PROSPECTIVE ANALYSIS OF RETROGRADE SUPRACONDYLAR NAILING IN THE MANAGEMENT OF SUPRACONDYLAR AND DISTAL FEMORAL FRACTURES

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MADRAS MEDICAL COLLEGE &
RESEARCH INSTITUTE
CHENNAI - 600003.

THE TAMIL NADU

Dr.M.G.R.MEDICAL UNIVERSITY,

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CERTIFICATE

This is to certify that the dissertation titled **"PROSPECTIVE ANALYSIS OF RETROGRADE SUPRACONDYLAR NAILING IN THE MANAGEMENT OF SUPRACONDYLAR AND DISTAL FEMORAL FRACTURES"** is the bonafide work done by **Dr. HEMENTHA KUMAR.G.** under our direct guidance and supervision in the Department of Orthopaedic Surgery, Madras Medical College, Chennai - 3, towards partial fulfillment of the requirement for the award of M.S. Degree in Orthopaedic Surgery, March - 2007.

Prof. MAYIL VAHANAN NATARAJAN
M.S.Orth. (Ma's)., M.Ch.Trauma (L'POOL),Ph.D.(Orth.Onco) D.Sc.,
Professor & Head of the Department,
Department of Orthopaedic Surgery,
Madras Medical College,
Chennai. - 600 003.

Dr.KALAVATHY PONNIRAIVAN ,B.SC., M.D.,
DEAN
Madras Medical College ,
Chennai - 3

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CONTENTS

INTRODUCTION

Fractures of the Distal femur are complex injuries that pose a challenge to the orthopaedic surgeon. It constitutes about 6 % of all femoral fractures. It usually occurs during high energy trauma in younger patients and frequently are associated with concomitant injuries. In contrast, elderly patients with severe osteopenia might sustain solitary distal femoral fractures from minor trauma such as a simple fall.

Significant advances has been made in treatment of these fractures in the past three decades. Neer in 1967 concluded that these fractures were not suitable for internal fixation and treated with traction & cast bracing.

It is recognized that operative fixation with the ability to maintain anatomical reduction of the joint surface, restoring axial alignment and early range of motion presents clear advantages over closed means of treatment. Numerous devices have been proposed for the treatment of these fractures. The principles of internal fixation must be met regardless of the choice of fixation. These include anatomical reduction of the distal femoral articular surface , stable internal fixation, minimal soft tissue stripping and early active mobilization. However, plate devices needed an extensive surgical exposure and a potential risk of infection.

Fixation with a lateral blade plate or its modifications became popular because it allowed fixation of intraarticular fractures and early mobilization. Their use requires significant soft tissue stripping, which can affect osseous healing and a potential risk of infection. Intramedullary implants offer potential biomechanical advantages over plate and screws because their intramedullary location results in less stress on the implant, they have potential for load sharing and they can be inserted with minimal soft tissue stripping. However the use of antegrade intramedullary nail in the treatment of supracondylar femoral fractures has been associated with angular deformities because of the inability of distal interlock of antegrade nail to achieve control of the small distal fracture fragment. To extend the practical and theoretical advantages of intramedullary nailing in distal femoral fractures, the supracondylar Nail was designed by Green, Seligson and Henry in 1988.

Several studies have been done to evaluate the role and efficacy of supracondylar nailing in the recent times showing variable results. This study was conducted to analyse the outcome of the Retrograde Supracondylar Nail in fractures of distal femur and supra condylar area.

AIM OF THE STUDY

The aim of the study is to analyse prospectively the results of Retrograde Supracondylar Intramedullary Nail in the management of Distal femoral & Supracondylar Fractures.

REVIEW OF LITERATURE

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

1937 - TEES suggested skin traction for reduction and 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 (ASIF condylar 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 - SCHATZKER 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 - 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 centre of the femoral shaft in the coronal plane.

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

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

1991 - MARK S BULTER et al. used interlocking intramedullary nailing for ispilateral 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)

ANATOMY

Supracondylar area of the femur is defined as the zone between the femoral condyles and junction of the metaphysis with femoral shaft. Distal femur comprises about distal 15 cm 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 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 gastrocnemius arises from the back of 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 the 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 sagittal plane , the shaft of the femur lies with anterior two thirds of condyle.

Tibial articular surface is convex anteroposteriorly as well as from side to side. Lateral & medial meniscus creates greater conformity between the femur & 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 the 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 the tibia. The fibular collateral ligament is cord like and is attached proximally to lateral epicondyle below the attachment of lateral head of gastrocnemius and above that of popliteus tendon. Its distal attachment is to head of the fibula.

The cruciate ligaments are a pair of very strong ligaments connecting tibia to femur. They are intracapsular and extrasynovial. Anterior cruciate ligament is attached to anterior part of tibial plateau between the attachments of anterior horns of medial nad 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 antero medially 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.

