“ROLE OF DYNAMIC HIP SCREW IN THE MANAGEMENT OF INTERTROCHANTERIC FRACTURES OF FEMUR - A CLINICAL ASSESSMENT”.

Submitted By

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in

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Under the guidance of

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LIST OF ABBREVIATIONS USED

AVN	Avascular Necrosis
AO	Arbeitsgemainschaft fur Osteosynthes fragen
BA	Bronchial Asthma
DHS	Dynamic Hip Screw
HP	Hemiparasis
OA	Osteoarthritis
OPD	Out Patient Department
RTA	Road Traffic Accident
TAD	Tip Apex Distance
COPD	Chronic Obstructivw Pulmonary Disease

ABSTRACT

BACKGROUND & OBJECTIVES: Fractures of proximal femur are amongst the most often encountered fractures by orthopedic surgeon. Many treatment techniques are described in literature but internal fixation with Dynamic Hip Screw is the treatment of choice. This study analyzes the outcome of treatment of intertrochanteric fracture with Dynamic Hip Screw.

METHODS*:* Between October 2009 and September 2011, 50 patients with intertrochanteric fracture who got admitted at B. L. D. E. U'S Shri. B. M. Patil Medical College,Bijapur in the department of Orthopedics were subjected to internal fixation with Dynamic Hip Screw and the results were evaluated with Kyle's criteria.

RESULTS*:* Incidence was more in males as compared to females. Average age of occurrence was 54.56 years, with level of osteoporosis singh's index 3 or 4. There were 22.23% excellent, 48.89% good, 15.56% fair, 13.34 % poor results.

INTERPRETATION & CONCLUSION*:* Internal fixation with Dynamic Hip Screw is the treatment of choice for treatment of intertrochanteric fractures.

KEYWORDS: Dynamic Hip Screw, Kyle's criteria, Intertrochanteric fracture.

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INTRODUCTION

Intertrochanteric fractures of femur are common in old age group, but it is not uncommon in younger age group. The frequency of these fractures has increased primarily due to the increasing life span and more sedentary lifestyle brought on by urbanization.

The incidence of these fractures is gender and race dependent and varies from country to country and these fractures in elderly is due to trivial fall,advancing age in relation to osteoporosis.[1]

In younger age group, incidence is increasing day by day due to increase in high velocity road traffic accidents.

Elderly patients usually have associated diseases like hypertension, COPD and central nervous system disorders. Such patients do not tolerate treatment with prolonged recumbency. If treated with skeletal traction, mortality and morbidity become high. They develop pneumonia, bedsores, deep vein thrombosis, muscle wasting and joint stiffness. And once skeletal traction is removed, they develop coxa vara with shortening of limbs.

The evolution in treatment of trochanteric fractures has been from conservative treatment to operative treatment in the form of nail plate device, dynamic hip screw, replacement by prosthesis.

The Dynamic Hip screw (DHS) offers provision of dynamic and static compression at fracture site along with sound fixation which favours union with reasonable cost efficiency ratio. This is a collapsible fixation device, which permits the proximal fragment to collapse or settle on the fixation device, seeking its own position of stability. The primary goal of treatment has to be early mobilization to avoid secondary complications which can be achieved by dynamic hip screw which is operative treatment of choice for intertrochanteric fracture as it allows early weight bearing and lower complication than other implants

In view of these considerations, this study is taken up to analyze the surgical management of Trochanteric Fracture using Dynamic Hip Screw and its outcomes regarding the union of the fracture and early mobilization of the patient.

AIMS AND OBJECTIVES OF STUDY

To study the results of Dynamic hip screw in the management of intertrochanteric fracture by analyzing the factors which influence post operative mobility.

REVIEW OF LITERATURE

History of fractures of the upper end of femur is traced in the sculptures of the Greek temples.

About 400 years ago **Pare** described these fractures.

In 1823 Sir **Cooper** classified the fractures of upper end of femur, into extra capsular and intracapsular fractures.

Cotton in 1910 classified fractures around the hip as fracture neck (intracapsular) and trochanteric (extracapsular) fractures. He divided extracapsular fractures into impacted and unimpacted and treated them conservatively by reduction, extension strap and weight traction. Sometimes, he abducted the limb to obtain reduction. The reduced fracture was maintained either by extension straps with traction in abduction or abduction spica with or without traction. Traction was removed after 3-4weeks. Weight bearing was started cautiously, after nonweight bearing for another two weeks. He observed that almost all fractures united, prognosis was good and some shortening and limp was encountered.

In 1924 **Hamilton Russell** made a major break through in the history of conservative treatment of trochanteric fractures, by his new method of skin traction, which even today, is one of the standard methods. The patients were comfortable and nursing care was made easier by this method.

Cleveland and **Bosworth**[3] in 1947 compared both operative and conservative treatment. The 38 cases treated by traction with an average of 78 years, showed a mortality rate of 34% and the 95 operated cases with an average age of 75 years, showed a mortality rate of 12.6%. The Jewett nail plate was used in most of the operated cases.

McLauglin[4] in 1947 devised a variable angled nail plate.

Merwyn and **Evans**[5] treated 101 cases conservatively, 22 cases by internal fixation with, Capener Neufeld, nail plate and 25 patients were sent home for lack of beds from 1941- 48 and reported a mortality rate of 15%, nil, and 44% respectively. He classified trochanteric fractures into stable and unstable types. Patient's treated conservatively, stayed in the hospital for about 15 weeks as against 7 weeks in the operative cases. The residual deformity was same in both the groups. He suggested that, operative treatment should be routine in trochanteric fractures for early mobility, better comfort, reduced mortality and economy of hospital beds.

Boyd and **Griffin**[6] in 1949 presented a classification for trochanteric fractures

which is still widely followed all over the world. The mortality rate was 18%, in 300 cases treated conservatively by him, which was comparable with other series. The incidence of coxa vara was 31.3% in his series.

Leonard[7] in 1949 suggested that, the usual cause of failure of the implant was due to marginal position of the nail and to avoid this, both anteroposterior and lateral views are necessary.

Scott[8] in 1949 compared the results of 27 patients, each treated alternatively by operative and conservative methods. He did not conclude as to the definitive treatment but, wrote that each case has to be reviewed in detail regarding all aspects and then to be reviewed in detail regarding all aspects and then to chose the best line of treatment.

Hafner[9] in 1951 reported trochanteric fractures treated with the 'Low Nail' technique of, Brittain H.A. and described the advantages of the low nail. He preferred internal fixation over other methods.

Evans[10] in 1951 reviewed 110 cases treated by internal fixation, with Capener-Neufeld nail plate. His results showed, a lowered mortality of 10.9%, improved fixation in 81.85%, economy of beds (5 weeks hospital stay); greater comfort and mobility of patients. The complications noted were, coxa vara in 23% (unstable fractures), overdrive of the nail in 7%, cutting out of nail in 1%, wound infection in 3%, pressure sores in 5% and pulmonary embolism in 1%.

Moore and **Cram**[11] discussed the importance of medial cortex and it's comminution and the subsequent collapse of the fracture into varus. Thus the unstable fractures gained more importance and attention.

Boyd and **Anderson**[12] in 1961 emphasized the use of internal fixation as a routine procedure. They advocated the use of additional fixation in some cases. They observed in 100 operated cases that, in Type-III and IV of Boyd and Griffin (unstable trochanteric fractures) fractures medial migration of the distal fragment, with protrusion of proximal end of nail into the hip joint and pelvis was seen more frequently than appreciated. Additional internal fixation like auxiliary buttress plates, screws and wire loops were necessary in as many as 26 cases.

Muller[13] in 1962 used acrylic cement along with internal fixation in unstable comminuted trochanteric fractures. It was claimed to give better results, as stable fixation of the implants was achieved, the posteromedial cortex was reconstructed and early weight bearing was made possible. Even Muhr et al used this acrylic cement in

231 patients and they allowed the patient to sit on the 2nd postoperative day and crutch walking was allowed on the 3rd day postoperatively. There was an impairment of blood supply to the femoral head by the use of cement. The complication noted were, circulatory collapse, air or fat embolism, infection and difficulty in implant removal.

Sarmiento[14] in 1963 reviewed 100 cases using 150° angle nail plate and early mobilisation and observed that, migration of the nail, loss of fixation of the fracture or both resulted in delayed rehabilitation. He stressed on the importance of the reduction of fracture, position of the nail, the reduction of anteromedial cortex of the femur and proper placement of the nail. Improper correction of varus deformity prior to insertion of nail, places the hip at a mechanical disadvantage. The 150° nail plate properly applied, provides better fixation, permits impaction of the fragments, reducing the number of complications and makes early mobilisation safe.

Hughston[15] in 1964 recommended recognition of stable and unstable fractures in a clinical review of 122 cases. He recommended reduction and internal fixation for stable fractures and for unstable fractures, primary medial displacement of the distal fragment (shaft) beneath the proximal fragment (head and neck) to produce stability and to push the major fragments together rather than traction and distraction and then insert a short nail and plate. Functional results noted were excellent.

Massie[16] in 1964 described the biomechanical principles affecting reduction and fixation of intertrochanteric fractures.

Dimon and Hughston[17] in 1967 reviewed 302 intertrochanteric fractures of which

167 were stable and 140 were unstable type and noted the value of displacement fixation in unstable intertrochanteric fractures. 75 unstable fractures were nailed conventionally and the remaining 75 were treated by primary medial displacement fixation. The numerous complications noted were: (i) The nail penetrates the femoral head and enters the acetabulum as the distal fragment migrates medially and proximally, (ii) The nail bends or break as the fractures collapses, (iii) The nail cuts through the head and neck as the fracture settles into varus deformity, and (iv)The plate pulls away from the femoral shaft. The most unstable intertrochanteric fractures in anatomical position, aligning head and neck segment with the shaft, which leaves posteromedial defect and hence stability was not achieved. So to achieve stability, primary medial displacement was necessary. The y concluded that, (i) To recognise stable or unstable fractures by reviewing radiographs preoperatively and at first reduction (ii) Stable fractures should be nailed conventionally (iii) Unstable types should be treated by primary medial displacement fixation which significantly reduces the post-operative tendency for the fractures to develop a varus deformity.

Sarmiento and Williams [18] in 1970 described valgus osteotomy and I-Beam nail plate fixation for unstable trochanteric fractures. 100 cases were treated from 1964 to 1969. They also observed that, accurate approximation of the medial cortices of the two major fragments greatly enhances the efficiency of the medial cortex, reduces the complications, usually being the proximal migration of the nail. This technique makes the plane of unstable fractures more horizontal, approximates the cortices at the femur in a valgus position.

Holland and **Gunn**[19] in 1972 reviewed 50 trochanteric fractures treated by Sliding hip screw. They confirmed that stable fracture could be satisfactorily fixed with any rigid internal fixation device.

Herrington and **Johnston**[20] in 1973 described a modification of the medial displacement osteotomy and fixation technique of Dimon and Hughston, using a Sliding compression screw plate device in 81 patients. Conventional internal fixation had 44% complications, whereas using medialisation technique, they observed complications in only 19.6% (11 out of 56%) cases. When a rigid 6 cms. Jewett nail is used for fixation, and telescoping displacement may concentrate the load at the tip of the nail and protrusion of the nail through the head into the acetabulum occurs and when a short Jewett nail is used, the depth of fixation in the proximal head neck fragment may be inadequate. This problem seems to be solved by the sliding nail which allows continued telescoping of the femoral head neck spike within the medullary canal of the shaft while maintaining the valgus alignment. The screw's blunt nose prevents it from migrating longitudinal through the femoral head into the acetabulum. The broad surface contact of the threads of the compression screw in the proximal segment discourages its lateral migration. In 77 patients, 5 patients died or were lost to followup, 67 patients had good results and 4 had progressive varus deformity. Majority were allowed weight bearing on the second day of operation with crutches or walkers. There was no metal failure or avascular necrosis.

In **1966,Kuntscher G**[21] introduced Condylocephalic Intramedullary nails. The Cephalomedullary fixation was attempted using a **Kuntschner Y-nail**, it was very difficult to introduce and resulted in fracture of the greater trochanter in many cases.

Collado[22] in 1973 introduced the condylocephalic nailing method. The condylocephalic nail is a clover leaf intramedullary nail, slightly curved. It is passed upwards into the medullary cavity from the medial condyle of the femur into the proximal fragment of the fractures, which has obvious advantage that, the fracture site is not operate and hence infection is prevented. The procedure is simple and the position of nail is favorable as it is in the long axis of the shaft and corresponds to the direction of mechanical forces acting on the fracture line.

Gupta[23] in 1974 reviewed results of conservative treatment in 170 cases. Though good results were obtained, he concluded that internal fixation was the treatment of choice provided adequate facilities are there.

Herrington[24] in 1975 reported 42 unstable intertrochanteric fractures fixed with Jewett nail or compression screw plate fixation with bone cement. He allowed patients to sit up in chair on 2nd postoperative day and weight bearing within three weeks.

Jensen and **Tondevold**[25] in 1978 treated eighty unstable trochanteric fractures with the sliding screw plate system. Early weight-bearing was encouraged and mobilization was obtained within the first week in 47 per cent of the cases .Technical complications were encountered in 5 per cent of the patients but none required reoperation. Telescoping of the screw occurred in 49 per cent .Through this secondary fracture impaction a stable load transmission system was established. Fracture union in the postoperative position was obtained in 49 per cent of the patients and non-union did not occur.

Hunter and **Krajbich**[26] in 1978 reviewed 88 patients, followed-up 83 for average period of 27 months. Of the 56 living, only 24 (43%) demonstrated a good functional result. Medial displacement osteotomy should be combined with a sliding screw plate device. Without a sliding screw plate, medial displacement osteotomy for unstable intertrochanteric fractures of the femur may not be as successful as would appear from reports in the literature.

Richard [27] in 1978 reported the use of compression hip screw in 236 patients. Rigid fixation was obtained and early mobilisation and weight bearing was allowed. Even in geriatric patient's they recommended internal fixation and early mobilisation.

Kyle and **Gustilo**[28] In 1979 treated 622 intertrochanteric fractures, of which 57% were stable (Types I and II), 28% were type III, and 15% were type IV (the unstable types). The 150 degree telescoping Massie nail proved superior to the fixed 135 degree Jewett nail (particularly for unstable fractures) because it allowed a controlled impaction of the fracture fragments to a stable position. In about one third of the fractures, some medial displacement occurred. With anatomical reduction and the use of the Massie or ASIF nails, we achieved a decrease in the morbidity and mortality and 96% satisfactory results. Our prospective study was compared with a retrospective study in which other devices were used. Early ambulation and weight-bearing also was a major contributing factor to the improved results in the prospective study. Intertrochanteric hip fractures that are unstable can be fixed with a collapsible nail, and that treatment appears to give as good or better results than the displacement method of Dimon and Hughston or Sarmiento.

Ganz and **Thomas** [29] in 1979 reviewed 1376 cases of trochanteric fractures which, did not include subtrochanteric fractures. They observed that, 70% of the patients were females, with an average age of 70 years, 70% had a domestic accident, 10% had traffic accidents, 9% had work or sports injuries and 11% had no information. The mortalit y rate was 10.5% during hospital stay. Reoperations were necessary in 8.6% of cases, mostly due to instability and fatigue fractures or a technical error. To avoid failure they advised, (a) the tip of the blade's position should be in the trabecular crossing point (b) to construct the medial cortex and (c) achieve impaction in valgus position. In the long term control 90% of the patient's were able to fully bear weight, 63% used a walking aid, 87% of the patient's had none or occasional pain. Results varied according to the type of fracture, but were same in all the age groups.

Doherty and **Lyden**[30] in 1979 reviewed 75 patients treated with hip compression screw and discussed some of its technical problems.

Laskin and **Zimmerman**[31] in 1979 analyzed 236 cases of intertrochanteric fracture treated with the Zimmerman compression hip screw. They argued that, of all the complex classifications, the simplest, i.e., stable and unstable, is the best from a biomechanical and clinical point of view. Primary medial displacement was the method of choice after much discussion of all the methods. Their average clinical shortening in the comminuted fractures was 1.5 cms, which was comparable to other series of Herrington (1.5), Eckar (2cm), Clawson (1.2cms) and Dimon (1.5 cms.). Non union in two cases as also seen in 2 cases of Mull Holland and Gunn's (1972) series of intertrochanteric fractures treated by compression hip screw and were supposed to be due to overzealous medial displacement, giving rise to over displacement. Avascular necrosis, which is rare with only 7 cases in world literature, they had it, in one case due to a subcapital stress fracture. They concluded that effective way of treatment for intertrochanteric fractures, regardless of advanced age in surgery and early mobilization.

Cameron and **Graham**[32]in 1980 concluded that distraction forces at the site of an unstable intertrochanteric fracture can cause disengagement of the sliding hip screw from the barrel of the side plate. If such a device is used for unstable comminuted intertrochanteric fractures, the compression screw should be retained.

Jacobs and **Armstrong**[33] in 1980 reviewed 173 cases of intertrochanteric fractures treated by internal fixation ,72 treated with the Jewett nail and 101 with the Richards compression hip screw. Both devices maintained adequate reduction in the majority of cases. Treatment failure: loss of fixation, symptomatic joint penetration, aseptic necrosis, malunion and nonunion occurred in 25% of the Jewett nail cases and 6% of the Richards screw cases. In vitro biomechanical studies demonstrate that the compression screw is subjected to less bending stress by acting as a lateral "tension band" in stable reductions and by allowing sliding, thus shortening the bending movement lever arm in unstable reductions. The compression hip screw is valuable in the treatment of intertrochanteric hip fractures. In stable conditions, it acts as a tension band producing more force transmission through the medial cortex, stressing the implant more in tension and less in bending. In unstable conditions with higher shearing forces, the device will shorten the lever arm, decreasing the bending moment, as well as avoiding penetration of the femoral head.

Jensen and **Tondevold**[34] in 1980 presented a series of 375 patients with stable trochanteric fractures were treated with the McLaughlin or Jewett nail plate, the sliding screw plate or Ender nailing. Technical failure of fixation was encountered in 5% of the cases regardless of the method of fixation used. Reoperations were performed in less than 3% of cases treated with hip implants but in 20% of cases with Ender nailing, mainly because of distal slipping of the nails resulting in knee problems. With an improved technique, however, Ender nailing can be used as successfully as any of the hip implants for the internal fixation of stable trochanteric fractures.

Jensen and **Tondevold**[35] in 1980 in a series of 1,071 patients with unstable trochanteric fractures who were treated by the McLaughlin or Jewett nail plate, the Sliding screw plate or Condylocephalic nailing according to Ender. Deep infection was encountered in 2.5% of the cases following surgery in the hip region and in 3.3% of the Ender's nailing. Statistical analyses showed that the quality of the reduction was determined by the comminution of the fracture, and the technical failure of fixation or secondary displacement of the fracture was determined by the quality of the reduction. Sliding screw plate fixation was found to be the only suitable fixation method for unstable trochanteric fractures, because of a low failure rate, a low reoperation rate and the possibility of secondary impaction without disturbing the fracture union.

In 1980, **Jensen**[36] concluded that implants with a 135 degree angle are recommended for the fixation of unstable trochanteric fractures.

Kyle and **Wright**[37] **i**n 1980 concluded that the higher the nail plate angle, the easier it is to impact the hip fixation device and thus allow bone impaction and stability at the fracture site. The potential for jamming a sliding hip screw is decreased by maximum engagement of the screw in the barrel.

Wilson[38] in 1980 inserted 1,015 Jewett nails forintertrochanteric hip fractures during the period 1957 to 1976. This is one of the largest series of intertrochanteric fractures studied at one institution using one method of treatment. Anatomic reduction was attempted in almost all cases regardless of comminution. Medial or valgus displacement was rarely carried out on purpose. The average delay to surgery was 2.1 days after admission. Most patients were on bed chair status on the first postoperative day and began toe touching ambulation 10 to 14 days after surgery. The reduction and nail placement were critical factors for fracture healing. Only 3.3% of patients with satisfactory nailing had nail related complications, such as penetration or cutting out.87% of patients with poor nailing had these problems. 97% of fractures united, 1.3 went to nonunion, and necrosis was seen in 2 united fractures (0.4%)

Chapman and **Bowman**[39] in 1981 showed that Ender's pins are ideally suited for elderly patients with stable fractures, particularly if the surgical risk is high. The y must be used with caution in unstable fractures and postoperative protection in traction may be necessary. However, the occasional external rotation deformity and the high incidence of problems with the knee make their use in younger, more active patients less desirable than the compression hip screw unless their unique advantages justify their use.

