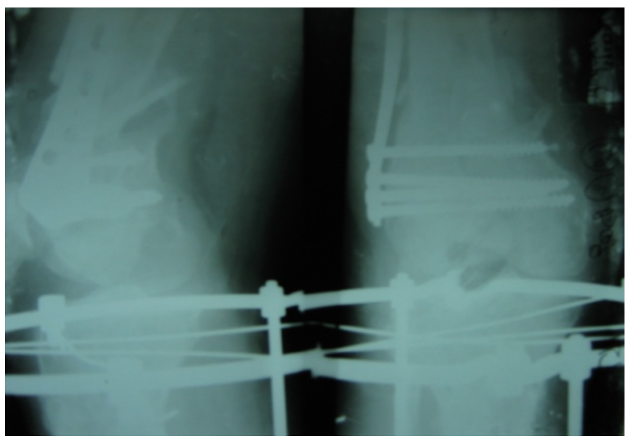
Pre OP X-ray



Pre OP CT Picture



Immediate Post OP X-Rays with LCP



6 Months Followup X-Rays

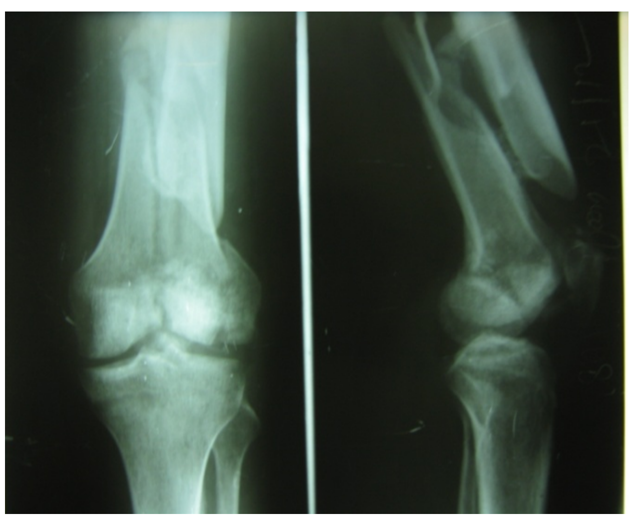
Healed Open Wound

Immediate Post OP

6 Month Follow Up

COMPLICATIONS

Infection



Flextion of Distal fragment leads to non union

Failed Dynamic Condylar Screw

Knee stiffness

MASTER CHART

S.NO	NAME	IPNO	AGE	SEX	MODE OF INJURY	SIDE	OPEN WOUND GRADE	TYPE OF FRACTURE	ASSOCIATED INJURIES	INITIAL MANAGEMENT	TIME OF SURGERY SINCE INJURY	DEFINITIVE MANAGEMENT	UNION IN WEEKS	ROM	COMPLICATIONS	SCORE	RESULTS
1	MANOKARAN	15763	55	M	ASSAULT	L	I	A3	HEAD INJURY	WD,UTPT	2 WEEKS	ORIF,LCP,BG	12 WEEKS	0-100	-	87	EXCELLENT
2	BALU	26101	55	M	RTA	R	IIIB	C2	#BB FA	WD,EX FIXAND MIF	DAY 1	SAME	24 WEEKS	0-30	KNEE STIFFNESS,KNEE PAIN,LIMB LENGTH DISCREPANCY	58	POOR
3	PERUMAL	71122	30	M	RTA	R	IIIB	C2	#METATARSAL	WD,MIF WITH K WIRES	DAY 1	ORIF,LOCKING PLATE,BG	20 WEEKS	0-90	-	80	GOOD
4	KUMAR	18482	29	M	ASSAULT	L	II	B1	UNITED #SOF WITH K NAIL	WD,CANCELLOUS SCREW FIXATION	DAY 1	-	12 WEEKS	0-100	-	86	EXCELLENT
5	SAMPATH	33158	28	M	RTA	R	II	C1	HEAD INJURY	WD,MIF WITH K WIRES,CANCELLOUS SCREWS	DAY 1 AFTER 2 WEEKS	ORIF,LCP,BG	26 WEEKS	0-30	KNEE STIFFNESS,KNEE PAIN,LLD	65	FAIR
6	PALANI	67425	40	M	RTA	L	II	C2	-	WD,UTPT	3 WEEKS	ORIF,LOCKING PLATE,BG	20 WEEKS	0-90	-	73	GOOD
7	VENKATESAN	51213	45	M	RTA	R	IIIB	C3	-	WD,EX FIX	5 WEEKS	ORIF,LCP,BG	30 WEEKS	0-90	-	77	GOOD
8	SILUPAN	93427	55	M	RTA	R	IIIB	C2	#PATELLA	WD,MIF,PARTIAL PATELLECTOMY	10 WEEKS	ORIF,LCP,BG	29 WEEKS	0-20	KNEE STIFFNESS,INFECTION, NON UNION,KNEE PAIN	50	POOR
9	KARTHIK	19984	46	M	RTA	L	IIIA	C3	#PATELLA	WD,MIF, EXFIX, SSG	DAY 1	-	12 WEEKS	0-30	KNEE STIFFNESS,	62	FAIR
10	BALARAMAN	58707	48	M	RTA	L	IIIA	C2	-	WD,UTPT	AFTER 2 WEEKS,12 WEEKS	ORIF,LCP,BG	24 WEEKS	0-90	-	77	GOOD
11	MANI	12703	34	M	RTA	R	IIIB	A3	-	WD,EX FIX	DAY 1	ORIF,LCP,BG	39 WEEKS	0-70	KNEE STIFFNESS, KNEE PAIN,LLD	63	FAIR
12	KUPPUSAMY	18863	51	M	RTA	R	IIIB	C1	-	WD,BIPLANAR EXFIX	DAY 1	-	-	0-30	NON UNION,INFECTION,KNEE PAIN	58	POOR
13	SELVI	18676	35	F	FALL	R	II	B1	-	WD,CANCELLOUS SCREW FIXATION	DAY 1	-	10 WEEKS	0-75	KNEE STIFFNESS,	64	FAIR
14	MURUGAN	66670	55	M	FALL	R	I	C2	#BB LEG	WD,UTPT	3 WEEKS	ORIF,LCP,BG FOR FEMUR,ILLIZA ROV RING FIXATOR	20 WEEKS	0-80	-	72	GOOD
15	PATTAMAL	40212	60	F	FALL	L	I	C2	#BB LEG	WD,UTPT	2 WEEKS	ORIF,LCP	18 WEEKS	0-90	-	88	EXCELLENT
16	DURAI	7481	32	M	RTA	R	IIIB	C2	-	WD AND EX FIX	DAY 1	-	1 YEAR FOLLOW UP	0-45	KNEE STIFFNESS, NON UNION,KNEE PAIN,LLD	47	POOR
17	BHARATHI	81539	42	M	FALL	L	I	C3	-	WD,EX FIX	3 WEEKS	ORIF,LCP	20 WEEKS	0-100	-	90	EXCELLENT
18	ANGUPILLAI	37582	57	M	RTA	R	I	C2	-	WD,UTPT	4 WEEKS	ORIF,DCS,BG	26 WEEKS	0-110	-	85	EXCELLENT
19	PATCHAPILLAI	73108	55	M	RTA	L	I	A1	-	WD,UTPT	3 WEEKS	ORIF,LCP	28 WEEKS	0-95	-	86	EXCELLENT
20	ARUMUGAM	79852	40	M	RTA	R	II	C1	-	WD,MIF	DAY 1	ORIF,LCP,BG	30 WEEKS	0-110	-	79	EXCELLENT