The intraarticular entry point of the retrograde supracond nailing is situated about 5mm anterior to the attachment of posterior cruciate ligament in the intercondylar notch.

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 made superficial to the facial layer because devitalisation of the skin can occur.

NERVE SUPPLY

The joint is supplied from the femoral nerve though 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 gastrocnemius muscles. Varus deformity may result from the pull of the adductor muscles. If an intercondylar fracture is present, there will often be rotational misalignment of the condyles (with resulting joint incongruity) because of the separate attachments of the gastrocnemius 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 acetabulum , 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- 10 % 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.

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., Schwatzker and Tile, Seinsheimer and Muller et al. The most widely accepted and used is that of Muller et al.

NEER CLASSSIFICATION

Neer classified these injuries into:

1. Minimal displacement

2. Displacement of condyles

   Medial

   Lateral

3. Concomitant supracondylar and shaft fractures.

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

SEINSHIEMER CLASSIFICATION

He classified these injuries into:

i. Non displaced fracture

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

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

a. Two Part fracture.

b. Comminuted fractures.

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

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

B. The lateral condyle is a separate fragment, medial condyle is intact.

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

iv. Fractures extending through the articular surface of the femoral condyles

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

B. 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:

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.

BIOMECHANICS OF INTRAMEDULLARY NAILING

Femur is the longest bone in the body and is subjected to load several times the body weight during normal physiological activity. Fracturing this bone requires a significant amount of force. The straight tubular anatomy of femur is well suited for intramedullary fixation. Nails provide predictable restoration of femoral shaft alignment. In simple shaft fractures nails automatically correct the alignment of the bone as they fit the medullary canal.

The physiological loading conditions of the femur by muscular and gravitational forces are also favourable for intramedullary fixation. Compared with plate or external fixation, intramedullary devices have a centre of motion close to the centre of motion of the bone and thus are subjected to lesser loads in compression bending and tension. This makes the intramedullary nail less likely to fail in fatigue than a plate. In fractures that are stabilised with cortical contact of major proximal and distal fracture fragment of the bone, load sharing increases as healing progresses. The fracture callus is progressively loaded which stimulates healing and remodelling. Thus it acts as an internal splint and serves as a load sharing device permitting weight bearing across the fracture site and allows healing by peripheral callus.

GENERAL PRINCIPLES OF FRACTURE FIXATION BY INTERLOCKING NAILS

Interlocking intramedullary nailing is an effective method of fracture treatment by fixing the fractures so firmly that soft tissues and joints can be mobilised early. Early ambulation and weight bearing can be allowed if there is at least 50 % of cortical contact between the main fracture fragments.

During the period of fracture healing, intramedullary implant aids in transmission of forces from one end of fractures bone to the other there by producing stresses in the implant.

The mechanical behaviour of the implant is determined by both material and geometry.

NAIL DESIGN AND WORKING LENGTH

The geometry of an intramedullary nail is responsible for its strength ,rigidity and fixation in the bone. The major geometric features of an intramedullary nail are longitudinal (anterior) bow, the cross sectional shape, transverse diameter, slot characteristics, material properties and structural stiffness.

LENGTH AND WORKING LENGTH

The nail length is considered from three viewpoints

1. Total nail length
2. Length of nail-bone contact.
3. Working length

The length of nail-bone contact reflects the total surface area of contact between the nail and the bone. The larger the contact area, the higher is the resistance to motion.

Working length of a nail is portion of the nail that spans fracture site between area of fixation in proximal and distal fragments. (I.e. Unsupported segments of the nail) In a comminuted fracture treated with a static locked nail, working length is distance between proximal and distal locking screws. The working length influences nail rigidity in both bending and tension. In bending, stiffness is inversely proportional to the square of working length. In tension, stiffness is inversely proportional to the working length so that doubling the working length halves tensional rigidity. A short working length improves both nail rigidity both in bending and in tension.

Gripping strength is the resistance to slipping at the implant bone interfaces and is essential for transmission of torque between fracture fragments. Cortical reaming is done to increase the length of cortical contact.

LOCKING

The distal locking screw is loaded in four point bending as axial load is applied during walking. The screw ends are supported by cortices. Thus increased span decreases the strength. Screws which have a threaded portion at one end are stronger than fully threaded one. Oblique orientation of locking holes prevents the medial lateral translation in varus-valgus bending. It is a must that two locking screws are used when the distal fragment is short.

DYNAMIC LOCKING

When the screws are inserted only at one end of the nail the fixation is called dynamic locking. Dynamic locking is effective only when the contact between the two major fragments is at least 50 % of cortical circumstances. Dynamic locking fails in the presence of unstable bone contact between the main fragments. The unlocked end of the nail attain fixation in the splinting mode, as it snugly fits in the reamed diaphyseal medullary canal.