Bonamo and **Accettola**[40] in 1982 reported that valgus closed reduction and internal fixation with a 150 degrees nail plate produced favourable results in unstable intertrochanteric fractures It was recommended that 20 to 25 mm of nail slide be madeavailable in stable fractures and 25 to 30 mm in unstable fractures. This will increase stability by allowing the sliding nail to accommodate the complete post fixation axial collapse of the fracture fragments.

Wolfgang [41] in 1982 discussed 317 intertrochanteric fractures, in 302 patients treated by sliding screw plate fixation and argued that an acceptable result may not be obtained due to errors of patient selection, operative technique and postoperative care. Stable reduction was seen to be more important than the fixation device, medial displacement reduced a number of complications as seen by several others. Mechanical fracture complications occurred in 9% of 142 stable fractures and 19% of 37 unstable fractures. The sliding screw side plate device provided satisfactory results but depends on many factors including reduction, operative technique and postoperative care.

In 1982 **Gathercole** and Pena [42] fixed 112 trochanteric fractures, with Jewett nail plate in 81 patients and Thorton nail-McLaughlin plate in 31 patients. Penetration of the nail into or through the hip joint was the only complication studied in detail. It occurred in 41 cases: 31 (38 per cent) with the Jewett nails and 10 (33 per cent) in the other group. Both groups are comparable in that the nail plate acts as a single rigid unit and the nail/plate angle varied, but the overall incidence of migration of the nail was similar. All the 112 cases were reviewed as one group. Penetration was more common in comminuted unstable types of fracture, in those poorly fixed, and in the older patients. Sixteen (14 per cent) well fixed fractures showed penetration. It appears that one important additional reason for penetration in this series was the rigidity of the device and the poor quality of the bone. The incidence of nail penetration in comminuted unstable fractures of the femur might be reduced by using methods of fixation other than rigid nail plate .

Harper[43] in 1982 reviewed a consecutive series of 61 unstable intertrochanteric fractures internally stabilized with a compression hip screw utilizing a medial displacement technique. Of the 50 fractures, osseous union occurred in 48. There were two cases of mechanical failure and two deep wound infections. Average limb shortening was 1.8 cm. The 6 weeks mortality rate was 6%. This experience suggests that this approach carries a low incidence of mechanical failure, acceptable morbidity and mortality rates, and no excessive shortening.

Moore and Evans[44] in 1983 concluded that patients treated with a Richards device mobilised more quickly and left hospital sooner, and more of them returned to their homes. Failures of stabilisation were fewer in this group.

Weiss[45] in 1983 reviewed one hundred sixty two cases of unstable intertrochanteric fractures treated by anatomic reduction and compression hip screw fixation. One hundred twenty four of these patients were followed up for an average of 19.2 months. Loss of fixation, with varus angulations of the fracture, occurred in five patients, a 4% incidence of failure. One hundred ten patients were bearing full weight an average of three weeks after operation. Fracture healing occurred in average of 18 weeks after operation. After compression was applied, 90% of the fractures moved into medial displacement position. Eight percent of the fractures laterally displaced; 2% of the fractures maintained their anatomic alignment. Non anatomic reduction, e.g., stable reduction accomplished by displacement osteotomy (After Dimon and Hughston), has no advantage over anatomic reduction and fixation by a compression hip screw. The advantages of the latter technique are that weight bearing can be started early, the device can be used for stable and unstable intertrochanteric fractures with identical technique, and fixation is rigid and allows for compression of the fracture site, while maintaining alignment.

Kulkarni GS[46] in 1984, reported 140 cases of trochanteric fractures treated with a Modified Richard's Compression screw. The overall failure rate was 6.3%. Early ambulation did not compromise the end results. Complications seen in 6 patients consisted of early infection in 2 patients, late infection in 2 patients, implant penetration in one patient and implant coming out of the head in one patient. Six patients had mild pain over the palpable nut. There was non-union in one patient.

Mohanty and **Chacko**[47] of Manipal in 1984, reported a comparative analysis of trochanteric fractures treated by operative and non operative methods. 135 cases were analysed for the merits and demerits of operative and non operative treatment.63 cases were treated by non operative methods and 53 by surgery. Though there was not much difference in mortality rate, 59.3% of cases treated by surgery had excellent results where as it was only 37.64% in the cases treated by non operative methods. There was not much difference in fair or poor results as most patients treated by non operative methods had good results (43.84%). In short the simple non operative treatment was found to be less superior than operative.

Pathak[48] in 1984 reported results of 294 cases of trochanteric fractures treated by operative (165 cases) and non operative methods (129 cases). He followed his own classification based on altered force vectors and behaviour of fragments. He observed that, operative treatment clearly show less morbidity and mortality. Nonoperative treatment gives superior result only in undisplaced fractures and avulsions.

Moller and **Grymer**[49] in 1984 showed that the sliding screw-plate is superior to the nail plate in both stable and unstable fractures.

Brink[50] in 1987 reported low (145°to150°) nail plate fixation (McLaughlin) for stable trochanteric fractures and early weight bearing ambulation. From 1978 to 1982, 52 stable trochanteric fractures in 52 patients were treated by low nail plate fixation. Within 1 week post operatively, the patient's started full weight bearing ambulation. The functional result was good in 88.2%. Despite the average age of 77.9 years the hospital mortality rate was 1.9%. On the basis of the results they concluded that low nail plate fixation and early weight bearing of stable fractures can be considered to be reliable.

Waddell[51] in 1987 reported Ender's nailing in fractures of proximal femur. They treated 723 consecutive patients with intertrochanteric fractures of femur by intramedullary nailing with Ender's nails. 644 patient's had survived for 6 months or longer with a patient requiring secondary surgery for delayed union and 6 patients requiring revision of fixation device. The morbidity had been low, the complication rate acceptable and the complications readily corrected. The overall result in terms of the healing, maintainance of reduction and functional activity had been very satisfactory.

Hornby and **Evans**[52] in 1989 studied all elderly patients with extracapsular hip fractures over a twelve months period and followed up for six months. Patients were randomised to treatment by AO dynamic hip screw or by traction. Complications specific to the two treatments were low, and general complications, six months mortality and prevalence of pain, leg swelling and unhealed sores, showed no difference between the two modes of treatment. Operative treatment gave better anatomical results and a shorter hospital stay, but significantly more of the patients treated by traction showed loss of independence six months after injury.

Davis [53] in 1990 in a prospective study assessed the causes of mechanical failure in a series of 230 intertrochanteric femoral fractures which had been internally fixed with either a sliding hip screw or a Kuntscher Y-nail. The overall rate of mechanical failure was 16.5%; cutting-out of the implant from the femoral head was the cause in three quarters of the instances. Implants placed posteriorly in the femoral head cut out more often (27%) than those placed centrally (7%). The cut out rate was also determined by the quality of the fracture reduction, but age, walking ability and bone density (assessed by the Singh grade and metacarpal indices) had no significant influence. We conclude that these fractures should be reduced as accurately as possible and it is imperative that the implant is placed centrally within the femoral head.

Larsson and **Friberg**[54] In 1990 reviewed 607 treated trochanteric fracture (563 atients) with a sliding screw technique and followed clinically and roentgenographically for at least one year. Of 351 patients admitted from their homes,209 (60%) were discharged to their homes after an average of 18 days in the hospital. During the first year another 61 (17%) patients returned home after rehabilitation in a geriatric ward. Of 446 patients walking without support or with one cane before surgery, 360 (80%) had regained the same mobility after one year. The one year mortality rate was 18%, while the ten year rate was 74%. The increase in mortality was influenced by advanced age, admission from long term care institutions, male gender, and ambulatory or nonambulatory status before surgery. Forty five (7.4%) were reoperated, 17 because of technical complications, three because of infection, and three because of nonunion. No further nonunion occurred. The deep infection rate was nine of 339 (2.7%) before and two of 268 (0.8%) after the introduction of antibiotic prophylaxis.

Rao and **Hambly**[55]in 1990 concluded that unstable and stable cases of intertrochanteric fractures showed a higher incidence of complications in the Ender's group; these included backing out, distal femur fracture, need for a secondary procedure, external rotation deformity, and knee pain. Indications for the use of Ender's rods may be found among patients with burns, soft tissue injuries of the proximal thigh, and patients refusing blood transfusions. Wiring of the distal ends of Ender's rods prevents backing out of the rods. The compression hip screw is a preferred treatment of choice in both stable and unstable intertrochanteric fractures.

Bridle and **Patel**[56] in 1991 have prospectively compared the fixation of 100 intertrochanteric fractures of the proximal femur in elderly patients with random use of either a Dynamic hip screw or a new intramedullary device, the Gamma nail. The y found no difference in operating time, blood loss, wound complications, stay in hospital, place of eventual discharge, or the patients' mobility at final review. There was no difference in failure of proximal fixation cut out occurred in three cases with the Dynamic hip screw, and twice with the Gamma nail. However, in four cases fracture of the femur occurred close to the Gamma nail, requiring further major surgery. In the absence of these complications, union was seen by six months in both groups.

Nungu and **Olerud**[57] In 1991 compared the results of two fixation devices for the treatment of intertrochanteric fractures in 220 patients. 101 patients were randomized to Ender nailing and 119 to fixation with a sliding screw plate. The two treatment groups were equal with respect to important preinjury variables. The two methods did not differ in operating time or perioperative blood loss. The proportions of good reduction of the fractures and of good positioning of the internal fixation devices were equal in the two groups. But the complication rate and the reoperation rate were more than twice as high in the Ender group as in the sliding screw plate group. The outcome at 1 year follow-up was approximately equal in the two groups.

Desjardins [58] in 1993 conducted a prospective randomised trial to compare the results of anatomical reduction and medial displacement osteotomy in 127 consecutive patients with unstable intertrochanteric fractures, of whom 109 completed the study. After an average followup of 11 months, they found no significant differences in walking ability, social status or failure of fixation in the two groups. Operating time and blood loss were significantly higher in the osteotomy group. With the use of modern sliding hip screws, medial displacement osteotomy is rarely indicated for unstable.

Radford and **Webb**[59] in 1993 made a randomised prospective comparison of the Dynamic hip screw and the Gamma locking nail for the internal fixation of 200 peritrochanteric femoral fractures in elderly patients. There was less intraoperative blood loss and a lower rate of wound complications in the patients treated by the Gamma nail. They had, however, a high incidence of femoral shaft fracture which we relate in part to implant design. We do not recommend the use of the Gamma nail for these fractures.

Curtis and **Jinnah**[60] in 1994 assessed the rigidity and strength of fixation provided by intramedullary and extramedullary devices for proximal femoral fractures. Stable and unstable intertrochanteric fractures were studied with the Gamma nail and Richards 135 degrees classic hip screw implants. There was no significan difference in the strength of fixation of stable and unstable intertrochanteric fractures between the Gamma nail and the hip screw, although the Gamma nail provided more rigid fixation.

Gargan and **Simpson**[61] in 1994 used osteotomy in the treatment of unstable intertrochanteric hip fractures in an attempt to increase the stability of the fracture fragments and assessed this stability in a randomised prospective trial on 100 consecutive patients, all having fixation by an AO dynamic hip screw, comparing anatomical reduction with two types of osteotomy. The groups were similar in terms of age, gender, mental test score, and fracture configuration. There were more failures of fixation in the osteotomy groups, and the operations took longer. They found no clear benefit from osteotomy and therefore recommend anatomical reduction and fixation by a sliding hip screw in most cases. Rarely, a fracture configuration which does not allow load-sharing between the fracture fragments and the device may benefit from an osteotomy or the use of an alternative implant.

Galanakis and **Dretakis**[62] in 1995 conducted a prospective study of 106 patients with 37 stable and 69 unstable trochanteric fractures treated with 2 different implants: a sliding screw plate and a triflanged nail plate. The fractures were classified according to Jensen's modification of Evans classification. The parameter migration was compared between the 2 implants and for the various areas of placement of the screw or nail within the femoral head. For stable fractures, the migration observed was independent of the area of implant placement or the type of implant used. For unstable fractures, central placement of the sliding screw resulted in a decreased mean value of migration. When the nail was used, the mean values of migration observed were independent of the areas of placement within the femoral head. In cases of central placement, the sliding screw appeared to be superior to the triflanged nail.

In 1996 **Parker**[63] reviewed the radiographic characteristics of 27 patients with a trochanteric fracture treated with a sliding hip screw in which fixation failure occurred, were compared with 74 cases having uneventful fracture union. Femoral medialisation was commoner in specific fracture types, particularly if there was comminution of the lateral femoral cortex at the site of insertion of the lag screw. Femoral medialisation was strongly associated with fixation failure, with a seven fold increase in the risk of failure if medialisation at more than one third occurred. These observations indicate that the value of implants preventing femoral medialisation in specific types of trochanteric fracture merit further evaluation.

Baumgaertner and **Solberg**[64] (fig-5) in 1997 compared the results of the surgical treatment of trochanteric hip fractures before and after surgeons had been introduced to the tip apex distance (TAD) as a method of evaluating screw position. There were 198 fractures evaluated retrospectively and 118 after instruction. The tip apex distance is the sum of the distance from the tip of the screw to the apex of the femoral head on anteroposterior and lateral views. This decreased from a mean of 25 mm in the control group to 20 mm in the study group. The number of mechanical failures by cut-out of the screw from the head decreased from 8% in the control group at a mean of 13 months to none in the study group at a mean of eight months.There were significantly fewer poor reductions in the study group. Our study confirms the importance of good surgical technique in the treatment of trochanteric fractures and supports the concept of the tip apex distance as a clinically useful way of describing the position of the screw.

Baumgaertner and **Curtin**[65] in 1998 reported that in patient's with unstable intertrochanteric fractures, the intramedullary device was associated with 23% less surgical time and 44% less blood loss; however, use of the intramedullary hip screw in patients who had a stable fracture pattern required 70% greater fluoroscopic time. Intraoperative complications occurred exclusively in patients in the intramedullary hip screw group. There were no differences in the rates of functional recovery between the two fixation groups.

In 1998 **Loch**[66] investigated the forces required to initiate sliding of the proximal screw in intramedullary devices and to compare these forces with those required to initiate sliding of hip screws. The loading configuration simulated the typical angle of 135 degrees between the intramedullary nail and the proximal screw. The forces required to initiate sliding of the proximal screw, with the screw extended fifty one, seventy six, eighty six, and 102 millimeters beyond the proximal end of the barrel, were measured for three different types of second generation intramedullary nails, a sliding compression hip screw, and an intramedullary hip screw, and these forces were then compared. With each amount of extension of the screw, the hip screws required lower forces to initiate sliding than did the second generation intramedullary devices. Of the second generation devices, the Gamma nail required the highest forces to initiate sliding; the Recon and ZMS nails required 20 to 40 percent lower forces compared with the Gamma nail. None of the devices jammed in any of the loading configurations that were tested. When the extension of the screw was increased, higher forces were required to initiate sliding.

Watson and **Moed**[67] in 1998 compared the Medoff sliding plate with a standard compression hip screw in a randomized, prospective study for the fixation of 160 stable and unstable intertrochanteric fractures with an average follow up of 9.5 months (range, 6-26 months). Overall, 91 fractures were treated using the compression hip screw and 69 were treated with the Medoff sliding plate. Stable fracture patterns (46) united without complication in both treatment groups. Unstable fractures (114) had an overall failure rate of 9.6%, 14% (nine patients) with the compression hip screw and 3% (two patients) with the Medoff plate; this difference was significantly different. The time to union for the 114 unstable fractures was not significantly different between the two devices. For all patients, no differences in lengths of hospitalisation return to ambulatory status before fracture, postoperative living status, or postoperative pain was observed between the two device groups. Use of the Medoff plate for all fracture types was associated with a significantly higher amount of blood loss and operating time.

Kenneth J. Koval[68] in 1998, in a study of 60 patients regarding post-operative weight bearing after a fracture of the femoral neck or an intertrochanteric fracture concluded that the elderly patients operated for fracture of femoral neck or an intertrochanteric fracture, who are allowed to bear weight as tolerated after operative treatment, appear to voluntarily limit loading of the injured limb.

Chinoy MA and **Parker MJ**[69] in 1999, in a met analysis of 14 studies; concluded that the incidence of implant cut-out, breakage, fracture nonunion, and re-operation rates are significantly lower in patients treated with sliding implants than in those with fixed nail plates. Although fixed nail plates are cheaper, they should not be used in the treatment of proximal femoral fractures.

Bolhofner BR., Russo PR and **Carmen B**[70] in 1999, reported the clinical results of the treatment of intertrochanteric fractures treated with a 135degree hip screw with a two-hole side plate. 69 patients underwent surgery. The average estimated blood loss was 77 cc., and the average surgical time was 31 minutes. Use of the 135degree sliding hip screw with a two-hole side plate produced satisfactory healing and results in relatively low blood loss and short surgical time without the loss of side plate fixation.

Baixauli and **Baixauli**[71] in 1999 treated three hundred fifty eight patients older than 60 years of age with a reinforced rigid fixation device with mean follow up, 16 months. Six months after surgery the fracture had united in 82% of the patients who were walking without aid or using only a cane. Weight bearing began when the patient's general overall condition allowed such activity (average, 5 days; mode, 3 days). No difference regarding the results between stable and unstable fractures. Intraoperative and postoperative complication rates were 3% and 7.1%, respectively. The failure of fixation rate was 5.4%. Mechanical tests and clinical results showed that immediate weight bearing can be allowed in all types of intertrochanteric fractures. This reinforced device is effective in treating unstable intertrochanteric fractures and is especially indicated for the most unstable types (Evan's Grades 4 and 5).

In 2000 **Parker** and **Handoll**[72] compared conservative with operative treatment for extracapsular fractures of the proximal femur (hip) in adults based on the Cochrane Musculoskeletal Injuries Group trials register and bibliographies of published papers, and contacted trialists. They randomised and quasi-randomised trials comparing these two treatment methods in adults with hip fracture. Outcomes sought fell into four categories: a) fracture fixation complications, b) postoperative or clinical complications, c) final outcome measures including mortality and d) anatomical restoration. Comparable groups of trials were sub grouped by implant type (fixed nail plate or sliding hip screw) and where appropriate, data were pooled using the fixed effects model. The four randomised trials identified involved only 402 elderly patients. The limited available evidence from randomised trials does not suggest major differences in outcome between conservative and operative management programmes for extracapsular femoral fractures, but operative treatment appears to be associated with a reduced length of hospital stay and improved rehabilitation. However these results are derived mainly from one study. Conservative treatment will be acceptable where modern surgical facilities are unavailable, and will result in a reduction in complications associated with surgery, but rehabilitation is likely to be slower and limb deformity more common.

Christopher and **Court-Brown**[73] in 2001 compared the surgical complications and functional outcome of the Gamma nail (Intramedullary fixation device) versus the

Richards sliding hip screw and plate, in the intertrochanteric femoral fractures. There were 400 patients entered into the study and 399 followed up to one year or death. The devices were assigned by randomization to either a short- type Gamma nail (203 patients) or a Richard's type sliding hip screw and plate (197 patients). The main surgical outcome measurements were fixation failure and reoperation. A functional outcome of pain, mobility status, and range of movement were assessed until one year. The requirement for revision in the Gamma nail group was 12(6%); for Richard's group, 8(4%). This was not statistically different. A subcapital femoral fracture occurred in the Richard's group. Femoral shaft fractures occurred with 4(2%) in the Gamma nail group and none in the Richard's group .Three required revision to another implant. Lag screw cut out occurred in 8 (4%) patients in the gamma nail group and 4(2%) in the Richard's group. This was not statistically significant. The development of other postoperative complications was the same in both groups. There was no difference between the two groups in terms of early or long term functional status at one year. The use of an intramedullary device in the treatment of intertrochanteric femoral fractures is still associated with a higher but non significant risk of postoperative complications. Routine use of the Gamma nail in this type of fracture cannot be recommended over the current standard treatment of dynamic hip screw and plate**.**

Olsson and **Ceder**[74] in 2001 compared 54 patients treated by a Medoff sliding

plate, with 60 stabilised by a compression hip screw in a prospective randomized study of, the management of intertrochanteric femoral fractures. Four months after the operation femoral shortening was determined from radiographs of both femora. In unstable fractures the mean femoral shortening was 15 mm with the Medoff sliding plate and 11 mm with the compression hip screw. A subgroup in which shortening was classified as large, comprising one-third of the patients in each group, had a similar extent of shortening, but more medialisation of the femoral shaft occurred in the compression hip screw (26%) than in the Medoff sliding plate (12%) group. Five postoperative failures of fixation occurred with the compression hip screw and none with the Medoff sliding plate. The marginally greater femoral shortening seen with the Medoff sliding plate compared with the compression hip screw appeared to be justified by the improved control of impaction of the fracture. Biaxial dynamisation in unstable intertrochanteric fractures is a safe principle of treatment, which minimises the rate of postoperative failure of fixation.