STATIC LOCKING

Here the nail is locked at both ends. Static fixation controls rotation, bending and axial load. It is useful in communited , non isthmal fractures of femur and tibia.

DYNAMISATION

Removing the screws from the longer fragment maintaining adequate control of the shorter fragment is called dynamisation. If the healing is progressing normally, there is a no need to dynamise. If the consolidation is continuing well, removal of static screw will not improve the quality of the callus. It is not a standard practice to dynamise as it weakens the interlocking nail assembly. Dynamization is indicated when there is risk of development of nonunion or in established pseudoarthrosis. Premature removal of locking screws may cause shortening, instability and nonunion.

REAMED AND UNREAMED INTERLOCKING NAILS

Medullary nails can be divided into two types depending upon whether enlargement of the medullary canal is an intended part of nail insertion.

UNREAMED NAILS

Here smaller diameter nails are used in nail insertion without reaming. Benefits are less heat production and less disturbances to the blood supply. There is also considerably less bone necrosis which appears to be one of the risk factors for the development of postoperative infection.

The main disadvantage is that it carries a reduced capacity to adapt to the shape of the bone.

REAMED NAILS

Reaming the medullary cavity causes damage to internal cortical blood supply which studies have shown to reversible within 8 - 12 hrs. There is reduced blood supply during early weeks after trauma and reaming might further damage the blood supply.

The general changes include pulmonary embolisation, temperature related changes of the coagulation system, humoral and inflammatory reactions. Reaming allows insertion of a longer nail which increases improve nail bone contact across working length of the implant.

CLOSED AND OPEN INTRAMEDULLARY NAILING

When the fracture site is not exposed and reduction is achieved by closed methods using fluoroscopy it is called closed intramedullary nailing.

ADVANTAGES OF CLOSED NAILING

* Less blood loss and less tissue trauma
* Fracture haematoma is not disturbed
* Reduces the risk of infection.
* Periosteal blood supply is not disturbed
* No interference with soft tissues and vascularity ensures early healing
* Useful in comminuted fractures

Open method is resorted when there was failure to obtain satisfactory fracture reduction.

ADVANTAGES OF OPEN NAILING

- Less expertise is required
- Anatomical reduction is easier to obtain
- Image intensifier is not required

DISADVANTAGES

* Fracture haematoma which is important in fracture healing is evacuated

* Increased rate on infection

* Increased incidence of non-union

FRACTURE HEALING WITH INTRAMEDULLARY NAILS

Fracture healing proceeds mainly by the formation of peripheral callus. Cortical reaming and nail insertion injure the medullary vascular system resulting in avascularity of significant portions of diaphyseal cortex for a short period of time.

A delay in the maturation of callus was noted with intramedullary nail but once union was achieved, the biomechanical quality of union was similar or superior to plating.

Fracture fixed with an intramedullary rod showed higher rates of whole bone & higher fracture site blood flow than comparable fractures fixed with a plate

In interlocking nail it has been observed that small vessels grow into the existing gaps between the bone & nail in an astonishingly short period of time, from where they penetrate into the neighboring malperfused cortical bone & initiate endosteal bone formation. It is postulated that even the bone dust

produced after reaming may have osteoinducing properties causing endosteal callus formation.

BIOMECHANICS OF RETROGRADE NAILING.

Studies[25,26,27,28] have proved that axial stiffness and torsional stiffness of intramedullary nail were less than that provided by the side plate.95° angled 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 fixed angle screw side plate.

RETROGRADE SUPRACONDYLAR NAILING

INTRODUCTION

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 simple or comminuted and those with intraarticular extension[1].
2. Fractures of middle and distal third in the femur.[6,8,9]
3. Supracondylar fractures occuring above total knee arthroplasty.[1,5]
4. Distal femoral fracture with nonunion due to failed plate osteosynthesis[41]
5. Supracondylar distal femur fracture in elderly above 75 years.[7,9]
6. Treatment of pathological fractures of distal femur[4]
7. Ipsilateral fracture of femur &tibia (floating knee injuries)[3,10]
8. Fixation after corrective osteotomy for multidirectional femoral deformity[43]

9. Retrograde nailing of femur fractures in patients with myelopathy and who are nonambulatory.[17]

10. In Polytrauma patients to decrease operative time by enabling to do simultaneous procedures for upper limbs &opposite lower limbs and life saving procedures such as craniotomy or laporatomy[3]

11. Ipislateral pelvic or acetabular fractures[14]

12. Patients with Pagets disease or in paraplegic patient[17]

13. Delayed definitive fixation of femur after external fixation and vascular repairs[8]

14. Fractures occurring below hip implants[7]

15. Patients with femoral shaft fractures with ipsilateral major arterial injuries.[14]

16. Femoral shaft fractures with ipsilateral through knee Amputation[14]

ADVANTAGES

1. Reduced soft tissue dissection and periosteal stripping as it may be inserted via a closed technique.

2. Operating time is reduced along with soft tissue retraction time.

3. Reduced overall blood loss.

4. Length of hospital stay is decreased.

5. Less techniquely demanding procedure

6. Advantages of an intramedullary position & biomechanical advantage over laterally placed conventional devices.

7. Medial parapatellar approach used ,permits direct visualization of the articular surface facilitating an anatomical reduction and allowing subsequent reconstructive procedure.