In 2001 **Kim WY,Han CH, Park JI, Kim JY**[75] in a study of 178 intertrochanteric fractures femur treated by Dynamic Hip Screw fixation .They used Singh's classification of trabecular bone structure in proximal femur on a measure of osteoporosis and also classified fractures according to 3 different systems (Boyd-Griffin,Evans,AO)Post-operative radiographic examination for loss of reduction i.e Varus angulation >100,perforation of femoral head,>20 mm extrusion of lag screw/metal failure.49 cases showed radiographic failures .2 stable,47 unstable fractures (Evan's classification)Unstable fractures with osteoporosis had a failure rate of >50%.In such cases DHS should not be 1st choice for treatment.

Haington and **Nihal**[76] in 2002 reported a randomised, prospective study comparing a standard sliding hip screw and the intramedullary hip screw for the treatment of unstable intertrochanteric fractures in the elderly. 102, 52 patients were treated with a compression hip screw, and 50 had intramedullary fixation with an intramedullary hip screw. The mean duration of operation and fluoroscopy screening time was significantly greater for insertion of the intramedullary hip screw. There was no difference between the groups with regard to transfusion requirements or time to mobilise after surgery. There were 2 technical complications in the compression hip screw group and 3 in the intramedullary hip screw group. There was no significant difference between the two groups in radiological or functional outcome at 12 months. It remains to be shown whether the theoretical advantages of intramedullary fixation of extracapsular hip fractures bring a significant improvement in eventual outcome.

In 2002 **Sadowski** and **Saudan**[77] reported that patient's treated with an intramedullary nail had shorter operative times, fewer blood transfusions, and shorter hospital stays compared with those treated with a 95 screw plate. Implant failure and/or nonunion was noted in seven of the 19 patients who had been treated with the 95 screw plate. Only one of the twenty fractures that had been treated with an intramedullary nail did not heal. The results of our study support the use of an intramedullary nail rather than a 95 screw plate for the fixation of reverse oblique and transverse intertrochanteric fractures in elderly patients.

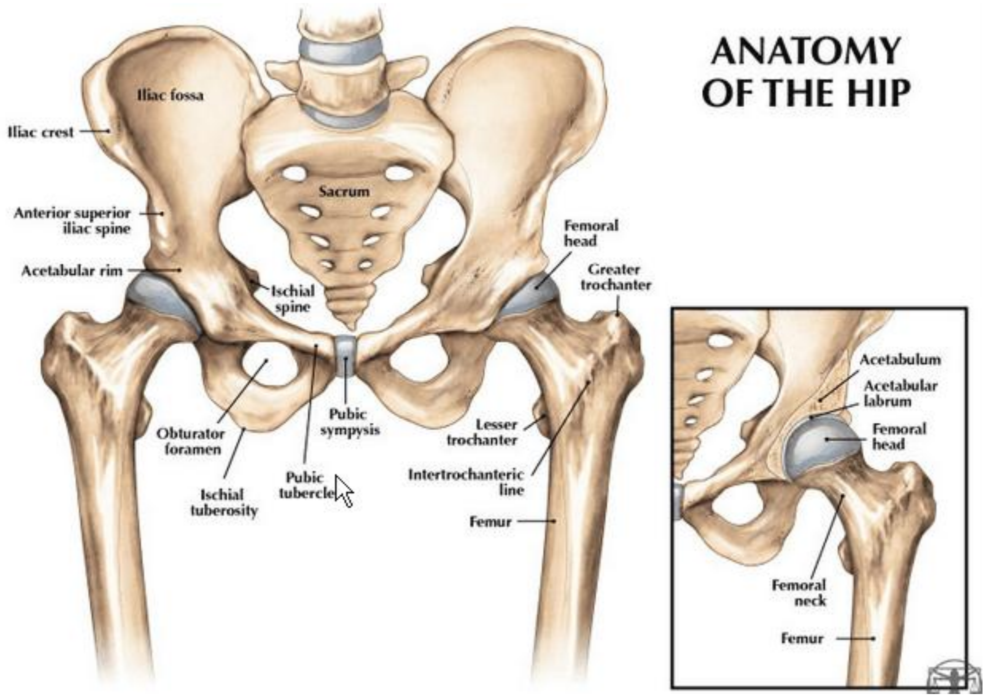
In 2004 **Arshad Bhatti,Sohail Qureshi**[78] conducted a retrospective study of 87 patients treated with DHS fixation in intertrochanteric fractures to examine roles of fracture stability,anatomic reduction and screw position on cut through failure of DHS implants.32 fractures were incompletely reduced.In 6 out of 32 cases,failed fixation by way of screw cutout of femur haed .Analysis of screw fixation showed 5.4% failure of screw placed centrally and 8% failure of screw placed off centre .They concluded that incomplete reduction is strong predictor of implant failure by cut-out.

In 2005, **Laohapoorungsee A, Arpornchayanon**[79] reviewed 83 patients with intertrochanteric fracture femur treated with 135 degree DHS and 2 holed side plate.55 patients had established osteoporosis.Mean time of union is 14 weeks.68% had minimal collapse ,24% moderate and 8% severe collapse .80% of moderate and severe collapses were associated with osteoporosis and unstable fracture pattern. 4 failures – 2 lag screw cut-out , 2 pull out from side plate.

In 2005, **Li H,Zhang Y, Zhongguo Xiu Fu Chong Jian Wai Ke Za Zhi**[80] conducted a research study to investigate the development of DHS internal fixation in treatment of intertrochanteric fracture of femur. Latest relevant articlesa were breviewed extensively including biomechanics and clinical application research.They concluded that for treatment of intertrochanteric fracture femur DHS is still the gold standard ,but strict selection of patients,proficiency operation and invasive manipulation are most essential principles.

In 2006,**Agarwala Sanjay, Kohli Amit ,Bhagwat Abhijit**[81] reported that DHS is reliable for intertrochanteric fractures.However the results of our study support the use of short barrel plates in Indian population with shorter femoral head and neck length to allow sufficient slide when using dynamic screws of 75 mm or less.

ANATOMY



PROXIMAL FEMUR:

The femur is the longest bone in the human body. The upper end of femur comprises of a head, a neck, a greater trochanter and a lesser trochanter.

The Head:

It articulates with the acetabulum to form the Hip joint. The medial convexity of the head has a pit, the **fovea**, situated just below and behind its center, providing attachment to the **ligament of the head** of the femur {round ligament/ligamentum teres}. The head is entirely intra-capsular and is encircled immediately lateral to its greatest diameter by the labrum acetabulare.

The Neck:

The neck connects the head of femur with the shaft.it is directed superiorly , anteriorly and medially from upper end of the femur.it is about 5cm in length.it is broader at its base and narrow in its upper end.it is slighty compressed antero-posteriorly.the neck shaft angle is around 130^o and an anteversion of 15^o approximately in adults . This point is essential for proper insertion of the implant.

The greater trochanter and lesser trochanter are the terms that refer to the lateral and medial prominences of proximal femur . The trochanteric region is defined as the area bordered proximally by the line of attachment of the hip joint capsule and distally by the inferior aspect of lesser trochanter . The words inter-trochanter and peri-trochanter are usually used synonymously to depict fractures within this region.

The neck is ridged particularly on the anterior aspect, indicating the attachment of retinacular fibers of the hip joint capsule, which are reflected proximally from the distal attachment of the capsule.

The hip joint capsule [83-87] is a strong fibrous structure that encloses the femoral head and most of its neck. That portion of the neck that is within the capsule has essentially no cambium layer in its fibrous covering to participate in peripheral callus formation during the healing process. Therefore, healing in the femoral neck area is dependent on **endosteal union** alone. Unless the fracture fragments are impacted, synovial fluid can lyse blood clot formation and thereby destroy another mode of secondary healing by preventing the formation of cells and scaffolding that would allow for vascular invasion of the femoral head.

Many vascular foraminae, directed towards the head, perforate the anterior and posterior surfaces of the neck. The neck is strengthened along its concavity by the **calcar femorale**.

The Greater Trochanter:

The greater trochanter is a large, quadrangular projection, projecting up and back from the convexity of the junction of the neck of the femur with the shaft. The upper border of the greater trochanter lies one hand breadth below the tubercle of the iliac crest and is on level with the center of the femoral head.

The Greater Trochanter has an upper border, an apex and three surfaces – anterior, medial and lateral. The **upper border,** projects into an **apex**. Posteriorly the apex continues down as the intertrochanteric crest to the lesser trochanter. The greater trochanter gives attachment to piriformis , gluteus minimus tendon , obturator internus , gamelli , obturator externus , gluteus medius , gluteus maximus and vastus lateralis.

The Lesser Trochanter:

The lesser trochanter is a conical eminence. It is directed medially and backwards from the shaft at the lowest part of the neck. Its rounded surface medially provides attachment for the psoas major tendon. Iliacus is inserted into the front of this tendon and into the bone below the lesser trochanter. The smooth posterior surface is covered by a bursa deep to the upper horizontal fibers of adductor magnus.

The Intertrochanteric Line:

It is the junction of the anterior surface of the neck with the shaft of the femur . It begins proximally at the anterosuperior angle of the greater trochanter as a tubercle, and runs downwards and medially continuing the line in front of the lesser trochanter.

The intertrochanteric line provides attachment to:

- The capsular ligament of the hip joint.
- The upper band of the Iliofemoral ligament at the upper end.
- The lower band of the Iliofemoral ligament at the lower end.
- Highest fibers of the Vastus lateralis from the upper end.
- Highest fibers of the Vastus medialis from the lower end.

The Intertrochanteric Crest:

It is the junction of the posterior surface of the neck with the shaft. It is a smooth rounded ridge, which commences at the postero-superior angle of the greater trochanter and runs downwards and medially to terminate at the lesser trochanter.

Nearly halfway down the crest is an oval eminence, the ***quadrate tubercle***, providing attachment for the quadratus femoris. Above the tubercle the crest is covered by the gluteus maximus, and below the tubercle it is separated from the gluteus maximus by the quadratus femoris and the upper border of the adductor magnus.

The Skeletal Anatomy:

The proximal femur consists of spongy bone, invested by a thin layer of compact bone. The trochanteric region consists more of spongy bone.

Trabecular System: fig 1

In 1838, **Ward**[2] described the internal trabecular system of the femoral head. The trabeculae are oriented along the lines of stress. There are five normal groups of trabeculae as described by Ward.

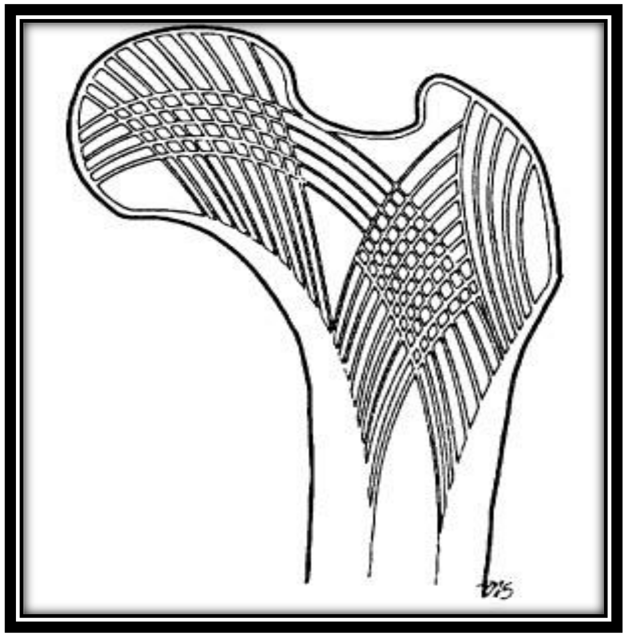
Primary Compressive Trabeculae: These are the strongest trabeculae, extending from the medial cortex at the base of the femoral neck to the subchondral bone of the superomedial part of the head.

Primary Tensile Trabeculae: These extend from the inferior region of the foveal area across the head and superior portion of the femoral neck into the greater trochanter, hence to the lateral cortex.

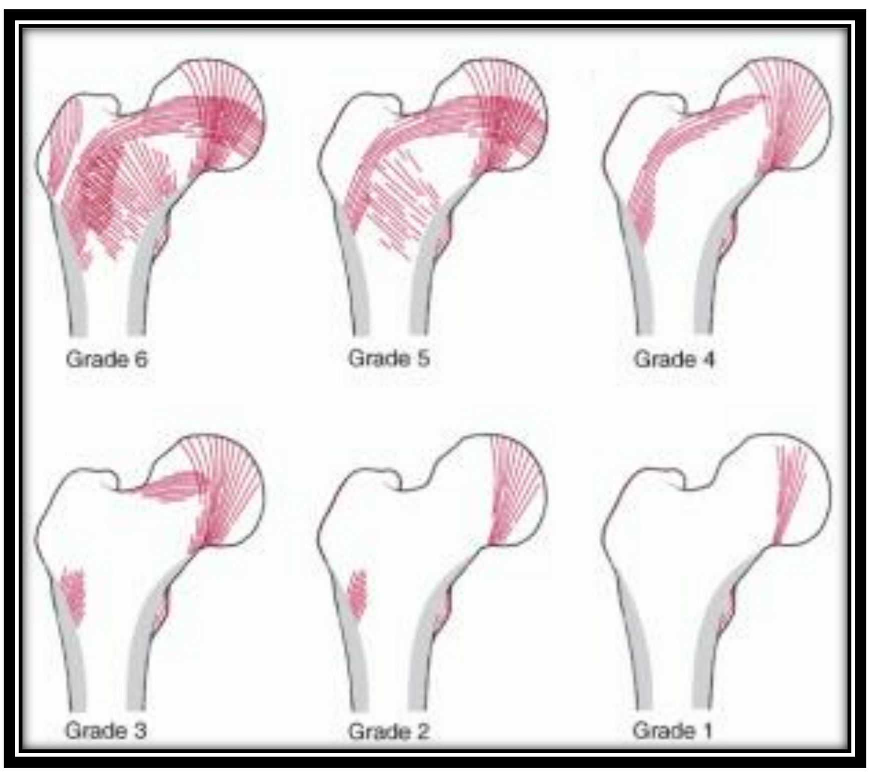
Secondary Compressive Trabeculae: These extend from the medial femoral cortex in the region of the lesser trochanter towards the greater trochanter.

Secondary Tensile Trabeculae: These extend from the lateral femoral cortex, inferior to the primary tensile trabeculae towards the middle of the femoral neck.

Greater Trochanteric Trabeculae: These extend from the superior border of the greater trochanter to its base . The space bounded by the primary compressive and tensile trabeculae and the secondary compressive trabeculae is known as the **Ward's Triangle**.



Trabecular pattern of Proximal femur



Singh's Index

Singh M[82] introduced a method of determining the degree of osteoporosis by evaluation of the trabecular pattern of proximal femur seen on x-rays. The degree of osteoporosis is graded from 1 to 6.

Singh Index:

Grade VI: All the normal trabecular groups are visible, and the upper end of femur seems to be completely occupied by cancellous bone.

Grade V: The structure of the principal tensile and compressive trabeculae is accentuated. Ward's triangle appears prominent.

Grade IV: Principal tensile trabeculae are markedly reduced but can still be traced from the lateral cortex to the upper part of the femoral neck.

Grade III: There is a break in the continuity of the principal tensile trabeculae opposite the greater trochanter. This grade indicates definite osteoporosis.

Grade II: Only the principal compressive trabeculae stand out prominently; the others have been more or less completely resorbed.

Grade I: Even the principal compressive trabeculae are markedly reduced in number and are no longer prominent.

The Vascular Anatomy:

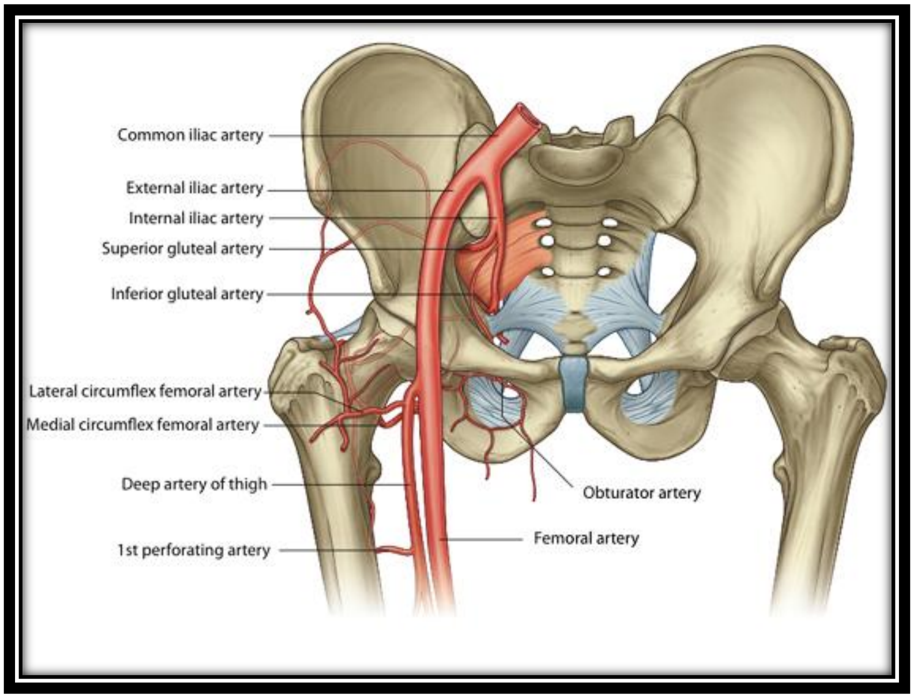
Crock[83] described the arteries of the proximal end of the femur in three groups:

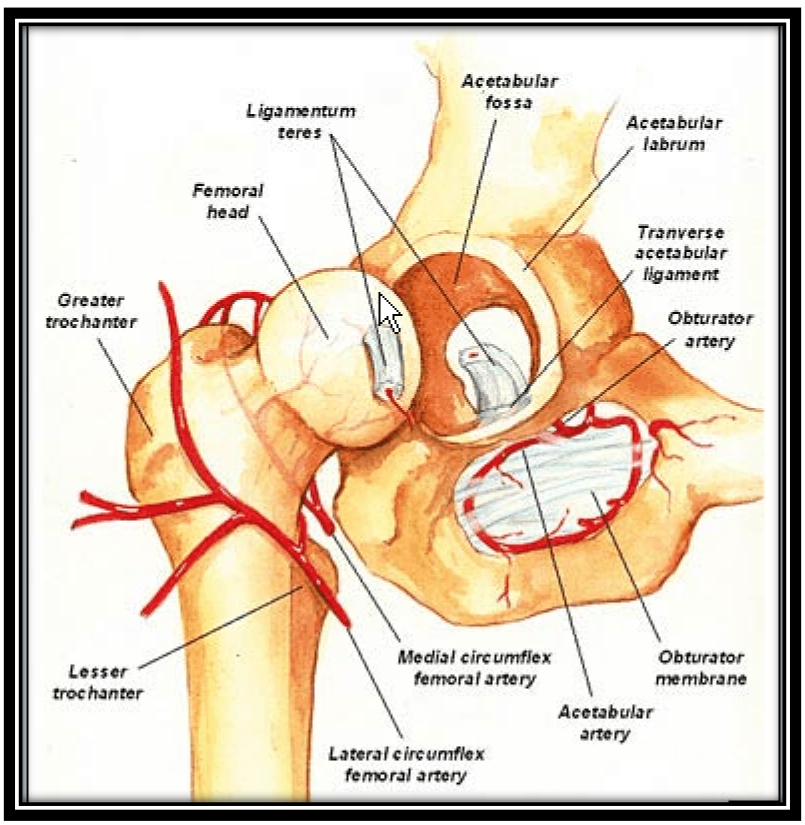
(a) an extracapsular arterial ring located at the base of the femoral neck;

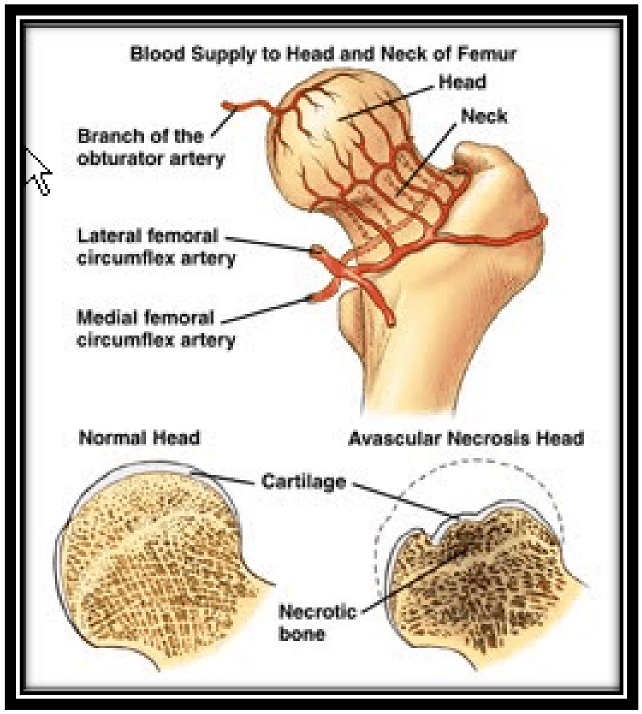
(b) ascending cervical branches of the extracapsular arterial ring on the surface of the femoral neck; and

(c) the arteries of the round ligament.

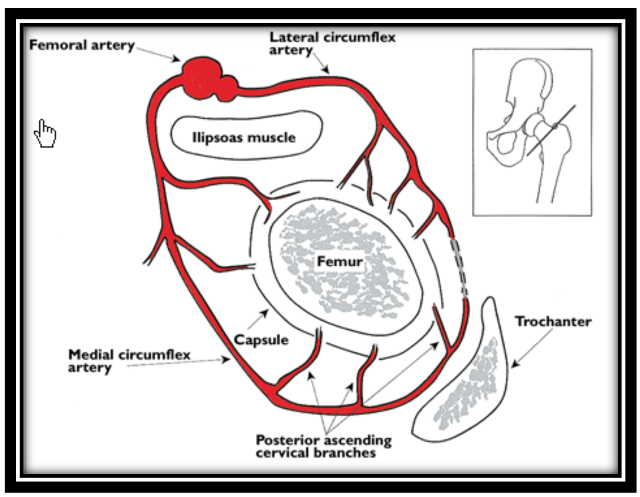
Arterial Supply to head of femur



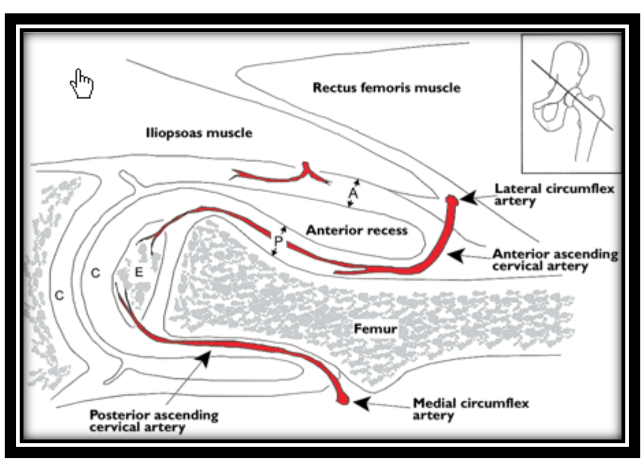




Blood Supply to Head and Neck of Femur
Head
Neck
Branch of the obturator artery
Lateral femoral circumflex artery
Medial femoral circumflex artery
Normal Head
Avascular Necrosis Head
Cartilage
Necrotic bone



Femoral artery
Lateral circumflex artery
Ilipsoas muscle
Femur
Capsule
Trochanter
Medial circumflex artery
Posterior ascending cervical branches



Rectus femoris muscle
Iliopsoas muscle
A
Anterior recess
P
Lateral circumflex artery
Anterior ascending cervical artery
C
C
C
E
Femur
Posterior ascending cervical artery
Medial circumflex artery

The extracapsular arterial ring is formed posteriorly by a large branch of the medial femoral circumflex artery and anteriorly by branches of the lateral femoral circumflex artery .

The ascending cervical branches arise from the extracapsular arterial ring. Anteriorly, they penetrate the capsule of the hip joint at the intertrochanteric line, and, posteriorly, they pass beneath the orbicular fibers of the capsule. The ascending cervical branches pass upward under the synovial reflections and fibrous prolongations of the femoral head from its neck. These arteries are known as **retinacular arteries of Weitbrecht**.The proximity of the retinacular arteries to bone puts them at risk for injury in any fracture of the femoral neck.

As the ascending cervical arteries traverse the superficial surface of the femoral neck, they send many small branches into the metaphysis of the femoral neck. Additional blood supply to the metaphysis arises from the extracapsular arterial ring and may include anastomoses with intramedullary branches of the superior nutrient artery system, branches of the ascending cervical arteries, and the subsynovial intra-articular ring.

In the adult, there is communication through the epiphyseal scar between the metaphyseal and epiphyseal vessels when the femoral neck is intact.This excellent vascular supply to the metaphysis explains the absence of avascular changes in the femoral neck as opposed to the head.

ACETABULUM:

The acetabulum is a concave hemisphere, on the lateral aspect of the hip bone about its center. The acetabulum is formed by all the three elements of the hip bone. Ilium forms the upper 2/5th, pubis forms the anterior 1/5th, and the ischium forms the posterior 2/5th. Its axis is directed laterally, downwards and backwards along the axis of the femoral neck.

The margin of the acetabulum is deficient in the anteroinferior part, forming the **acetabular notch**. The transverse ligament bridges the notch. The floor of the acetabulum is partly articular and partly non-articular. The articular area for the head of the femur is lined with hyaline cartilage and is shaped like a horseshoe called the **lunate surface**. It is widest superiorly. The inner border of the lunate surface forms the margin of the non-articular part of the floor called the **acetabular fossa**.

It contains a pad of fat, the **haversian fat pad**, which is lined by synovial membrane. The fibrocartilaginous **acetabular labrum** is attached to the margin of the acetabulum; it deepens the acetabular cavity.

HIP JOINT[83-87]:

The hip joint is a **multiaxial synovial joint** of the **ball and socket variety**, formed between the acetabulum of the hip bone and the head of femur. Its center lies 1.2cms below the middle third of the inguinal ligament. This joint provides a high degree of both **stability** and **mobility**.

These features arise from:

 The depth of the **acetabulum**, which is increased by the **labrum acetabulare**. The strength of the **ligaments** and the surrounding muscles.

 The long, narrow **neck of the femur** increases the range of movements.

The cup shaped acetabulum is formed by the fusion of all the three components of the hip bone. The articular surface covered with hyaline cartilage, is a C-shaped concavity that is broadest above, where the body weight is transmitted in the erect posture.

The spherical head of the femur is covered with hyaline cartilage. The nonarticulating summit of the head is excavated into a pit [***fovea***] for the attachment of the ligamentum teres

LIGAMENTOUS ANATOMY[83-87]

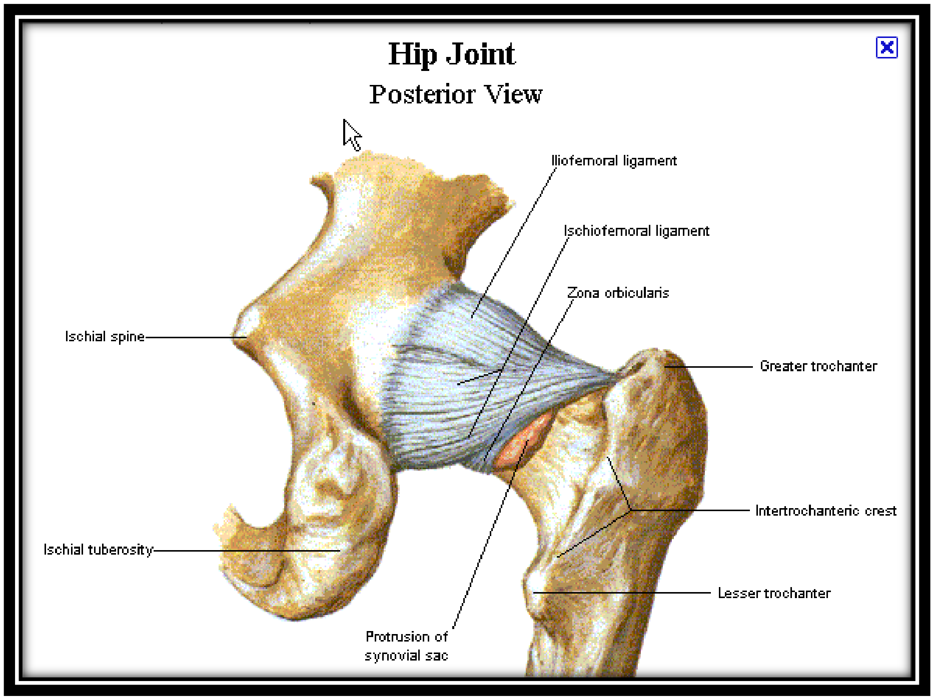
The hip joint is a constrained ball-and-socket joint. The head rotates within the acetabulum and is incompletely covered. The depth of the acetabulum is supplemented by the fibrous labrum, which makes the joint functionally deeper and more stable . The labrum adds more than 10% to the coverage of the femoral head, creating a situation that keeps the head more than 50% covered during motion.It takes more than 400 N of force just to distract the hip joint.The capsule of the hip is strong and extends from the rim of the acetabulum to the intertrochanteric line anteriorly and the femoral neck posteriorly. The longitudinal fibers are supported by spiral capsular thickenings termed ligaments.

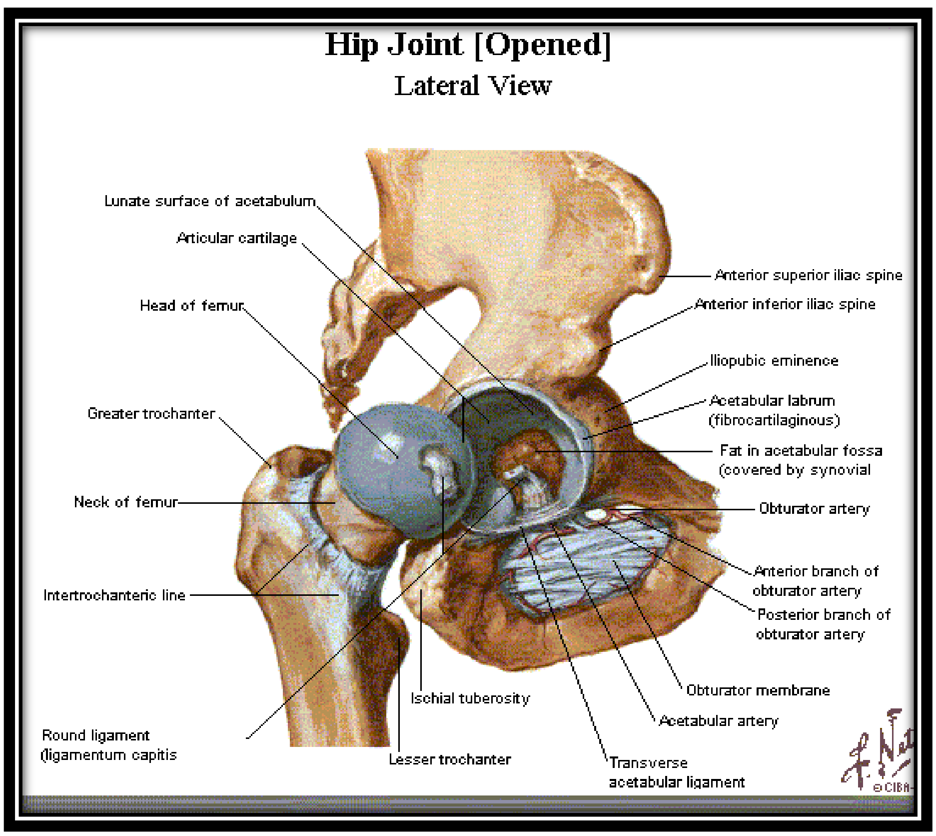
Anteriorly, the iliofemoral or Y ligament originates from the superior aspect of the joint at the ilium and anterior inferior iliac spine. It runs in two bands inserting along the intertrochanteric line superiorly and just superior to the lesser trochanter inferiorly.

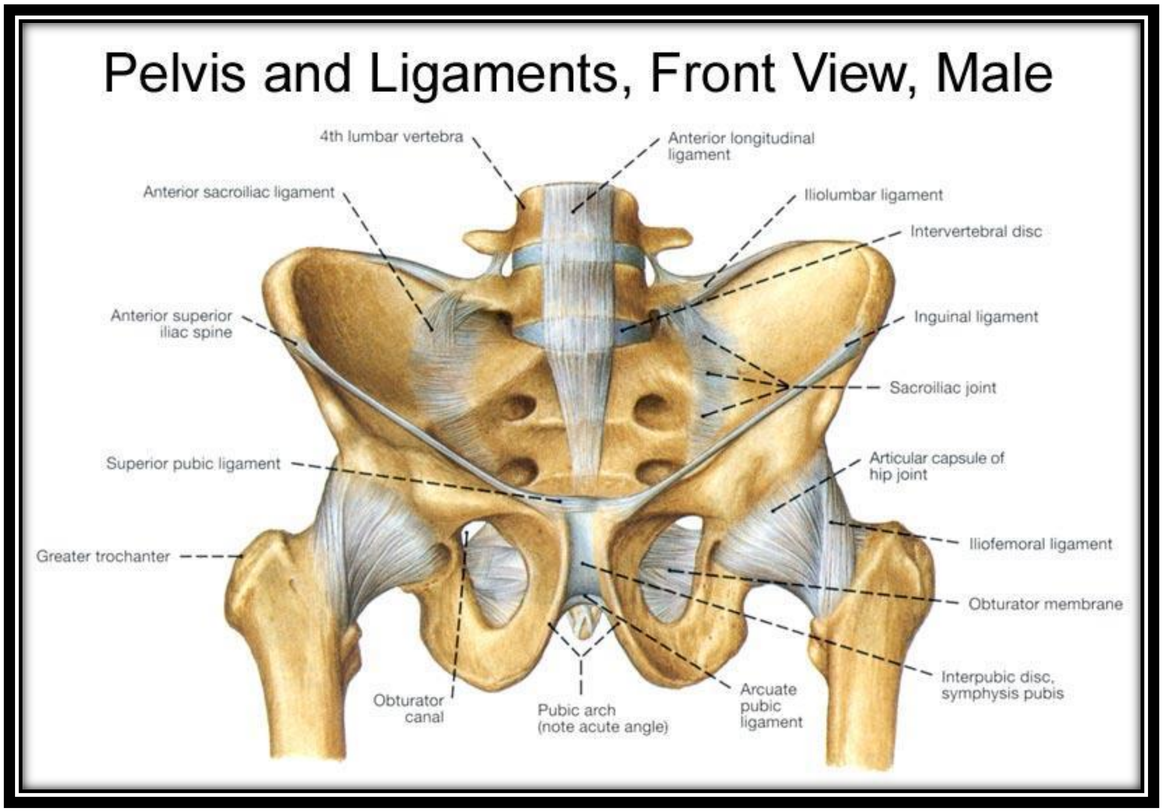
The inferior capsule is further supported by the pubofemoral ligament, which takes its origin from the superolateral superior ramus and inserts on the intertrochanteric line deep to the Y ligament

Posteriorly, the capsule inserts on the femoral neck just inferior to the head medially and extends to the base of the greater trochanter laterally. The ischiofemoral ligament within the capsule posteriorly originates at the junction of the inferior posterior wall with the ischium. It runs obliquely lateral and superior to insert on the femoral neck with the capsule .In addition to these ligaments, the short external rotators lie on the posterior capsule, providing additional support.

Ligaments of Hip joint







Blood Supply:

The hip joint is supplied by an anastamosis formed around the femoral neck:

a) Ascending branches of the medial and lateral circumflex arteries

b) Acetabular branches of the obturator and medial circumflex arteries

c) Branches of the superior and inferior gluteal arteries.

Nerve Supply:

The nerves supplying the hip joint are from:

a) The femoral nerve, via the nerve to rectus femoris.

b) The obturator nerve, directly from its anterior division.

c) The nerve to quadratus femoris.

d) The articular twigs from the sciatic nerve.

e) The accessory obturator nerve.

Relations of the Hip Joint:

Anteriorly: The psoas major tendon separates the capsule from the femoral artery and more medially pectineus intervenes between the capsule and the femoral vein. The femoral nerve lies lateral to the artery in a groove between iliacus and the psoas tendon. Iliacus is partly separated from the capsule by the bursa.

Superiorly: The reflected head of rectus femoris (medially) and gluteus minimus (laterally) are in contact with the capsule.

Inferiorly: Obturator externus spirals below the capsule to the back the femoral neck.

Posteriorly: There is piriformis, and below it the obturator internus tendon and the gamelli separate the sciatic nerve from the capsule.

Laterally: he capsule blends with the iliotibial tract.

Medially: The acetabular fossa forms part of the lateral wall of the pelvis, and in the female ovary lies adjacent, separated only by the obturator internus, the obturator nerve and vessels and the peritoneum.

BIOMECHANICS OF HIP JOINT AND FRACTURES

The loading pattern of upper end of femur during physiological activity is cyclical and can never be reproduced accurately in an experimental set up[88] .

Variations in the local morphology[88,89] : Muscle mass, limb position and other momentary influences, continually alter the resultant stresses on the femoral neck. Static femoral loading is of the cantilever type, with compressive stresses on the medial side and tensile stresses on the lateral side.

During routine one legged stance with femur underneath the body, there are only compressive stresses, very high, along the medial cortex and calcar, and minimal along the superior cortex. In nonphysiological loading, like during abduction there are high compressive forces along the medial cortex with moderate to high tensile forces along the superolateral cortex. Resultant is a high bending stress leading to fracture in varus. After the break the same would continue as shear force and cause displacement.

In a single leg stance the superincumbent body weight W acts at an angle of 15° to the vertical, in the coronal plane. The resultant force can also be resolved into two components.

1) Shear component = Fs = F shear acting at right angles to the neck.
2) The axial component = Fa = F axial acting along the neck.

For any given hip, the forces can be represented mathematically,

F shear= W X Sin (180 - (X- 15))

Where W = Super incumbent body weight

X = Neck shaft angle

F = Axial = W X Cos (180 - (X + 15)).

Frankle's studies have shown that the final resultant force direction on the neck would change the fracture into various morphological groups. The high ratios of F axial to F shear would cause subcapital fracture. Lesser values of F axial to F shear ratio cause high cervical, more vertical fractures. In vivo, the total force quantum would depend upon gravitational force, muscle force, and also force of impact against the ground. Some people consider rotational stresses responsible for femoral neck fractures. However, Backman's experience disproved alleged role of rotation. Due to very low friction between the acetabulum and head, it was impossible for him to cause fracture by rotational stresses.

Biomechanics of Hip joint[88,89]:

The hip joint transmits weight several times that of the body weight particularly during running, functioning as both a highly mobile and very stable joint. In weight bearing the pressure forces are transmitted to the head and neck of the femur at an angle of 165^0 to 170^0, regardless of the position of pelvis. The planes of force coincide with strongly developed trabeculae. The reacting force normally runs perpendicular to the cartilaginous epiphyseal plate.