8. Avoidance of heterotrophic ossification in hip.

9. Simultaneous treatment of bilateral lower extremity injuries.

10. Treatment of supracondylar fractures and unilateral knee replacement at same surgery.

POTENTIAL DISADVANTAGE

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 15 cm, 20 cm, and 25 cm. 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 or arthroscopically assisted 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.

SELECTION OF FRACTURES

The Supracondylar nail can be used for virtually any intraarticular or extraarticular distal femoral fracture (closed or open) that extends no further proximally than approximately 15 cm from the knee joint provided that

comminution of the medial or lateral epicondylar cortices does not prevent secure bicortical purchase of at least two distal interlocking screws.. Under such circumstances a condylar buttress plate would be a better choice. Using the AO classification suitable fracture types include A1, A2, A3, C1, and C2.

Extraarticular diaphyseal fractures with at least 7 to 9 cm of intact distal femur are better treated with standard antergrade femoral nailing except under the circumstances mentioned previously because the knee joint is not violated making it less prone to stiffness. However the intraarticular entrance point is worthwhile compromise when the poor overall condition of the patient mandates immediate femoral stabilization with minimal surgical insult, blood loss and reduced operative time.

SPECIAL INSTRUMENTS

The instruments set for supracondylar intramedullary nailing consist of

1. Drill guide
2. Guide bar
3. Guide bar bolt
4. Wrench
5. Drill sleeve
6. 300 mm length drill bit
7. Measuring gauge

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.

PATIENT POSITIONING

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. Alternatively, it can be viewed arthroscopially through a standard anterolateral or anteromedial portal. One further option is to use the C -arm to confirm 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 is easily 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 either deepening the drill hole or by passage of hand-held reamers is the most crucial reduction maneuver of the entire procedure. Intraoperative imaging must confirm that the path taken is in perfect alignment along the longitudinal axis of the distal fragment, because the final varus/valgus and sagittal alignment of the fracture will be determined at this time.

A guide wire is then passed into the axial path created in the distal fragment, the fracture is reduced by manual traction and application of corrective translational forces to the thigh, allowing the guide wire to be passed

into the proximal canal if difficulty is encountered, as occasionally occurs with delayed nailing, one of the drill sleeves included in the instrument set can be passed over the guide wire to serve as a short rod of application of leverage on the distal fragment. Alternatively, 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 nail is driven over the guide wire with the targeting device on the lateral side. The distal end of the nail should be seated 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.

Fractures with intraarticular extension are best addressed with a formal medial para patellar arthrotomy. This allows anatomic reduction and interfragmentary screw stabilization of the articular fragments. Simple intercondylar split patterns (AO type C1 and C2) are stabilized by passing 6.5 mm cancellous lag screws anterior and / or posterior to the anticipated path of

the nail. Additional support is obtained during entry hole preparation, reaming and nail insertion with a large pointed reduction tenaculum applied across the condyles. Coronal splits in type C3 fractures are stabilized with screws passed from anterior to posterior. The screw heads are counter sunk when the screws pass through articular cartilage. Once anatomic reconstruction of the articular segment has been accomplished, reaming, nail insertion and interlocking proceeds as described above for extraarticular fractures.

PERCUTANEOUS TECHNIQUE

In this technique, reduction of the articular surface is obtained by closed manipulation and checked under C-arm. The condyles are fixed with a large tenaculum clamp. Once acceptable reduction is obtained, compression of the fracture is done with 6.5mm cannulated screws placed anteriorly and posteriorly. The distance between the screws must be a minimum of 14mm.

A 2.5 cm midline incision is made from the distal pole of patella to just proximal to tibial tuberosity . A vertical mid patellar tendon splitting incision is made and entry point is identified under C-arm control. Fracture reduction done and nail inserted as with open technique.

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. Bone grafting in open procedures is recommended where there is a significant communition is present.

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.

POST OPERATIVE REGIMEN

The suction drain is removed after 48 hours. Active knee mobilization is started after 48 hrs. Crutch walking with non weight bearing is allowed after pain subsides and toe touch walking after 2 weeks. Weight bearing increased gradually according to the callus formation. Full weight bearing is allowed only after radiological evidence of solid union. In grossly comminuted fractures, weight bearing is delayed until evidence of callus formation.

EFFECT ON PATELLO FEMORAL ARTICULATION & OPTIMAL ENTRY POINT[18,22,23]

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 cm^2. At 60 degrees; the femoral contact area is located at the femoral groove, slightly inferior to and encompassing a greater area (4.72 cm^2) than at 30 degrees. At 90 degrees, the femoral contact area is somewhat larger (5.0 cm^2) 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[22] 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.

COMPLICATIONS

KNEE PAIN

It is a common symptom reported with many authors[1,3, 4].The cause of knee pain may be due to presence of many cases of open fractures and polytrauma that may delay return of passive or active motion of the knee leading to quadriceps atrophy and pain. Other causes are attributed to damage of articular surface of patella during nail insertion.

NAIL IMPINGEMENT

Nail impingement on inferior patella or tibial plateau may be due to technical error, when distal interlocking screws missed the nail allowing the nail to migrate easily.

KNEE SEPSIS

Using intraarticular starting point for retrograde nailing causes concern regarding infection of the knee joint. Several studies[1,4,5] have shown this

complication is uncommon. It has been postulated that intramedullary nail may act as a conduit for infection to the knee joint.

KNEE STIFFNESS

Arthrotomy of the knee for intra articular starting point raises concern over post operative knee arthrofibrosis and stiffness of knee joint. The average range of knee motion in various studies was 90-127degrees [1, 2, 3, 4, 9]

OTHER COMPLICATIONS

Intra articular heterotrophic ossification

Synovial metallosis as reported by Johnson et al in 1995.

Malalignment

MATERIALS AND METHODS

This is a prospective study of 20 patients with supracondylar and distal femoral fractures treated with Retrograde Supracondylar nail at Government General Hospital , Chennai from June 2005 to September 2006.

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

INCLUSION CRITERIA

All patients above 18 years with closed & grade I & II open fractures of supracondylar & distal femur fractures extending up to 15 cm from distal articular surface.

FRACTURES INCLUDE

1. Closed distal femoral fractures & nonunion
2. AO type A1 A2 & A3 fractures.
3. AO type C1 C2 fractures.

EXCLUSION CRITERIA

1. AO type B1 B2 & B3 fractures.
2. AO type C3 fractures.
3. Grade III open fractures

The age of the patients ranged from 19 - 65 years with a mean age of 37.5 years. The male female ratio was 5.4:1. The mode of injury was RTA in 15 patients(75 %) , one patient (5%) was injured due to wall collapse and in another 4 patients (20%) the history was fall from height.

Of the 20 patients, 11 cases were supracondylar fractures and nine cases were distal femoral fractures . Of the nine, one patient with distal femur fracture treated with plate osteosynthesis developed non union. He subsequently underwent plate removal and supracondylar nailing.

All the patients were preoperatively managed with pin traction until they were taken up for surgery.

Standard anteroposterior and lateral radiographs of lower femur and knee were taken for preoperative analysis. Intraarticular extension of the fractures was looked into.

CT scan of the distal femur was done wherever necessary, to know about the extent of intararticular communition of these fractures.

AGE DISTRIBUTION

The age of occurrence of these fractures varied from 20-65 years. The number of patients in different age group is as follows.

Age group Yrs.	**No. of patients**
20 – 30	6
31 – 40	6
41 - 50	2
> 50	6
Total	20

SEX

The male female sex ratio was 5.4:1

MALE	17
FEMALE	3

SIDE

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

RIGHT	11
LEFT	9

MODE OF INJURY

The mode of injury was mainly due to RTA (75%)

Road traffic accident	15
Fall from height	4
Wall collapse	1

ASSOCIATED INJURY

The associated injuries in this study include:

HEAD INJURY	3
FRACTURE METATARSAL	1
FRACTURE BOTH BONES LEG	1
FRACTURE BOTH BONES FOREARM	1
FRACTURE TROCHANTER	1
FRACTURE TIBIAL CONDYLE	1
TOTAL	8

TYPE OF INJURY

Of the 20 patients, 15 patients sustained closed injury & 5 patients had open injuries

Closed	15
Grade I compound	3
Grade II compound	2
Total	20

FRACTURE TYPE

There were 11 cases of supracondylar fractures (55%) & 9 cases of distal femur fractures(45%). Of these Distal Third femur fractures were the most common (40%).

A1	6
A2	1
A3	2
C1	2
C2	-
DISTAL THIRD FRACTURE FEMUR	9

TIME INTERVAL BETWEEN INJURY AND SURGERY:

The time interval between injury and surgery varied from less than 1 week to more than 4 weeks.

TIME INTERVAL	Number of cases
BELOW 1 WEEK	1
BELOW 2 WEEKS	6
BETWEEN 2 WEEKS – 3 WEEKS	3
BEWEEN 3 WEEKS -4 WEEKS	5
BETWEEN 4 WEEKS- 5 WEEKS	--
> 5 WEEKS	5

The reasons for the delay in taking up for surgery were due to non availability of theatre days ,compound nature of the wound or associated injuries.