The hip usually acts as fulcrum of a lever system. The centre of gravity of the supported parts, which is usually medial to the hip joint, exerts a rotational effect upon the pelvis. If pelvic position is to be maintained this force must be counter balanced by the muscles. The force transmitted by the hip joint is the sum of the supported body weight and the tension in the balancing muscles. This force often exceeds the total body weight. In general, the loss of one pound of body weight relieves the hip joint of three pounds of pressure. A long femoral neck is an advantage to hip motion. Medial displacement of the femoral head upon the pelvis may cause a great decrease in joint pressure but medial displacement alone of the shaft upon head and neck does not influence the mechanics of the joint. The position of the centre of gravity of supported parts is easily altered by slight variations in spinal position. Great changes in the hip joint pressure are caused by small coronal spinal movements, but the advantages to man of being able to walk with eyes steady, out-weighs the mechanical disadvantage to which this hip is subjected. A femoral abduction osteotomy improves the mechanics of a hip joint deformation in abduction. A walking stick or a crutch is most helpful in relieving joint pressure and reducing the work done by hip muscles.

Biomechanics of Hip fractures[88,89]

The mechanism of bone failure: A structure will fail if it suffers an overload situation. An overload situation will occur if the system is unable to absorb the energy that is applied to it. In the hip joint area this overload situation can occur as a result of number of independent but often interrelated factors, the following being important.

1. Falling
2. Impairment of energy absorbing mechanics
3. Bone weakness.

1. Falling: The body possesses of considerable amount of potential energy in the standing position. In falling, the potential energy changes to kinetic energy, which, upon impact with the floor, must be absorbed by the structures of the body if a fracture is not to occur. There is sufficient potential energy in the standing body which, if unabsorbed at falling could break any bone in the body. In an average sized woman, the amount of potential energy to be absorbed in a fall would be approximately 4000 kg/cm and the energy absorbing capacity of the upper end of the femur is only 60kg/cm, approximately. Thus, if a bony injury is not to occur, energy absorbing mechanisms must operate.

2. Impairment of energy absorbing mechanisms: The principal dissipation of energy is performed by active muscle contraction. This dissipation requires time and in the event of high speed trauma, there is not sufficient period for the muscular contraction to absorb energy before overloading of the bone has occurred and failure results. In the elderly, the neuromuscular response may be slower, and thus the energy absorption may not be rapid enough to prevent a fracture. In the elderly, the normal protective muscle contraction in the event of slip rather than fall, may lead to an uninhibited muscle contraction around the hip joint and produce a force as great as 600 kg/cm to fracture the neck of the femur without implicating any other factor.

3. Bone weakness: In osteoporosis or osteomalacia, bone weakens to about 1/4th of normal healthy young bone and has a lower energy absorbing capacity leading to failure.Basal and intertrochantric fractures are not satisfactorily reproduced experimentally. It was assumed that a direct blow over the greater trochanter causes the fractures of trochanteric region. But this may not be so, as, usually in all the patients, the skin over the greater trochanter is normal and in many the trochanter itself is not fractured at the site of impact which would have other wise occurred if a direct blow was given to the trochanter. Moreover, usually there is comminution on the medial side of the trochanter and not the lateral side which a direct blow may not cause so easily.

Thus considering that falling, impairment of energy absorbing mechanisms and bone weakness, all may contribute more so for femoral neck fractures, they also do so for fractures of the trochanter. Even direct blows over the greater trochanter causing these fractures being unlikely, it is mostly due to failure of the bone to withstand sudden bending or twisting forces acting on it when the patient is about to fall from standing position, impairment of energy absorbing mechanisms particularly in the elderly and bone weakness, again usually in the elderly and more so in females (as the incidence the world over indicates) adding to the causes of the fracture of the trochanter.

CLINICAL FEATURES

A history of trivial trauma, usually a slip in the bathroom or while walking, inability to stand up after the fall and pain around the hip joint in an elderly is the usual presentation. On examination, the attitude of the affected limb will be in the classical external rotation with shortening and the lateral border of the foot touches the bed completely unlike that of fractures of the neck of the femur which are intracapsular and hence held short of full external rotation of the limb. There is also slight flexion at hip and knee. There may be swelling around the hip and proximal end of the thigh depending upon the severity of the trauma. Acute tenderness may be elicited over the greater trochanter. Patient is unable to lift the limb. There is supratrochanteric shortening given rise to true shortening of the limb. Abnormal movements and crepitus at the fracture site, though not routinely seen for, as there is acute pain, may be elicited. Subcutaneous hemorrhages may become evident with the passage of time. Roentgenograms are diagnostic; both anteroposterior and lateral view should be taken. It shows the site and type of fractures used in a variety of classifications[90,91]. MRI or Bone scan are useful in diagnosis of occult fractures[91].

CLASSIFICATION

These classifications are of benefit in planning internal fixation and also have some prognostic importance.

1. Boyd and Griffin's classification[6] :

Since 1949, it is the most widely used classification for planning treatment and estimating prognosis. They classified fractures extending from the extracapsular part of the neck to a point 5cms, distal to the lesser trochanter, into four types:

Type-I: Fractures extending along the intertrochanteric line from the greater to the lesser trochanter. This fracture is easily reducible and easy to maintain. Results are usually good.

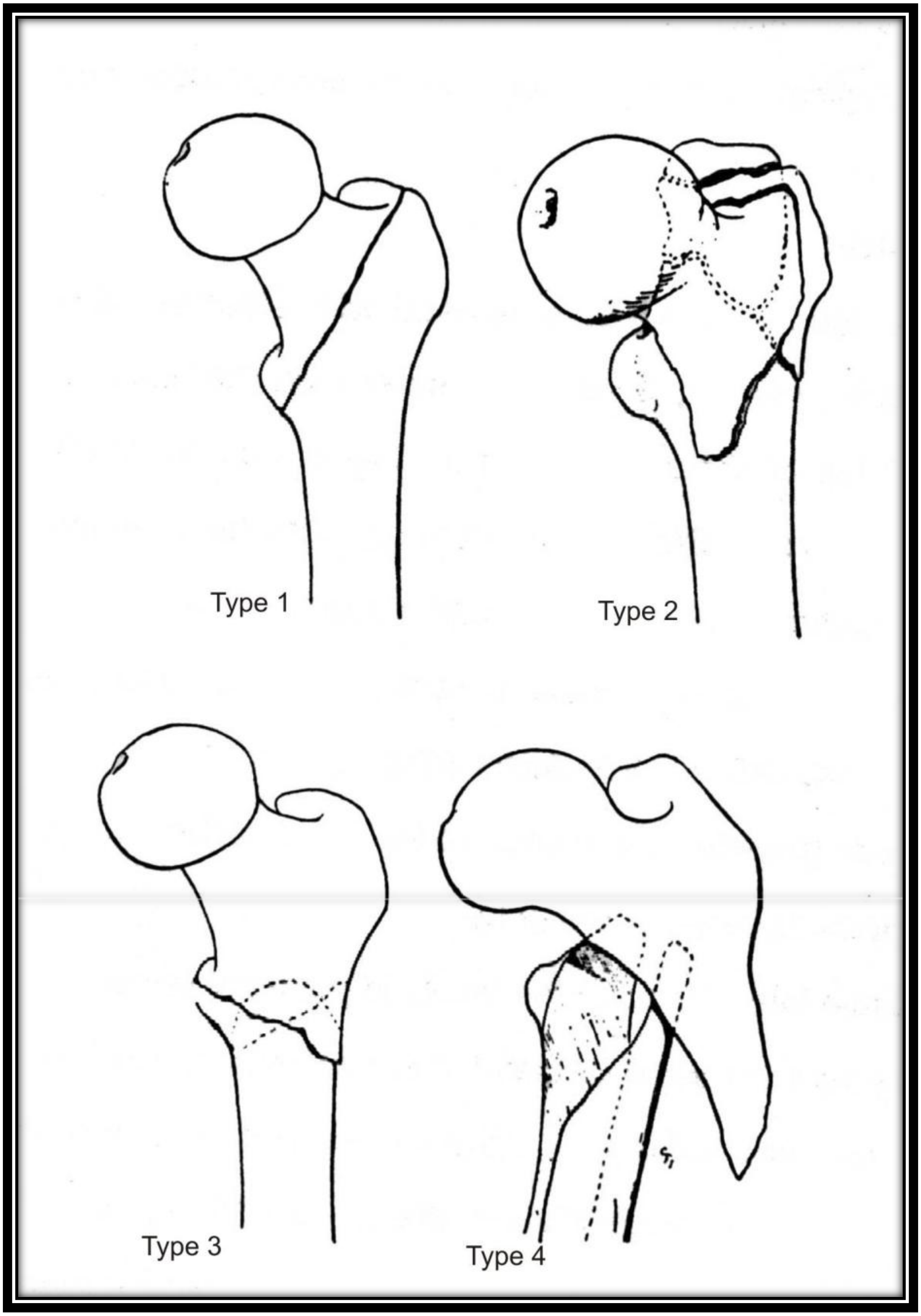
Type-II: Comminuted intertrochanteric fractures, the main fracture line is along the intertrochanteric line with multiple fractures in the cortex along with a intertrochanteric fracture line in anteroposterior view, sometimes there will be an additional fracture in coronal plane also, seen only in lateral x-ray. This fracture is difficult to reduce because of slight to extreme comminution.

Type-III: Basically subtrochanteric fractures, with atleast one fracture line passing across the proximal end of the shaft just distal to or at the lesser trochanter with varying degrees of comminution. These fractures are difficult to reduce and result in more complications both at operation and during convalescence.

Type-IV: Biplane fractures of the trochanteric region and proximal shaft. The fracture of the shaft is spiral, oblique or butterfly shaped, so, it should be reduced and internally fixed in two planes.

Type-III and IV comprise 1/3rd of trochanteric fractures which are most difficult to manage. Subtrochanteric fractures include in type-III and IV of this classification.

Boyd and Griffin Classification



2. E. Merwyn Evan's classification [5,10]:

E. Merwyn Evan of Birmingham, England has classified trochanteric fractures in 1949, into:

1. Stable fractures.
2. Unstable fractures.

Type-I: Fracture line runs upwards and outwards from the lesser trochanter and there are four subtypes.

a) Inner cortical buttress has not been disturbed, there is no displacement, and fracture unites in perfect position.

b) Simple overlap of the inner cortical buttress can be reduced by manipulation and the fracture thus becomes stable.

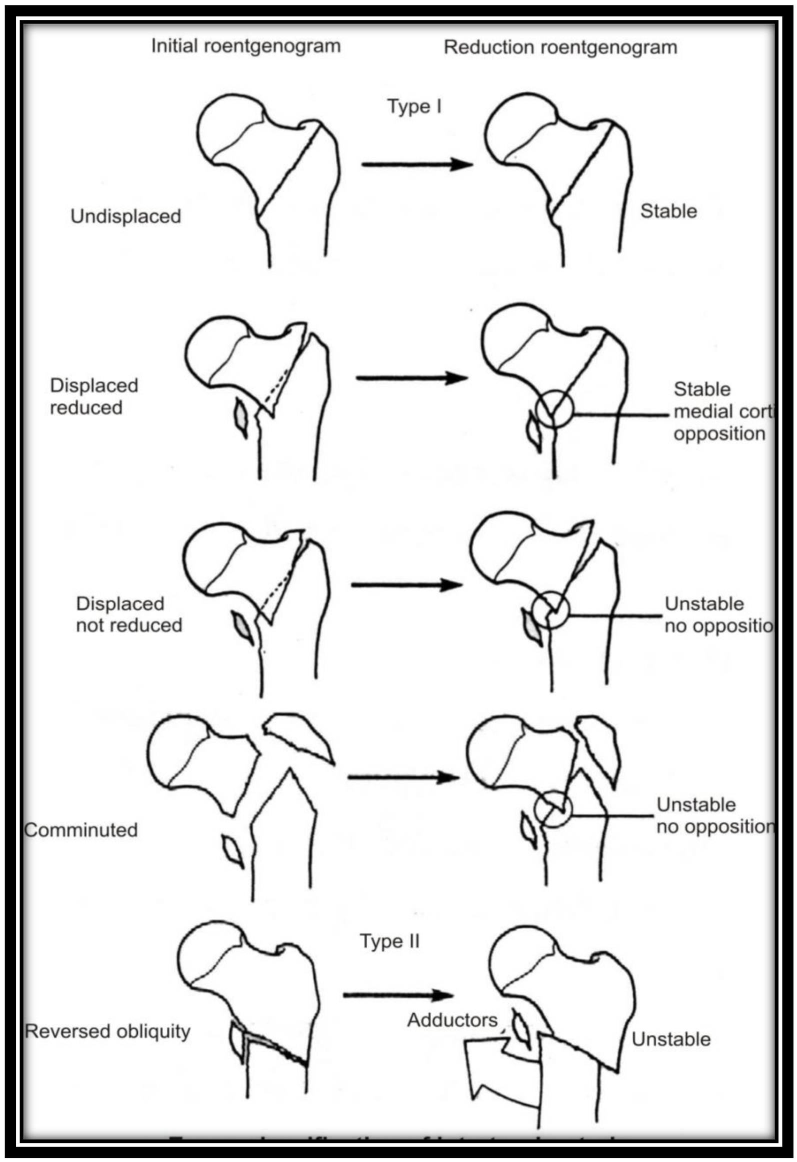
c) and d) There is unreduced overlap or distinction of this cortical buttress and coxa vara deformity is to be expected.

Type-II: Fracture line is reverse of type-I, corresponding roughly with the line of Mc-Murray's osteotomy. There is a marked tendency to medial displacement of the femoral shaft because of pull of adductors but does not affect the ultimate function. The two subtypes are:

a) In which stability could be restored by anatomic or near anatomic reduction.

b) In which anatomic reduction would not create stability.No fracture is really stable unless it is internally or externally fixed. In unstable trochanteric fractures there is no internal stability because the two solid pieces of bones are not equally opposed.

This classification is based on the level of fracture: basal, peritrochanteric, transtrochanteric and intertrochanteric. It is helpful in prognosis and deciding the mobility of the patient, but is not of much practical significance.



Evan's classification

3) Tronzo's classification[92].

Tronzo, in 1973, has classified intertrochanteric fractures based on mode of reduction potential into five types. This classification is also widely used.

Type-I: Incomplete trochanteric fractures with only greater trochanter fractured. These are reduced with traction, and anatomic reduction is achieved. The iliopsoas tendon is still attached and may interfere with reduction but presents little difficulty in management. If the inferior spike is sharp and long, it can get caught under the tendon of illiopsoas and makes the reduction difficult. Then, for reduction, either the tendon should be cut or the lesser trochanter should be fractured.

Type-II:Uncommunited bitrochanteric fractures with or without displacement, with an intact posterior wall and a relatively small lesser trochanteric fragment. These fractures can be well reduced with traction because there is no comminution and only a small lesser trochanteric fracture exists. An anatomic reduction can usually be achieved.

Type-III: Comminuted fractures in which the posterior wall is exploded with the beak of inferior neck already displaced into the medullary cavity of the shaft fragment. The lesser trochanteric fragment is large. These are unstable fractures. This fracture is usually reduced, erroneously, by approximating the fragments anatomically,leading to a high rate of complications. The characteristics of this type are:

- The posteriorly placed large lesser trochanteric fragment is displaced medially.
- The major portion of the fragmented greater trochanter is displaced posteriorly and only a shell of lateral cortex is left behind.

- The neck portion is in varus position and its inferior portion is tucked into the shaft fragment i.e. it is medialised, and
- Entire posterior wall is comminuted.

A variant of this type has the greater trochanter fractured off and separated. The posterior wall is comminuted with telescoping of neck spike into the shaft fragment.

Type-IV: Comminuted trochanteric fractures with disengagement of two main fragments. Again these are unstable with the posterior wall exploded, but the spike of neck fragment is displaced outside of or medial to the shaft. The difference between type-III and IV is that here the posterior wall is fractured away with disproportionate amount of comminution and the neck fragment has a long beak. Here, the upper fragment swings out of the shaft portion. So, application of more traction will cause it to displace further. Thus, it can be stabilised by either shifting the shaft medially or osteotomising the greater trochanter and pushing under the centre of the neck.

Type-V: Trochanteric fractures with reverse obliquity to the fracture line. These are uncommon. The shaft fragment is displaced medially and the greater trochanter may or may not be attached to the neck fragment. This fracture is most unstable due to the odd obliquity. The posterior wall is usually not so comminuted. The lesser trochanter is intact or slightly fragmented without displacement.

4. R.C, Murray and J.F.M. Frew's classification[93]:

In 1949, R.C. Murray and J.F.M. Frew, Scotland, classified intertrochanteric fractures into five types.

1. Basal.
2. Intertrochanteric.
3. Comminuted Intertrochanteric.
4. Oblique intertrochanteric.
5. Transverse subtrochanteric.

5. Jenson's classification[94]: Jenson has modified Evan's Classification in 1981 as follows:

I. Stable: a) Two fragmentary undisplaced fractures.

b) Two fragmentary displaced fractures.

II. Unstable: a) Three fragmentary fractures without posterolateral support.

b) Three fragmentary without medial support.

c) Four fragmentary fractures.

6. J.C. Scott's classification[95]:

Three groups have been described:

I. Oblique basal fractures, involving one or both trochanters with little or no displacement.

II. These are oblique basal fractures with varying degrees of comminution and displacement.

III. These are fractures with reverse obliquity, involving the lesser trochanter and sometimes separation of the greater trochanter.

In group- I, results are good with both conservative and operative methods. In group - II results are not as good as most of the problems are met with here, than in group - III.

7. R.M.V. Hafner's classification[9]:

Hafner classified fractures of the trochanter into three types:

I. Displacement of the fractures without cortical overlap. The lesser trochanter is usually avulsed.

II. Fractures with displacement and minor comminution, usually with cortical overlap.

III. Grossly comminuted fractures which cannot be internally fixed by any method.

8. W.K.Massie's classification[16]:

Three groups are described

I. Stable and Undisplaced - These are almost transverse type fractures in the intertrochanteric area. The fracture line is almost perpendicular to the weight bearing stress line (the medial trabeculations). Though vulnerable to rotational stresses these types may tolerate full weight bearing without displacement. Hence to allow ambulation, internal fixation must be done.

II. Stable and Displaced: The fracture line is similar to type- I, but the fragments are completely separated. Results are usually good in this group which can be treated by both methods.

III. Unstable and Displaced - There are comminuted fractures with more than one fracture line. These tend to displace and require strong traction or internal fixation, but still results are discouraging.

9. K.P.Pathak's classification[48]:

The behaviour of fragments has been related to the altered force vectors. It has direct bearing on approach to fracture treatment.

Based on radiological findings, the fractures were classified into 5 types:

I. The free fragment.

II. Thefixed fragment.

III. The unstable fragment.

IV. The subtrochanteric fracture.

V. Avulsed fragment.

10. May and Chacha's classification[96]**:**

J.M.B. May and P.B. Chacha have classified fracture of the trochanter into two types.

I. Proximal fragment of the femur consists of head and neck alone.

II. Head, neck and major part of the greater trochanter constitute proximal fragment.

This classification is based upon the greater trochanter being attached to the proximal fragment or not, thus helping in the reduction of the fracture for Internal fixation. May and Chacha, in their study of 100 cases, internally fixed with angled nail plate, conclude that, in type-I fractures, for reduction it requires rotation of the distal fragment to neutral rotation and in type-II fractures, some degree of lateral rotation is required. It is a simple and practical classification, enabling the correct method of reduction to be chosen. It is useful only in cases which are to be internally fixed.

11. AO Classification of intertrochanteric fractures :

These can be divided into the (1) easily stabilized fractures and into the (2) unstable problem fractures. Stable fractures (about 70% of all intertrochanteric fractures) have an intact medial buttress. In unstable intertrochanteric fractures, there is in addition to the medial fragment a large posterior fragment. These are so called 4 part fractures, in which at times may be even more comminuted than described.

I Stable Intertrochanteric fractures:

a) Fracture runs from greater trochanter obliquely downwards and medially to exit just above the lesser trochanter. A good portion of the calcar is attached to the proximal fragment anteromedially. Quite commonly there is an avulsion fracture of lesser trochanter. As a rule the distal fragment is in external rotation. Rarely the inferomedial spike of the proximal fragment is impacted into the metaphysis of the distal fragment.

b) An avulsion fracture of lesser trochanter - this type of avulsion does not result in instability because it does not weaken the medial buttress.