METHOD OF NAILING

The method by which reduction of fracture was obtained was as follows

OPEN	18
CLOSED	2

BONE GRAFTING

Three patients had bone grafting at the time of nailing . Two patients had bone grafting as an additional procedure.

FOLLOW UP PERIOD

The follow up period ranged from 4- 14 months. The mean follow up period was 7.7 months.

OBSERVATIONS

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

1. The mean age of patients was 37.5 years. In 50% of the patients fracture occurred below the age of 35 years. In 30 % the fracture occurred in patients above 50 years.

2. There was a definite male preponderance with 85% occurring in males.

3. The side of occurrence was nearly equal , 55 % in the right and 45 % in the left.

4. Road traffic accidents was the main mode of injury (75%).

5. Associated injuries was present in 45% of these patients.

6. Closed injuries constituted 75% of these injuries

7. Supracondylar fractures constituted 55% of the fractures in our study. Of these AO type A was the most common.

8. The time interval between injury and surgery averaged 4 weeks.

9. In 90% of the cases, open reduction of the fracture was done.

10. Additional bone grafting was done in 15% of the cases.

RESULTS

In our study, 20 cases were treated by retrograde intramedullary supracondylar nail. Patients were followed up every 3 weeks till fracture united and there after at 3 months, 5 months and 1 year. The minimum follow up period in our study was 4 months and maximum follow up period was 14 months.One of them had expired one month following surgery due to septicaemia secondary to pressure sores and not directly attributable to the operative procedure.

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 analysed 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 analysed 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 MINUTETS	10
1 – 5 BLOCKS STANDING 15 > 30 MINUTES	8
< 1 BLOCK	4
CANNOT WALK	0
STAIRS	
NORMAL	5
WILL 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
O – 10 DEGREES	08
10- 20 DEGREES	05
>20 DEGREES	00

INSTABILITY - 5 POINTS

NONE	05
0 - 5 DEGREES	04
6 -15 DEGRES	02
> 15 DEGREES	00
TOTAL	97

SUBTRACTIONS

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

KNEE SCORE = TOTAL POINTS – TOTAL SUBTRACTION

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

OVERALL RESULTS

Of the twenty cases, nineteen were available for follow up. The functional outcome was good to excellent in twelve patients (63%), fair in 4(21.0%)and poor in three patients.(17.6%).

Results	No. of patients	Percentage
Excellent	7	36.8
Good	5	26.3
Fair	4	21.0
Poor	3	15.7

Analysis of the 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.

In this study, patient no 5, a 35 year old male with grade 2 open A0 type A1 fracture of left femur with associated fracture both bones of opposite of opposite leg and patella underwent SC nailing 2 weeks after injury. He developed infection at fracture site in the immediate post op period, which was not amenable to antibiotics and debridement. The fracture failed to unite, hence

nail removal and Illizarov fixation was done at 10 months. The fracture had not yet united till the end of study period.

Of the other two, patient number 10 who had fracture of distal femur developed delayed union , noticed at 4 months and was put on long period of immobilization in knee brace and was advised full weight bearing. Patient number 17, who had sustained A1 type of fracture femur also had delayed union for which bone grafting was done.

COMPLICATIONS

The following complications were encountered : -

No	COMPLICATION	No of patients
1.	Delayed union:	3
2.	Knee Joint stiffness < 90	8
3.	Knee pain	4
4.	Infection	1
5.	Nail impingement	1
6.	Leg length discrepancy	1

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, stability of the fixation and protrusion of the distal end of the nail into the joint and non compliance to aggressive physiotherapy.

KNEE PAIN

About 20 % of patients developed moderate knee pain at rest, 40 % had pain on walking which was relieved by analgesics.

NAIL IMPINGEMENT

One of the patients had nail protrusion into the knee joint in whom distal locking was missed. Weight bearing was delayed but collapse of fracture site with eventual migration of the nail in knee joint was found at 4 months. Patient was having knee flexion of 40degrees.

DELAYED UNION

Three patients developed delayed union found at 12 weeks. Two of them underwent bone grafting and the other was treated with partial weight bearing in a tube cast. All of them are on regular follow up and have shown no signs of union till now at 4 weeks after they underwent bone grafting.

INFECTION

One patient developed infection in the early post operative period which failed to respond to antibiotics and debridement. Fracture failed to unite and nail was removed and Ilizarov fixation was done at 10 months after surgery. Now patient is on Iizarov for 6 weeks and has shown no signs of union yet ,till the completion of the study.

LEG LENGTH DISCREPANCY

Two our patients had an insignificant leg length discrepancy of 1cm.