II. Unstable intertrochanteric fractures:

a) The medial fragment varies in size and reaches distally to a varying degree. As a rule it contains the lesser trochanter. If the lateral wall remains intact then the distal fragment migrates proximally because of muscle pull. Commonly there is in addition quite a large posterior fragment. Occasionally the proximal fragment contains a long medial spike made up of calcar and lesser trochanter. This makes it into a long oblique or spiral fracture.

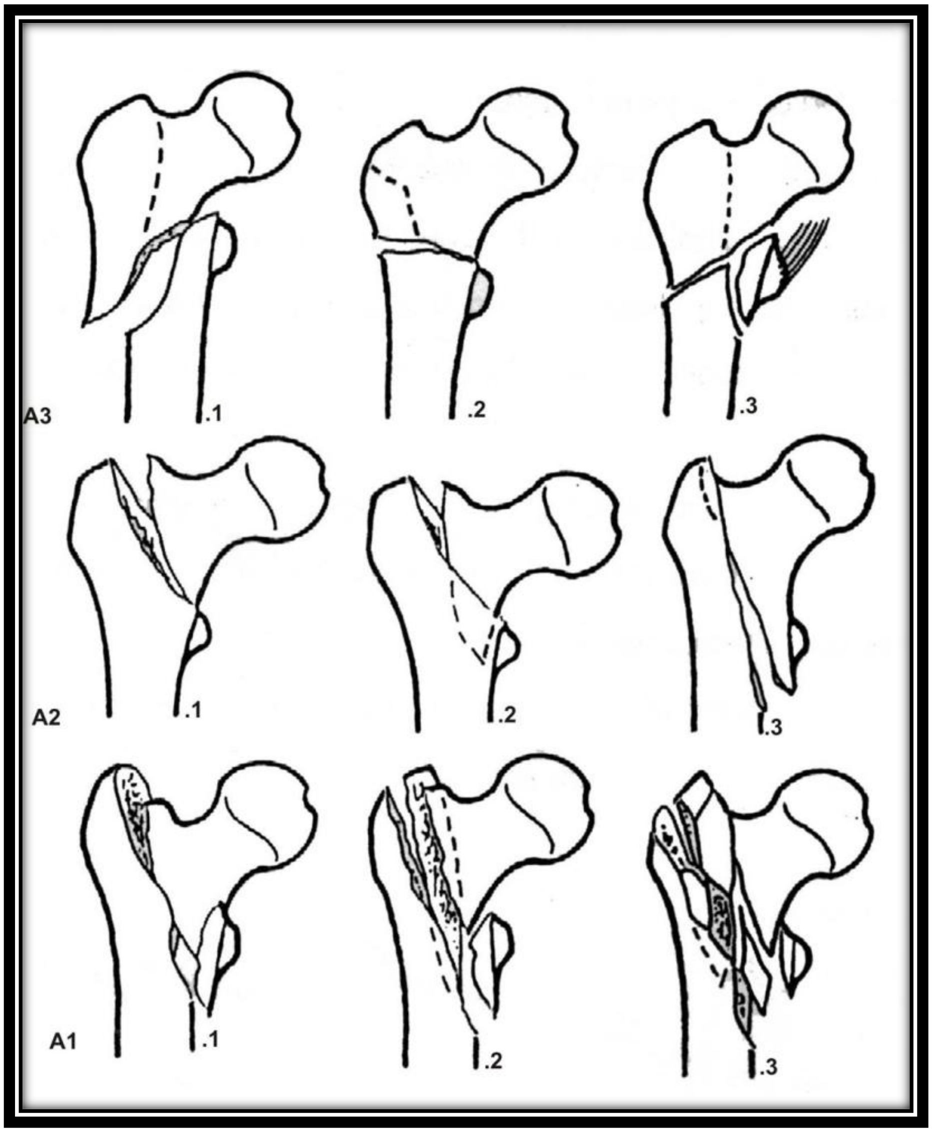
b) If the greater trochanter is fractured, then the distal fragment is not pulled upwards.

c) A badly comminuted intertrochanteric fracture has in addition to the fracture of lesser and greater trochanter further comminution posteriorly and medially.

d) The intertrochanteric fracture line is almost horizontal. Often one finds this fracture associated laterally with a further anterior or posterior fragment, and occasionally both.

e) Occasionally the fracture has reverse course beginning laterally and distally and running upwards and medially. Medially it exits above the lesser trochanter. Commonly it is associated with a fracture of the greater trochanter.

The problem with fractures (d) and (e) (about 5% of intertrochanteric fractures) is their reduction and stabilization which, because of muscle pull and fracture pattern, are particularly difficult.



A.O classification

MANAGEMENT OF TROCHANTERIC FRACTURES

Watson-Jones[97] states that "fractures through the intertrochanteric line of the upper end of the femur, and peritrochanteric fractures, unite readily no matter what treatment is used because the broad fractured surfaces are richly supplied with blood and there is seldom wide displacement. But at the same time, unless suitable precautions are taken, the fracture may unite in a position of coxa vara with shortening of the limb and limitation of hip movements. Moreover, this fracture occurs in the elderly patients the risks from prolonged immobility and recumbenc y arise. Thus treatment should be so planned as to encourage union without deformity, and at the same time allow early mobilization."

Hence the trochanteric fractures can be managed in two ways –

1. Conservative or Non-operative method.
2. Operative method.

CONSERVATIVE MANAGEMENT:

"Two strong men will suffice by making extensions and counterextension" as, stated by **Hippocrates** (350 BC).

The indication for non-operative treatment of intertrochanteric fractures is unclear.

The indications for conservative management according to **Friedenberg et.al.** are –

a.The terminal patient.

b.A patient with an old fracture.

c.A non-ambulatory patient who is comfortable with the fracture.

Rowe[98] recommended conservative treatment if the fracture could not be stabilized adequately by open reduction.

Conservative Treatment Regimes include:

- Simple support with pillows.
- Splinting to the opposite limb.
- Buck's traction.
- Skeletal traction through the lower femur or upper tibia.
- Well-leg traction.
- Russell's balanced traction.
- Plaster spica immobilization.

Buck's Traction:

This is the skin traction applied to the lower extremity. The traction force is applied over a large area of skin. This spreads the load, and is more comfortable and efficient. In treatment of fractures, the traction must be applied only to the limb distal to the fracture site.

Buck, in 1861 introduced the application of adhesive plaster to the skin of the leg for the purpose of achieving isotonic traction in the treatment of fracture of femur into surgical practice shortly before the Civil war of America. According to **John D.M. Stewart**, the maximum traction weight that can be applied with skin traction is 15lb (6.7kg).

When the skin traction is applied in senile patients with thin, atrophic, inelastic skin, the result is often most distressing. The control of lateral rotation of the limb in skin traction is also difficult. Hence in the treatment of intertrochanteric fractures,which frequently occur in the aged patients, a skeletal traction is preferred.

Skeletal Tractio[99]:

In 1907, **Fritz Steinmann,** of Bern described a method of applying skeletal traction through the femur by means of two pins driven into the femoral condyles. Shortly, after the initial description of the two pin technique, in 1916 he introduced the Steinmann pins, which are rigid stainless steel pins of varying lengths, 3-5 mm in diameter and perfected the 'through and through' pin technique.

In 1909, **Martin Kirschner**, of Greifswald introduced small diameter wires for application of skeletal traction. These wires are insufficiently rigid until pulled

taut in a special stirrup introduced by him in 1927. Rotation of the stirrup is imparted to the wire.

In 1929, **Bohler** of Austria introduced a special stirrup that is attached to the Steinmann pin. The Bohler stirrup allows the direction of the traction to be varied without turning the pin in the bone.

In 1972, **Denham** introduced a pin identical to the Steinmann pin, except for a short raised threaded length situated towards the end held in the introducer. This threaded portion engages the bony cortex and reduces the risk of the pin sliding. This type of pin is particularly suitable for use in cancellous bone or in osteoporotic bone in the elderly.

For management of an intertrochanteric fracture by skeletal traction, a metal pin or wire is driven through the lower end of femur or the upper end of tibia. By this means the traction force is applied directly to the skeleton. It may be employed as a means of reducing or maintaining the reduction of a fracture, by overcoming the muscle spasm. A serious complication of skeletal traction is osteomyelitis.

After applying the skeletal traction the limb is applied the limb may be rested

on a Bohler-Braun frame. It acts as a cradle for the limb. The patient's body and the proximal fragment move relative to the distal fragment, which is immobile. This may predispose to the occurrence of a deformity at the fracture site.

Well-Leg Traction[99]:

Roger Anderson in 1932 described a traction method wherein; skeletal traction was applied to the injured leg, while the 'well' leg was employed for counter-traction.

It is valuable in correcting an abduction or adduction deformity at the hip. The principle of this method is that, if there is an abduction deformity at the hip, the affected limb appears to be longer. When traction is applied to the 'well' limb and the affected limb is simultaneously pushed up (counter-traction), the abduction deformity is reduced. Reversing the arrangement will reduce an adduction deformity.

This technique allows the patient to be moved from bed to chair and eliminates the cumbersome apparatus required by skeletal traction. But, using the normal limb for counter-traction can lead to skin problems and ulceration in the elderly.

Russell's Balanced Traction[99]:

Hamilton Russell of Melbourne introduced it in 1924.

It is an extremely simple and uncomplicated form of balanced traction. The underlying principle is the application of two forces at the knee, which tend to establish a resultant of their pull more or less in the axis of the femur.

Non-Operative Treatment of intertrochanteric fractures may follow one of the two fundamentally different approaches –

1) Early mobilization:

Shaftan[100] suggested this approach.

In this approach, the patients are mobilized immediately, just as if they had been operated. They are given analgesics and placed in a chair daily. If the physical condition improves, they are begun on non-weight bearing crutch walking. Shaftan and colleagues reported that fracture pain after a few days is rarely more severe than wound pain after open reduction. They also stressed that non-operative treatment by their technique did not prevent the fracture from healing.

However, in this approach, a deformity of varus, external rotation, and shortening is accepted.

2) Traction:

Aufranc[99] recommended skeletal traction in balanced suspension for 10 to 12 weeks. The leg is kept in slight abduction, which allows easier reduction and maintenance of the normal head-neck angle. The patient is then mobilized and allowed partial weight bearing until fracture healing is solid.

Aufranc and associates noted that partial weight bearing might be required for 6 months before good fracture stability is obtained and that varus displacement could occur as late as 3 to 4 months after fracture.

If conservative treatment is elected, especially those methods requiring prolonged traction, great care must be taken to avoid the secondary complications of pneumonia, urinary tract infection, pressure sores over the sacrum and heels, equinus contractures of the foot and thromboembolic disease. Finally, the cost of this method of treatment should be considered.

OPERATIVE MANAGEMENT:

The treatment of choice of intertrochanteric fractures should be operative, employing some form of internal fixation.

The goals of operative treatment is –

- Strong and stable fixation of the fracture fragments.
- Early mobilization of the patient.
- Restoration of the patient to his or her pre-operative status at the earliest.

Kaufer, Matthews and Sonstegard[101] have listed the variables that determine the strength of the fracture fragment-implant assembly.

The variables are –

- Bone Quality.
- Fracture Geometry.
- Reduction.
- Implant Design.
- Implant Placement.

The bone quality and fracture geometry, are beyond the control of the surgeon. Therefore the surgeon has within his control the quality of reduction and the choice and placement of implant to achieve a stably reduced and internally fixed intertrochanteric fracture.

Surgical Techniques:

In the 19th century, patients with intertrochanteric fractures were simply placed in bed for prolonged periods of time until healing or more commonly until death.

Plate and Screw Devices:

The first successful implants in the treatment of intertrochanteric fractures were **Fixed Angle Nail Plate devices** (e.g., Jewett nail, Holt nail) consisting of a triflanged nail fixed to a plate at an angle of 130 to 150 degrees.

These devices provided stabilization of the femoral head and neck fragment to the femoral shaft, but they did not effect fracture impaction. The collapse of the fracture fragments led to inadvertent penetration of the tip of the nail into the hip joint through the superior portion of the femoral head. Other technical problems with these devices were difficulty in obtaining a satisfactory fit of the side plate to the shaft of the femur or failure to obtain adequate purchase within the cancellous bone of the femoral head. Unstable fractures still had a tendency to heal in varus with broken or bent nails, broken side plates, and screw fractures or pulling out of the screw from the femoral shaft.

These experiences led to the modification of the fracture site rather than the implants. Later it was documented that the osteotomies were not without problems, since rotation was difficult to estimate, shortening of the leg was common and the valgus position of the proximal fragment with medial displacement of the distal fragment often led to genu valgum.

The stage was thus set for the introduction of an entirely new device, that would allow controlled fracture impaction. The **Sliding Nail Plate devices** were devised with the following solution –

- ***Screw threads on the hip nail*** – to improve purchase in the porotic bone of the femoral head.
- ***Blunt tip on the screw*** – to minimize the chance of head penetration.
- ***Sliding feature*** – to allow collapse and impaction of the fracture while maintaining the neck-shaft angle and controlling rotation.
- ***Tongue in groove barrel collar*** – to control rotation and provide additional strength at the nail plate junction.

One early modification to the sliding hip screw maximized fracture impaction by allowing the proximal lag screw to telescope within the plate barrel and the plate to slide axially along the femoral shaft. To accomplish this bi-directional sliding, the plate was modified by replacing the round screw holes with slotted screw holes – **Egger's Plate.**

More recently, a two-component plate device, the **Medoff Plate** was introduced in which a central vertical channel constrains an internal sliding component.

Kulkarni G.S.[46] has modified the Richard's hip screw called the **Miraj Screw,** to make the procedure simpler and biomechanically sounder. The following modifications have been made in the standard device –

a. The lag screw is longer, while its proximal end has coarse threads as in the standard device; its distal end is also threaded. The compression is applied by a nut, which passes over the distal end instead of the nut entering the distal end. This makes the procedure simpler.

b. The distal shaft thread junction is made tapering to prevent the distal end of the barrel getting stuck.

c. The key and slot mechanism in the screw and barrel of the standard device, which prevent rotational movement of the fragment, has been eliminated.

In unstable trochanteric fractures in patients with severely osteoporotic bone some authors have suggested the use of **Polymethylmethacrylate (PMMA)** to augment the fixation and improve the stability.

The **Alta Expandable Dome Plunger** is a modified sliding hip screw designed to improve fixation of the proximal fragment by facilitating cement intrusion into the femoral head. Cement is kept away from the plate barrel so that the device's sliding potential is maintained. The method of insertion is similar to that of the sliding hip screw, except that the dome unit is manually pushed into the pre-reamed femoral neck and head; proximal fixation is achieved as the plunger is then advanced, expanding the dome in the cancellous bone of the femoral head and extruding the contained cement.

Intramedullary Devices:

Intramedullary fixation of the intertrochanteric fractures from the medial side began with **Lezius** in 1950, who inserted the nail at the junction of the proximal and middle thirds of the femur.

In 1964 **Kuntscher**[21] moved the point of insertion to the medial femoral condyle, where the cortex was thinner and minimal soft tissue requiring less exposure. The results were impressive, but the large diameter of the nail, the use on guide wire and inflexibility of the nail led to problems with its use.

Ender in 1970 advocated the use of multiple, flexible nail known as **Ender's Nail** inserted just above the adductor tubercle to hold these fractures in reduction. These devices are inserted under image intensification in a retrograde manner. The advantages of this technique are –

- The incision remote from the fracture site reducing bleeding and infection.
- Minimal soft tissue dissection simplifying the surgery and thereby shortening the operative and anesthetic time.
- Intramedullary placement allowing for fracture impaction with weight bearing, while maintaining the normal neck shaft angle.
- As they are placed close to the mechanical axis of the femur, they are subjected to smaller bending moments than a plate and screw device.

They have been associated with a significant incidence of complications such as –

- Rotational deformity.
- Supracondylar femur fracture.
- Proximal migration of the nails through the femoral head.
- Back out of the nail with resultant knee pain and knee stiffness.

Other intramedullary devices such as the **Gamma Nail, Intramedullary Hip**

Screw, Proximal Femoral Nail and Russell Taylor Reconstruction Nail have been used for the fixation of intertrochanteric fractures. Second generation of interlocking nails called the **Trochanteric Gamma Nail** can be used without extension into the subtrochanteric area.

The **Gamma Nail** being an intramedullary device lies medial than the standard sliding compression hip screw and plate, hence less force is dissipated on the implant with weight bearing. The device transmits the patient's body weight closer to the Calcar, resulting in greater mechanical strength. The duration of surgery and blood loss is minimal.

The **Intramedullary Hip Screw** couples a sliding hip screw with a locked intramedullary nail. This design offers several potential advantages –

- The intramedullary fixation, because of its location, theoretically provides more efficient load transfer than does a sliding hip screw.
- The shorter lever arm of the intramedullary device can be expected to decrease tensile strain on the implant, thereby decreasing the risk of implant failure.
- As it incorporates a sliding hip screw, the advantage of controlled fracture impaction is maintained.
- It theoretically requires shorter operative time and less soft tissue dissection.

These devices are associated with the risk of late femoral fractures at the tip of the device or the distal locking screws.

The **Russell Taylor Reconstruction nail**[102] has been recommended for use in unstable intertrochanteric fractures or in fractures with reverse obliquity or subtrochanteric extension.

Prosthetic Replacement:

Prosthetic replacement for intertrochanteric fractures has not gained widespread support.

The indications for primary prosthetic replacement remain ill defined. Most authors cite elderly, debilitated patients with a comminuted, unstable intertrochanteric fracture in severely osteoporotic bone, as the primary indication for prosthetic replacement.

The indications for primary prosthetic replacement as per **Kenneth J. Koval**[91] are –

1.Symptomatic ipsilateral degenerative hip disease, where a total hip replacement is ideal.

2. Attempted open reduction and internal fixation that cannot be performed because of extensive comminution and poor bone quality, where the procedure should be aborted and a hemiarthroplasty should be carried out.

Primary prosthetic replacement is a much more extensive and invasive procedure then internal fixation, with the potential for increased morbidity and complications including prosthetic dislocation. Furthermore, the cost of the prosthesis is high.

Hence, prosthetic replacement is a useful technique for the occasional patient with an intertrochanteric non-union and failure of fixation.

External Fixators:[103]

The application of external Fixators in the management of intertrochanteric fractures is simple, safe and economical. It is the method of choice in high-risk geriatric patients.

Two or three 6.5mm Cancellous Shanz pins are passed percutaneously, into the femoral neck under image intensification, after reducing the fracture on a fracture table. Three or more preloaded 4.5mm Cortical Shanz pins are passed percutaneously transversely into the shaft. These pins are then connected to the tubular rods with universal clamps.

The application as well as removal of the external fixator is simple, and it can be done under local anesthesia. The patients can be mobilized on the first post-operative day with the help of crutches.

The advantages of external fixation are –

- Short operative time.
- Minimal blood loss.
- Early mobilization.

The complications with external fixation are –

- Pin tract infection.
- Varus collapse at the fracture site.
- Pin breakage.
- Proximal pin migration.

DYNAMIC HIP SCREW

The Dynamic Hip Screw and Barrel Plate assembly remains the implant of choice for most intertrochanteric fractures.

Biomechanics of the Dynamic Hip Screw:

In a 1935 study, **Pauwels** concluded that the forces acting on the hip in a single limb stance amount to approximately three times the body weight applied at an angle of 159^0 to the vertical plane. This same force acts on any hip fixation device that is placed across the fracture site.

The optimal angle between the barrel and the side plate of a hip compression screw has been the subject of controversy.

Many authors have argued that 150^0 plates are preferable because the angle of the lag screw more closely parallels the compressive forces within the femoral neck. Theoretically, this should lead to less binding of the screw within the barrel of the side plate and less chance of failure of the implant from bending.

The use of a 150^0 side plate often resulted in –

- Unacceptably high placement of the lag screw in the relatively weak bone of the antero-superior part of the femoral head.
- As it necessarily enters the shaft below the fracture in thick cortical bone, the angle of entry has to be exact, since the bone at the entry hole is too thick to permit crushing to correct minor errors of angle insertion.

There is no difference in fracture impaction between 135degree and 150degree plates. For these reasons a 135degree side plate is used in most fractures.

The major force acting in a trochanteric fracture is the joint force through the femoral head. This force has two components –

1. The force parallel to the fracture line causes sliding of the fracture surfaces, and inferior displacement and varus angulation of the femoral head.
2. The force perpendicular to the fracture drives the fracture surfaces together, causing friction and mechanical interlocking.

Therefore the aim of fixation of trochanteric fracture is to use the perpendicular component to drive the surfaces together and gain stability. This is the basic principle of the dynamic hip screw.

In using the dynamic hip screw, it is important to ensure that the screw can slide in the barrel of the side plate. When this occurs the screw is protected from bending as it is supported by the fracture surfaces. Two basic principles enhance the ability of the screw to slide in the barrel –

1. Within the clinical constraints of the fracture geometry, the higher angle device will allow less resistance to sliding because the screw axis is more closely aligned to the direction of the joint force.

2. The screw should be engaged as deeply as possible within the barrel. For the same force acting at the femoral head end of the screw, the internal force between the barrel and the screw, which keeps it from bending downward, is greater when the length of screw in the barrel is smaller. To balance the moment caused by the force acting at the femoral head end of the screw (this moment is equal to the force acting perpendicular to the screw multiplied by the distance to the proximal edge of the barrel), the internal force (for the balancing moment, which is equal to the force

acting between the screw and the barrel multiplied by the distance of this force from the proximal edge of the barrel) must be larger, if its moment arm is smaller. If this force is larger, the frictional force

between the screw and barrel increases, and greater resistance to sliding results.

To ensure impaction, the barrel of the hip screw device must cross the fracture site. There must also be enough room for the implant to collapse before the screw impinges on the barrel because, when such impingement occurs, the device acts as a fixed- angle plate. Jamming, or failure of the hip screw to slide, also results in the implant's functioning as a fixed-angle plate.

Failure of the lag screw to telescope can also occur as the result of impingement of the sleeve of the side plate on the base of the proximal fragment.

Hybrid fixation is the fixation of the fracture with one material with two or more fixation genres. The Dynamic Hip Screw is the most commonly used hybrid device, which combines an intramedullary device (the lag screw) with an extramedullary device (the side plate).

The Dynamic Hip Screw may be applied with static compression during surgery and with dynamic compression and gliding after resumption of physiologic loading. This combination of effects is desirable in unstable intertrochanteric fractures in porotic bone and stands as an ideal indication for hybrid fixation. In high subtrochanteric osteotomy, the same device can be placed to function as a compression plate having dynamic tension-band properties.

Parts of the Dynamic Hip Screw:

The Dynamic Hip Screw has three parts –

1. **The Lag Screw:** It is available in variable lengths. Its proximal tip is blunt and has broad threads at the proximal end, which is threaded into the femoral head.

The diameter of the threaded part is 12.5 mm, and the length of the threaded part is 22 mm. the pitch of the thread is 3 mm. The diameter of the

shaft of the lag screw is 8 mm.

The inner surface of the distal end of the shaft is threaded for the application of the compression screw.

2. **The Side Plate with a Barrel:** It is available in various lengths. The barrel for the lag screw to slide through it is set at an angle (135^0 or 150^0) to the plate. The side plate has oval slots for fixation to the shaft of the femur.

3. **The Compression Screw:** It is 19mm in length, and is screwed into the distal end of the lag screw after the side plate is fixed.

Ideal Dynamic Hip Screw:

1) **Position of the Lag Screw:** The ideal location for the placement of the lag screw in the femoral head has been the subject of much controversy.

Mulholland and **Gunn**[19] in a retrospective study, found that central placement of the lag screw on the anteroposterior and lateral x-rays with deep penetration of the head was optimum.

Kaufer[101] recommended placing the screw in the posteroinferior quadrant of the head on the lateral x-rays and low on the Calcar on the anteroposterior x-ray so that the nail would have to "plow through" a maximum amount of bone before cutting out of the femoral head.

Although the optimal position of a compression screw within the head and neck is controversial, there is uniformity of the agreement that it should be central or inferior and posterior, and the anterior and superior aspects of the femoral head should be avoided, owing to the increased risk of the implant cutting out.

2) Depth of the Lag Screw: Kaufer[101] recommends placing the lag screw within 2 cm of the subchondral bone for maximum purchase.

Baumgaertner[64] described the **tip-apex distance(TAD)** to determine the positioning of the lag screw in the femoral head. It is the sum of the distances from the apex of the femoral head to the tip of the lag screw on both the anteroposterior and lateral x-rays, correcting for magnification. They found that if this sum was less than 25mm, there were no failures caused by cutting out of the lag screw.

a. Angle of the Barrel Side Plate: The optimal angle between the barrel and the side plate is controversial. 150^0 plates are preferable because the angle of the lag screw more closely parallels the compressive forces within the femoral neck. The 135^0 devices are easily placed and because their clinical results are similar to those of the 150^0 plates. Hence the 135^0 barrel plates are ideal.

b. Length of the Barrel: The barrels are available in two sizes –

- The standard barrel (38 mm).
- The short barrel (25 mm).

The longer barrel maximizes the amount of screw barrel engagement and minimizes the likelihood of the lag screw “jamming” within the plate barrel.

A short barrel plate is indicated for specific clinical situations, including -

- Cases in which the standard barrel may not provide sufficient glide
- For the lag screw; i.e., a long impaction distance is expected.
- A medial displacement osteotomy.
- Unusually small femurs.

A short barrel is also used if a lag screw less than 85 mm has been inserted, because if sliding does occur, it is less likely to use up the sliding capacity of the device, resulting in contact of the lag screw and the plate barrel.

Optimal sliding results when the tip of the screw shaft is within 1 cm or less of the barrel plate junction.

c. Shape of the Lag Screw and Barrel: A ”keyed” sliding hip screw system is ideal.

In a keyed system, the lag screw is captured within the plate barrel such that the screw can slide along the barrel but cannot rotate. This mechanism theoretically maximizes rotational stability of the femoral head and neck compared to a nonkeyed system in which the lag screw can rotate within the plate barrel.

d. Length of the Plate: For majority of fractures a 4-holed plate is adequate. A 5-holed plate is suggested for those fractures with a subtrochanteric extension.

It is essential to have a minimum of four screws distal to the fracture line. The plate should fit the shaft without stress and is attached to it with atleast four screws, engaging eight cortices.

e. Length of the Screw: The lag screw length is determined by measurement at the time of fixation. If a screw of excessive length is used, it will protrude laterally. A lag screw 5 mm less than the measured length will allow 5 mm of compression.

f. The Compression Screw: The need for a compression screw is determined by direct visualization of the lag screw within the plate barrel. A compression screw is inserted if there is risk of post-operative screw-barrel disengagement.

REDUCTION OF TROCHANTERIC FRACTURES

A stable reduction of an intertrochanteric fracture requires providing medial and posterior cortical contact between the major proximal and distal fragments in order to resist varus and posterior displacing forces.

The restoration of normal anatomy is the ideal goal, but unfortunately anatomical reduction of a comminuted intertrochanteric fracture is difficult to achieve. Therefore, a non-anatomical but stable reduction is indicated in those fractures in which an anatomical stable reduction cannot be obtained.

With the use of dynamic implants that allow for controlled, post-operative axial impaction, absolute anatomic reduction of trochanteric intermediate fragments to achieve mechanical stability is not necessary.

METHODS OF REDUCTION: Intertrochanteric fractures can be reduced by closed or open means.

CLOSED REDUCTION: Closed reduction under anesthesia is obtained by –

- Direct Traction.
- Slight Abduction.
- Slight External Rotation.

Traction: Longitudinal traction is applied to restore the normal neck-shaft angle and overcome the shortening caused from muscle swelling and bleeding into the proximal thigh.

Traction uses the remaining soft tissue attachments to the bone fragments as an aid to restoring fracture alignment.

Massie[104] believed that this was the most important step in reducing an intertrochanteric fracture.

Abduction: The limb is abducted to overcome any residual varus deformity.

External Rotation: Massie[10] emphasized the reduction in external rotation of 15^0 to 20^0 to close the defect that occurs in most comminuted intertrochanteric fractures posterolaterally. He recommended evaluating a lateral x-ray after reduction, and if fracture separation was present posteriorly, limb rotation was used to correct this separation.

In non-comminuted linear fractures without displacement, the limb is simply fixed to the table in neutral or slight internal rotation before the surgery. Satisfactory results can be obtained in such stable fractures with most internal fixation devices.

The degree of rotation required for reduction is variable, depending on the degree of comminution. This can be determined at the time of surgery by visualization under image intensifier.

OPEN REDUCTION:

After the manipulation is performed, the reduction is evaluated for stability, and if the stability of the fracture has not been restored, open anatomical reduction is indicated.

Tronzo[92] noted difficulty in closed reduction of specific intertrochanteric fractures in which the lesser trochanter remained intact and there was a large spike on the proximal fragment.

In these fractures, the iliopsoas tendon remains attached to the lesser trochanter, and the long spike on the head-neck fragment often gets caught between the iliopsoas and the lesser trochanter. Even with strong traction, this fracture tends to remain in varus. A simple surgical release of the iliopsoas tendon off the lesser trochanter allows reduction.

The intertrochanteric fracture with reverse obliquity requires specific surgical treatment. For stability, these fractures require open reduction and notching of the distal shaft so that the neck fragment will be impacted into the notch in the shaft to prevent medial migration of the shaft.

If the fracture still remains unstable after closed or open reduction, non-anatomical stable reduction must be carried out.

Unstable Intertrochanteric Fractures:

The unstable intertrochanteric fracture is a serious and difficult problem. Inadequate treatment results in significant complications such as –

- Failure of fixation device.
- Delayed union or non-union.
- Penetration of the device through the femoral head or neck with destruction of the hip joint.
- Multiple surgeries with increased incidence of infection.
- High morbidity and mortality unless the patient can be mobilized early.

Therefore some degree of bony stability must be obtained in these fractures.

Anatomical Stable Reduction:

Laskin[31] **and Riska**[105] have mentioned open anatomical reduction and internal fixation for unstable intertrochanteric fractures. The displaced lesser trochanteric fragment should be reduced and fixed to the femoral shaft to provide a stable buttress for reduction to the proximal fragment.

The anatomic reduction and fixation of a large posteromedial fragment allowed the femur to resist an ‘average load’ 57% greater than if the fragment was ignored.

These techniques are of limited value, especially when there is comminution of the lesser trochanteric fragment or when extensive surgical exposure is required to attain an anatomic reduction.

Non-Anatomical Stable Reduction:

Internal Fixation of the fracture in the Varus position:

Cram and **Evans**[5,10] mentioned internal fixation of unstable intertrochanteric fractures in their displaced varus position.

Fracture stability exists in the displaced position because of the medial contact between the two major fragments. This results in limp and shortening of the limb.

Internal Fixation with a Sliding Screw without obtaining bony stability:

The use of a sliding device allows an unstable fracture to impact and thereb y seek its own stability.

Jacobs[33] demonstrated that, as the sliding device shortens with settling of the

unstable fracture, the lever arm acting on the nail-plate junction shortens, thereb y reducing the force on the implant.

Clawson[106] and **Ecker**[107] noted that unstable fractures treated with sliding device underwent shortening and medial displacement.

If the unstable intertrochanteric fractures are treated with a sliding screw without obtaining bony stability, success rests on the ability of the device to slide. If the device impinges, it will act as a fixed-angle nail plate and result in either cutting out or penetration of the head as these unstable fractures settle into a position of stability.

The sliding hip screw is the most satisfactory method for treating unstable intertrochanteric fractures after a stable reduction is obtained. If a stable reduction is inadvertently not obtained at the time of surgery, the sliding apparatus is “forgiving”; it allows for subsequent displacement to achieve stability.

Wayne County or Valgus Reduction –

In this reduction, the shaft of the femur is displaced lateral to the medial cortex of the femoral neck, thereby creating a buttressing force to resist varus displacement. This is referred to as the **medial cortical overlap technique** by **Stover**[108]**.**

This technique is helpful in unstable fractures with only slight medial and posterior cortical instability.

If more cortical instability is present, an osteotomy must be performed.

Elective Osteotomy of Femoral Shaft to achieve stability –

Dimon and Hughston's Medial Displacement Osteotomy:

In 1967, **Dimon** and **Hughston**[17] reported that four part fractures with a posterior or medial gap after an unstable reduction collapsed into varus. This collapse resulted in implant failure. The addition of the medial displacement osteotomy reduced the incidence of failure.

Naiman[109] added that, oblique intertrochanteric fractures with a thin greater trochanteric component and intertrochanteric fractures in which the greater trochanter is fractured during nail insertion along with four part intertrochanteric fractures are indications for medial displacement osteotomy.

The addition of sliding hip screw has altered the use and indications for medial displacement osteotomy.

Chang[2] reported that an anatomic reduction of a four part intertrochanteric fracture internally fixed with a sliding compression screw provides significantly higher compression across the Calcar region and lower tensile strength on the plate than fractures treated by medial displacement osteotomy.

Medial displacement osteotomy has resulted in limitation of range of hip and knee motion, shortening of 1 to 2.5 cm and limp.

The failure of fixation after medial displacement osteotomy varies from 10% to30%.

Sarmiento's Valgus Osteotomy:

In 1973, **Augusto Sarmiento**[18] introduced a valgus osteotomy for the unstable intertrochanteric fracture in an effort to gain medial cortical stability.

This technique changes the fracture plane form vertical to near horizontal and creates contact between the medial and posterior cortex of the proximal and distal fragments.

The advantage of this valgus osteotomy is that valgus realignment of the proximal fragment makes up for the loss of length at the osteotomy site so that the limb remains equal.

Sarmiento[18] has pointed two possible errors in the technique of valgus osteotomy. They are

▪ If the osteotomy is made too transverse, it places the head in an exaggerated valgus position. This may result in the leg's being too long or in the hip's being unstable. To avoid this the medial displacement of the osteotomy should exit 1 cm below the fracture surface medially to compensate for the increased length caused by the valgus osteotomy.

In addition **Kaufer**[101] also warns against excessive valgus reduction as it results in increased demands of abductor power to stabilize the pelvis in single-stance phase and incongruous hip joint, leading onto limp and arthritic changes.

- Creation of an external rotation deformity after nailing. This can be prevented by attaching the shaft to the proximal fragment in slight internal rotation.

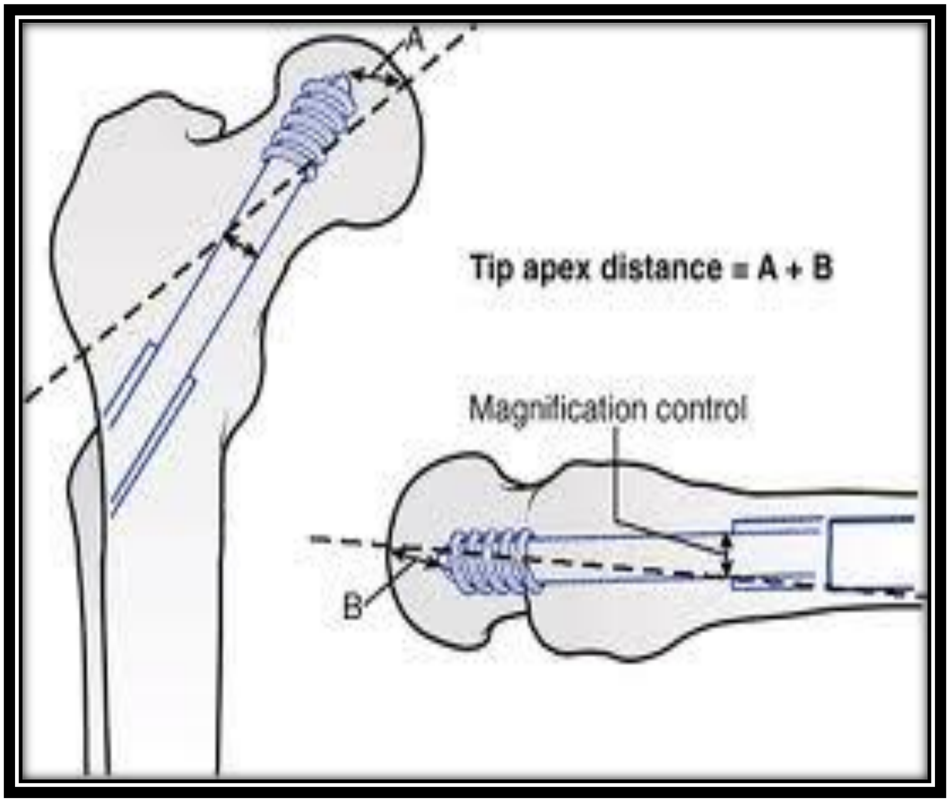
Sarmiento also mentions that in some fractures medial comminution is so extensive that osteotomy will not create enough bony contact to ensure stability.

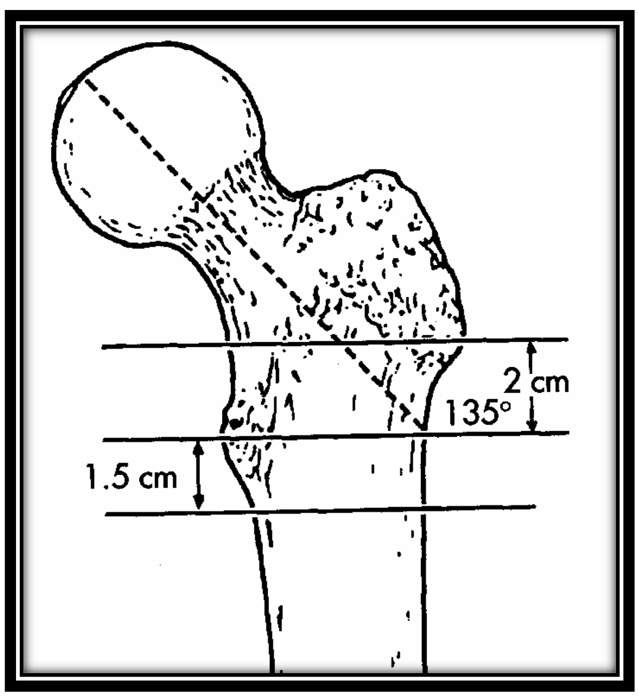
Augmentation with Polymethylmethacrylate:

The use of polymethylmethacrylate to augment medial stability has been recommended in comminuted intertrochanteric fractures.

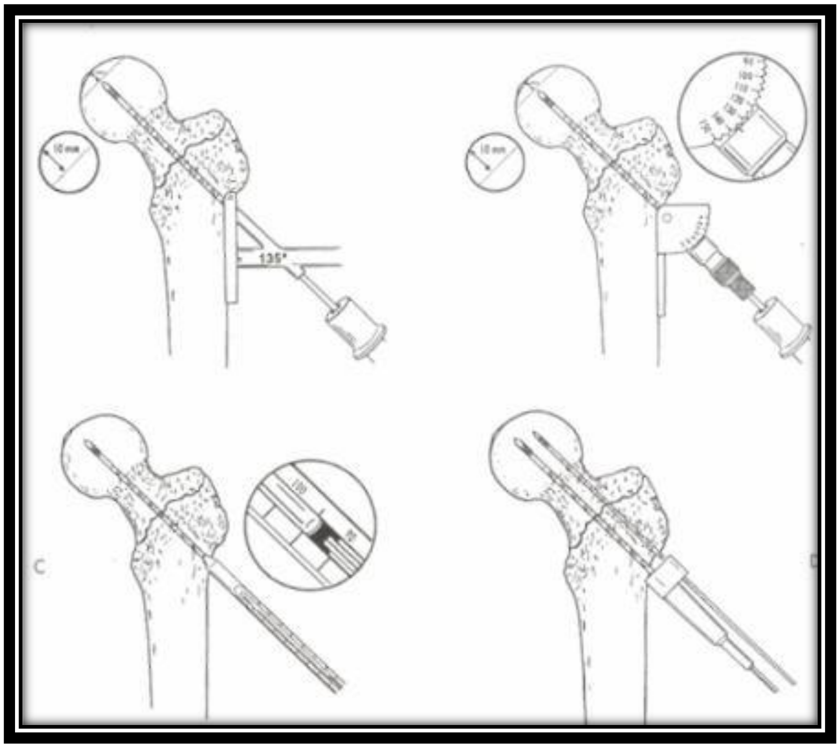
The addition of polomethylmethacrylate increases the magnitude of the operation and may introduce complications of non-union and delayed union.