CASE ILLUSTRATIONS

CASE - 1

19 year old male, Mr. Usman I.P. No.748988 brought with alleged history of road traffic accident and had sustained open fracture of supracondylar fracture of right femur (AO type A1).He was initially managed conservatively by UTPT . He underwent retrograde intramedullary supracondylar nailing (200 X 12 mm) 2 weeks after the injury.

There were no preoperative or immediate post operative complications. He was advised non weight bearing and mobilization of the knee and ankle. After 3 weeks, radiologically fracture showed formation of mild callus and clinically the range of movement obtained at knee was 0-40 degrees. At three months, fracture had united well and ROM had increased to 0-90 degrees. At final follow up after a year, patient had excellent range of movement at knee and there was no residual deformity or restriction of movements. He has returned to his previous job as a tailor and leading an active life.

CASE- 2

65 year old male, Mr. Mohan babu I.P.No.797172 was brought with alleged history of road traffic accident and had sustained open type of supracondylar fracture of the right femur(A0 type A3). He was put on MTPT and taken up for retrograde intramedullary supracondylar nailing (200x11mm) with bone grafting, 10 days after the injury. The immediate post operative period was uneventful. He was advised non weight bearing and mobilisation of knee and ankle. At final follow up, radiologically the fracture had united well.Patient had good functional outcome with a range of motion of 90° and leading a independent life.

CASE - 3

34 year old male, Mr.Jayavel I.P.No.758678, a tea shop owner , was brought with alleged history of fall and had sustained a closed fracture of the supracondylar region of the left femur(A0 type A1). After MTPT, he was subjected to retrograde intramedullary supracondylar nailing (200 x 12 mm) , 2 weeks after the injury. There were no complications during his hospital stay and hence was discharged with a knee brace and advised non weight bearing. Follow up at 6 weeks revealed callus at fracture site and subsequent follow up at 1 year showed good union of fracture with return of full functional ability .

CASE - 4

53 year old female, Mrs. Rajammal I.P.No.767229, a noon meal centre worker by occupation , had sustained open fracture of the supracondylar region of the left femur (A0 type C1) following a fall. After initial management with UTPT, She underwent retrograde supracondylar intramedullary nailing (20X 11mm) about 2 weeks after the fall. She had no further post operative complications and was discharged with a knee brace, with advice to do static quadriceps exercise. At follow up after 12 weeks there were early features of fracture union in the x-ray and was advised knee mobilization. At final follow up, patient had excellent outcome with no obvious deformity or functional disability.

DISCUSSION

Fractures of distal femur are complex injuries that can be difficult to manage and have the potential to produce significant long term morbidity. Operative treatment is the treatment of choice in these injuries nowadays, resulting in anatomic reduction and early mobilization combined with early weight bearing. Previously stabilization was usually achieved with a condylar screw and plate.

Retrograde intramedullary nailing has been developed in order to address some of the previous problems associated with distal femur fractures. Biomechanical properties of retrograde supracondylar nailing has been studied by many authors.[25,26,27,28,31] Henry et al[5] in 1991 reported that by nature of the intramedullary position, GSH nail has a bio mechanical advantage over laterally placed conventional devices. The intramedullary position decreases the lever arm, reducing varus or valgus angulations.

In 1995 Firoobakhsh et al[31]mechanically tested the retrograde intramedullary nail & 95 screw & side plate. He found plate & screws were found stiffer in lateral bending and in tension than a supracondylar nail. He had concluded supracondylar nail had comparable biomechanical rigidity to condylar screw & plate with varus loading. Benefits of supracondylar nailing include less extensive exposure, no periosteal stripping, reduced blood loss, decreased operating time and hospital stay[25, 26, 27, 28].

In our study 20 patients with supracondylar & distal femoral fractures underwent retrograde supracondylar nail. The mean age of occurrence of fracture in our study was 37.5 years (19-65 years) as compared to 29.4 years reported by Ostrum et al[11] , 50 years reported in a study done by Gellman etal[1] and 32.4 years in a study done by Herscovici and Whiteman[4]. According to our study, the incidence of fracture was high in the age group between 21- 35 years. The most common mode of injury was road traffic accidents in our study similar to other studies[12, 6, 1].

There was a definite male preponderance (85%) in our study. 0strum [3] reported 75% in his study and 60% was reported by Seifert et al [12]. The mean age in males were found to be 39 as against 45 years in females in our study.

The average time interval between injury and surgery was higher in our study (4 weeks) which is attributed to time taken for the wound to heal in compound injuries, delay in the patient reporting time to the hospital after taking native treatment, non availability of theatre time and management of associated injuries. This delay resulted in difficult reduction of fracture by closed methods during surgery. Consequently in 90 % of our cases fracture site was opened and reduction achieved by open method. Primary bone grafting was done in fractures with gross communition and fractures with gross osteoporosis.

The follow up period ranged from 4 months to 14 months. The follow up period is short due to the fact our study period was between June 2005 and September 2006. Callus formation was prompt in 13 of the 17 patients seen at 6 – 8 weeks with radiological & clinical evidence of union by 12 – 14 week similar to other studies[1, 3, 6]

In our study, 3 cases (15.1%) had delayed union and one case developed infected non union (5.2%).Of the three cases of delayed union, two underwent bone grafting and one patient was advised full weight bearing with a tube cast. The fracture had not yet united completely at the completion of the study. The patient with non union underwent implant removal and Ilizarov fixation was done. Our results were comparable to studies by Iannacone .et.al[15] in 1994. He had reported 41 complex distal femoral fractures treated with GSH nail resulting in four nonunion, and five delayed unions. This he attributed to the use of open technique in his study. In a review of one hundred twenty five supracondylar fractures by Henry et.al [5] in 2000 , percutaneous technique of supracondylar nail was compared with open reduction & fixation using a GSH supra condylar Nail. Twenty nine patients out of eighty patients treated with open arthrotomy and open reduction of the fracture, needed bone grafting as an additional procedure. The incidence of nonunion & delayed union was also higher in the group. He had concluded that treatment of supracondylar fractures should be placed percutaneous with distinct advantages of decreased operating time, decreased blood loss and avoidance of extensive surgical

dissection. In the study of comparison between antegrade and retrograde nail insertion by Ostrum et.al[11], had concluded that time to union was slightly longer in the retrograde group & more secondary procedures were needed to obtain union .We attribute our rates of delayed union to open method of reduction (in 90%of our cases), delay in fixation and overall stability of fixation

In our study series of twenty patients, 63% had good to excellent results and 15.1% had poor results as against the study by Gellman et al[1] which showed higher percentage (80%) of good results. In our study, excellent results were obtained in patients operated early and in those with closed non articular type of fracture. We attribute our poor outcome to the development of nonunion and delayed union in some patients, and presence of associated injuries which may decrease the functional outcome of the patients. In our study, the use of open technique for supracondylar nailing has been associated with poor functional outcome.

Our study showed knee range of motion averaged 70 degrees. Studies by Papadokostasis et.al[8] in 2004 showed that mean range of motion was 104 ± 17.2 and 93 degrees by Henry et al[5]. There has been a concern expressed regarding the use of intraarticular entry and development of arthrofibrosis and stiffness of the knee. In our study, younger patients regained higher range of motion than the elderly similar to other studies[9, 12]. The cause of knee stiffness could be due to prolonged immobilization after surgery with a knee brace done

based on fracture patterns stability, delay in taking up patients for surgery, lack of patient compliance regarding knee mobilization & presence of associated injuries.

In our study, patients with stable fixation were mobilized in the first or second postoperative day. Static quadriceps exercises and knee mobilisation exercises were taught. In some patients with less stable fixation, knee was immobilsed in a knee brace for 3 weeks. No continuous passive motion was tried in our patients. The main problem encountered was non compliance of patients regarding physiotherapy exercises at home possibly due to lack of awareness regarding its importance or may be due to fear.

Knee pain has been encountered as a major problem in 30% of our patients. In the series by Lauri. Handolin et.al[6] in 2004 anterior knee pain seen in patients about 20 - 30%. The knee pain possibly could be due to distal screw prominence, impingement of iliobitibial band, due to secondary nail protrusion or previous osteoarthritis.

In summary, retrograde supracondylar nailing is a excellent technique with good union rates in the management of supracondylar fractures. However in view of some of the complications associated with it, less invasive stabilization system and locking plates has been gaining popularity nowadays. Long term comparative study regarding the use of different methods of fixation should be undertaken in the future.

CONCLUSION

Distal femoral fracture poses a challenging problem to the orthopedics surgeon as it occurs in young with high velocity and elderly with low velocity trauma. Early internal fixation and mobilization of the patients is of paramount importance. Presence of osteoporotic bone and presence of other injuries around the knee complicate the problem further.

Retrograde supracondylar nail has evolved to address some of the problem in fixation of these fractures. It has benefits of less periosteal stripping, reduced blood loss, decreased hospital stay and operating time. Based on our study, we conclude that early surgical intervention and mobilisation of patients will give better results. Moreover, closed method of reduction should be done wherever possible and percutaneous nailing should be advocated to yield better results.

The retrograde intramedullary locked nail provides the surgeon with a different option in treatment of specific supracondylar fracture patterns. It offers a practical advantages of simple and efficient technique for patients with polytrauma, floating knee injuries and in elderly. However proper selection of patients and fracture patterns should be done in other cases and cautious use of retrograde supracondylar nailing in diaphyseal fractures should be exercised. Further studies comparing with other alternative methods of fixation are required to validate the outcome.We conclude that this technique is easy and adds to armamentarium of every orthopedic surgeon.

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