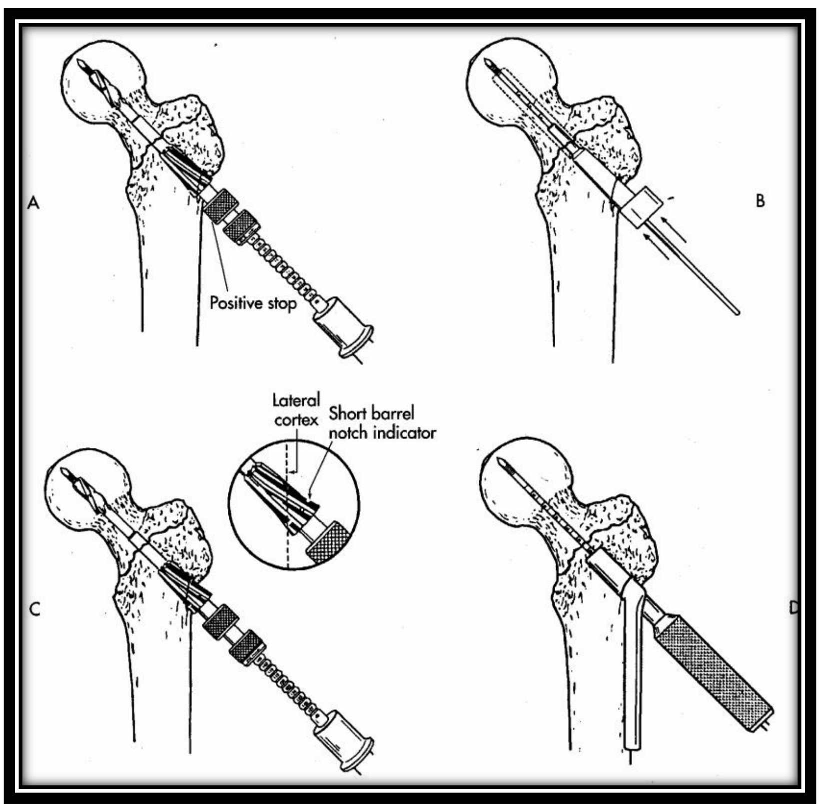
Maintainance of Tip Apex Distance

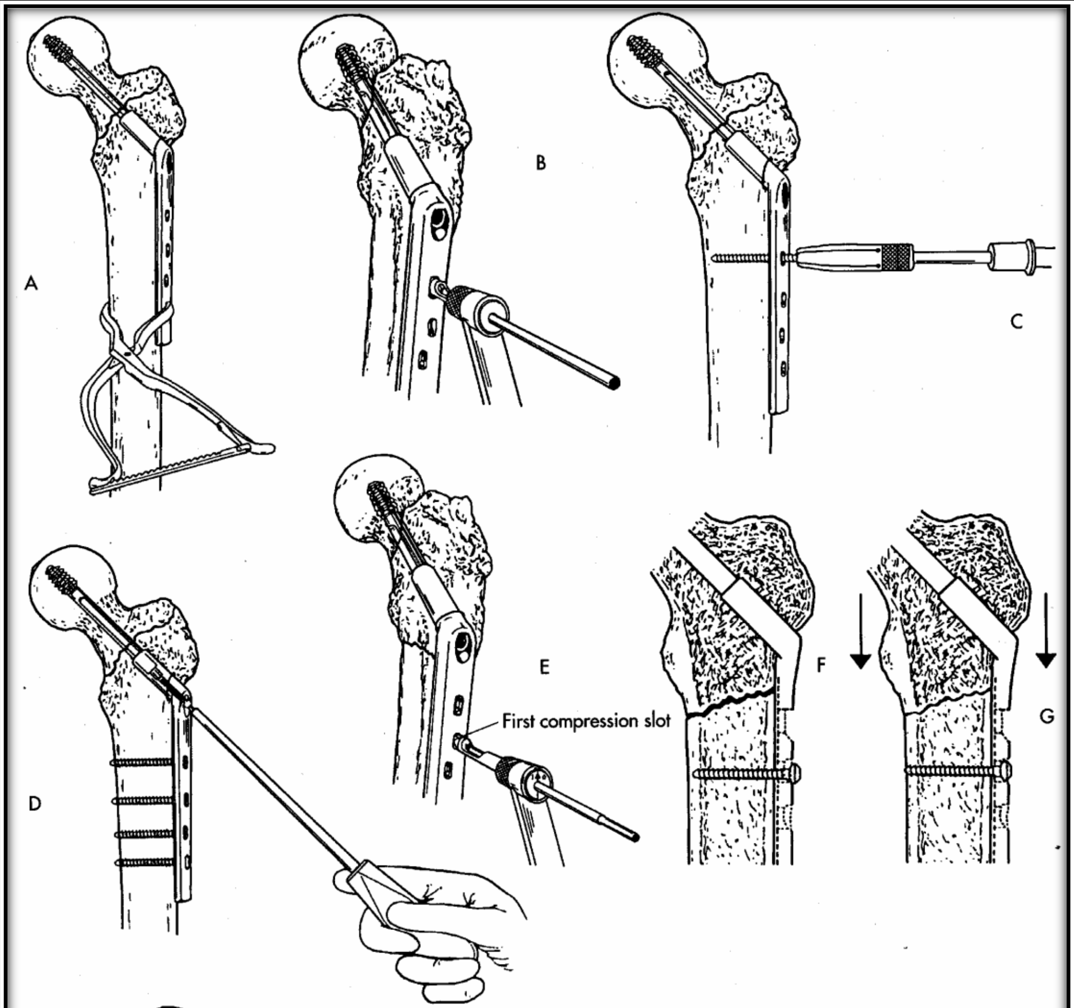




Procedure of DHS fixation







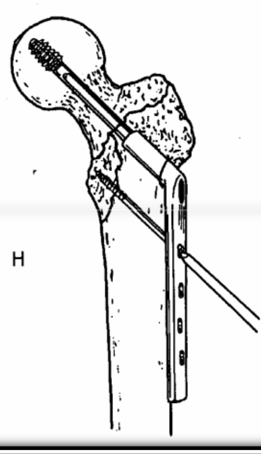


Fig. 48-16 Compression hip screw fixation of intertrochanteric hip fracture (see text). **A,** Plate is secured to shaft with plate clamp. **B,** Bone screw holes are drilled. **C,** Screw is inserted with hex screwdriver. **D,** Compression is applied with compression screw. **E,** Autocompression holes allow up to 2 mm of fracture compression. **F,** Self-tapping, 4.5-mm cortical screw is used in distal part of slot, away from fracture. **G,** First bone screw is inserted, producing approximately 1 mm of compression. **H,** Posteromedial fragment is fixated with cannulated screw through plate. (From Baumgaertner MR: Compression hip screw plates, technique manual, Memphis, Smith & Nephew.)

Dimon and Hughston 's Osteotomy

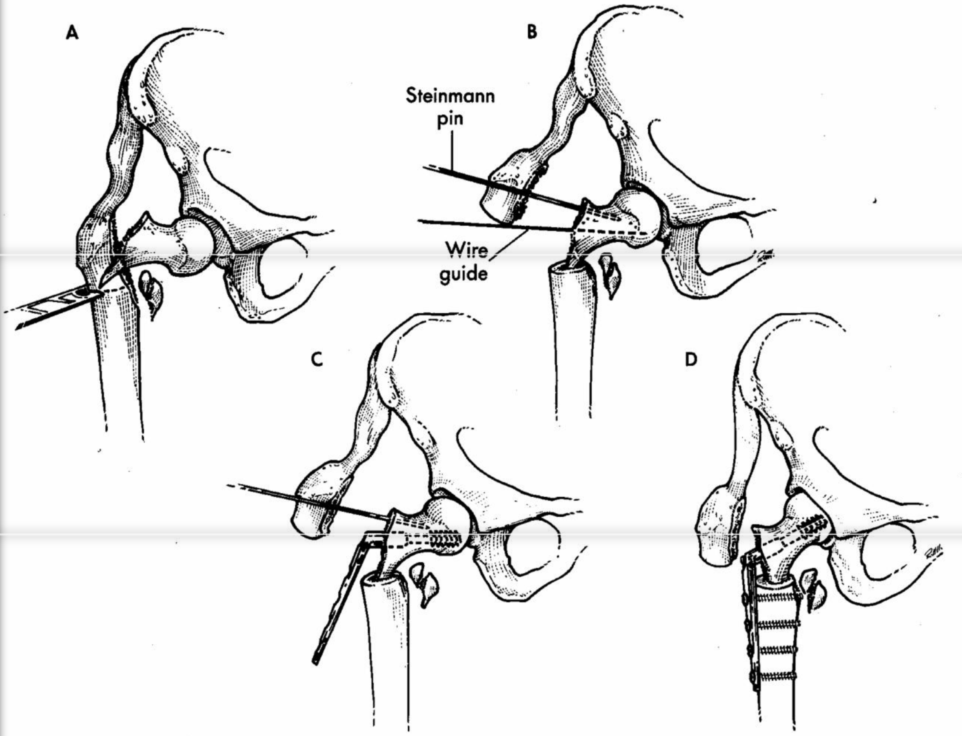
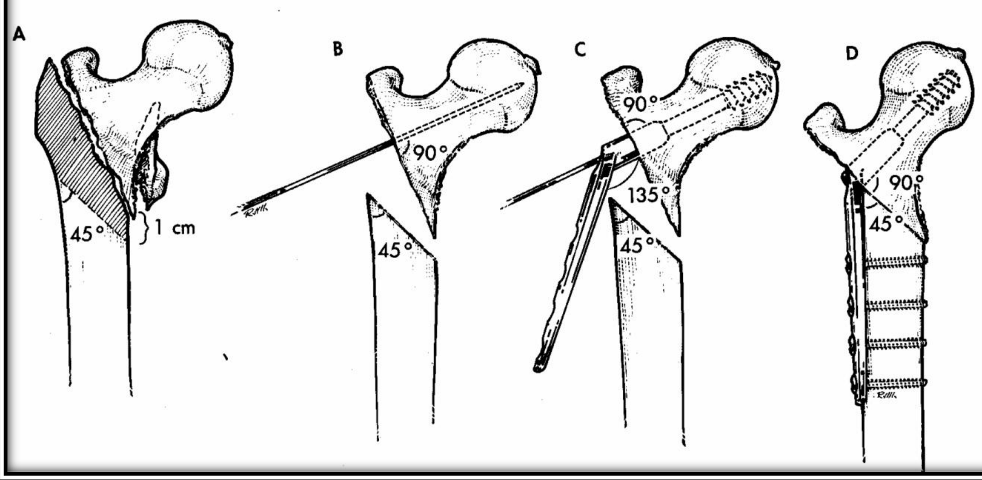


Fig. 48-17 Dimon and Hughston method of internal fixation of unstable trochanteric fractures. **A,** Transverse osteotomy of lateral shaft is performed. **B,** Guide pin is inserted with Steinmann pin for control of fragment. **C,** Nail is inserted into proximal fragment. **D,** Side plate is fixated to shaft. (Redrawn from Hughston JC: *Orthop Clin North Am* 5:585, 1974.)



COMPLICATIONS

The complications following the surgical management of intertrochanteric fractures are –

General Complications:

As a result of prolonged immobilization of the elderly patients, following the fracture and surgery, they may develop some general complications. These include –

- Thromboembolism.
- Pneumonia.
- Urinary tract infection.
- Cerebrovascular accidents.
- Deep vein thrombosis (DVT).

Local Complications:

As a result of surgery there may be certain complications locally at the operative site. These include –

- Hemorrhage.
- Wound infection.

The incidence of post-operative wound infection following surgery for an intertrochanteric fracture varies from 1.7% to 16.9%.

Barr[110] has listed a few factors significant in the development of post-operative wound infection –

- A patient population including patients in the seventh, eighth, and ninth decades with decubitus ulcers, bladder infections, and cardiovascular disease.

A disoriented patient, who may remove the bandage and contaminate the wound.

Proximity of the wound to the perineum. -***Barr***[110] has divided post-operative infections into four groups as follows –

-Early Superficial Sepsis – with fever, wound swelling, erythema and spontaneous drainage. The recommended treatment is removal of skin sutures, debridement of subcutaneous tissues and administration of parentral antibiotics; allowing the wound to heal secondarily.

Early Deep Sepsis – in this group mortality rate was high. He recommended extensive early debridement and parentral antibiotics.

Late Sepsis without Joint involvement – treatment included removal of the metallic internal fixation device.

Late Sepsis with Joint involvement – it is difficult to diagnose and the clues that suggest joint involvement are spiking fever, aching in the hip region post-operatively, muscle spasm and decreased range of motion and an ESR of 30 or above. It often requires extensive reconstructive procedure for pain relief.

The patients with late sepsis included those diagnosed from 6 to 24 months after the fracture.

Mechanical and Technical Failures: These include –

- ***Varus Displacement.***

It is associated with failure of nail fixation in the proximal fragment and failure to obtain a stable reduction and internal fixation.

It is accompanied by

a.Implant bending.

b.Breaking.

The prolonged operating time that may occur in unstable fractures.

c.Cutting out of the head.

d.Pulling off the femoral shaft.

Taylor[102] found the varus displacement to be symptomatic with pain, weakness of the hip and a short extremity only if the varus was less than 120. If varus occurs there are three options –

1. Accept the varus deformity.
2. Attempt to correct the varus with skeletal traction until bone union.
3. Resurgery.

- ***Nail Penetration:***

It may account for one third of the treatment failures.

Taylor[102] concluded that nail penetration was secondary to too long a nail or to a reversed intertrochanteric fracture with medial shaft migration.

They recommended leaving the nail in the penetrated position until union was certain.

Rotational Deformity:

It is common in unstable fractures.

Massie[16] stressed avoidance of internal rotation in reducing intertrochanteric fractures to prevent rotational deformity post-operatively.

Dimon and **Hughston**[17] also stressed the need for correct interpretation of rotational alignment at the time of nailing to prevent post-operative deformity.

Nonunion:

Since intertrochanteric fractures occur in cancellous region with good blood supply, nonunion has been uncommon.

The incidence of nonunion has found to be 1% to 2%.

The intertrochanteric fractures prone to nonunion include comminuted unstable fractures with loss of medial Calcar continuity, which when stabilized tend to fall into varus.

The treatment options for nonunion include:

a. Repeat attempts at open reduction and internal fixation with bone grafting. The open reduction and internal fixation may be done in a valgus position.

b. Endoprosthetic replacement.

c. Total hip replacement.

Aseptic Necrosis:

The incidence of aseptic necrosis after an intertrochanteric fracture is low as it is extracapsular. The incidence is about 0.8%.

Rotation of the proximal fragment during screw insertion may be responsible for damaging the blood supply to the femoral head and subsequent aseptic necrosis.

Baixauli[71] have reported that osteonecrosis should be included in the differential diagnosis in patients developing hip pain following surgery for intertrochanteric fractures.

 Stress Fracture:

Tronzo[92] reported that, if an intertrochanteric fracture was internally fixed with a nail that did not enter the head, the nail could cut out of the proximal fragment as the patient flexed the hip and rotated the limb, or the nail could act as a stress riser in the femoral neck and result in a subcapital stress fracture.

According to **Mariani** and **Rand**[111], the predisposing factors include elderly patients with osteoporotic bone, placement of the implant in the anterosuperior aspect of the head of the femur and insertion of the implant not deep enough.

Therefore a sliding compression hip screw should be used, the tip should be within 1 cm of the subchondral bone and the anterosuperior quadrant of the femoral head should be avoided.

 Miscellaneous Complications.

Evans[5,10] reported one patient with **Peritonitis** secondary to a guide pin's violating the pelvis during hip nailing and one patient with **Gangrene** secondary to a dissecting aneurysm.

Soballe and **Christensen**[112] reported a case of **laceration of the superficial femoral artery** by a displaced lesser trochanteric fragment in an elderly patient with an intertrochanteric fracture.

Punn[113] report that in one third of all patients operated on for fracture of the hip an **effusion of the ipsilateral knee** developed.

MATERIALS AND METHODS

SOURCE OF DATA:

The material for the present study was collected from patients who attended and were admitted in Department of Orthopaedics in B.L.D.E.U's Shri B. M. Patil Medical College Hospital and Research Centre,Bijapur with diagnosis of intertrochanteric fracture and managed surgically by Dynamic Hip Screws between October 2009 to September 2011. A minimum study of 50 cases were taken and the patients were informed about study in all respects and informed written consent was obtained.

METHOD OF COLLECTION OF DATA:

- By clinical examination.
- By interview.
- By follow up at intervals of 1,2,4,6 months post operative.
- By analyzing case papers.

INCLUSION CRITERIA:

- Patients more than age of eighteen years.
- Patients who have been diagnosed as having intertrochanteric fracture.
- Patients who are fit for surgery.

EXCLUSION CRITERIA:

- Patients below the age of eighteen years
- Patients who are unfit for surgery
- Patients who are admitted for re operation
- Patents with compound fractures
- Patients with pathological fractures

Procedure

The study was approved by the Ethical and Research Committee of Shri B.M.Patil medical college and research centre,Bijapur. After finding the suitability as per inclusion and exclusion criteria ,patients were selected for the study and briefed about the nature of the study, the interventions used and written ,informed consent was obtained (Annexure– I). The consented patients were enrolled in the present study. Further, descriptive data of the participants like name, age, sex, detailed history, were obtained by interviewing the participants and clinical examination and necessary investigations were recorded on predesigned and pretested proforma (Annexure II).

Pre-Operative Evaluation

As soon as these patients were admitted in the ward, history was recorded and detailed clinical examination was done.

Name:

Age: Age is an important factor to be noted, to select the type of procedure to be done. There could be a difference between the chronological and physiological age. Usually trochanteric fracture of femur occurs at an older age. In the elderly, bone is usually osteoporotic and osteosynthesis may fail due to poor regenerative osteogenic potential of bone. Many a times, it is ideal to replace the head and mobilize the patient early to prevent the complications of prolonged immobilization. The Dynamic hip screw and plate can be used in comparatively younger active patients.

Sex : Fracture trochanter is common in older females due to hormonal imbalance in the post menopausal age and associated osteoporosis.

Address: Address was noted to communicate with the patient and for further follow up.

History of Present Illness

The patient usually presented with a history of trivial injury following which he had pain and inability to walk.

Past History

History of any disease like hypertension, diabetes mellitus, tuberculosis or stroke were noted.

History of major cardiac or pulmonary problems is noted.

Any History of previous anaesthesia and its details noted.

History of previous operation on hip, with any evidence of infection, aspirate of the hip was taken and cultured and patient operated only if culture was negative.

History of abnormal gait due to insufficient abductor musculature or neuropathic joint or progressive neurological diseases.

History of drug intake like aspirin, anticoagulants or steroids. Aspirin and anticoagulants were stopped prior to surgery but patients who were dependent on cortisone continued drugs and booster was given during surgery to avoid crisis.

History of fever or burning micturition if present, was treated before undergoing the operation.

With a history of familial bleeding tendencies like hemophilia, factor VIII was maintained preoperatively and 4 weeks post operatively.

Personal History

Whether the patient was a smoker, alcoholic, having vegetarian or non-vegetarian food with a normal or altered bladder and bowel function noted. Whether the patient used Western style or Indian style of toilet was also noted. (There is a high bleeding tendency in alcoholics, so liver profile should be looked for).

Menstrual history was also noted in females.

General Examination

Detailed clinical examination was done regarding the built, nutrition, pallor, cyanosis, icterus, pedal edema, lymphadenopathy, physiological age, psychological status, intelligence, willingness to undergo operation and post operative cooperation of the patient. The temperature, pulse, blood pressure and respiratory rate were also noted.

A thorough examination of the hip was done and deformities, contractures, weakness and limb length discrepancies if any were noted.

A detailed systemic clinical examination of C.V.S, R.S, C.N.S and per abdomen and Genito-urinary system was done and if there was anything significant, it was noted and treatment obtained.

Condition of skin around the hip was noted.

Height and weight of the patient was also noted.

A detailed examination of spine, knee and ankle was done to rule out any deformities or contractures. (A flexion contracture of the ipsilateral knee or equines deformity of the foot may require correction before joint replacement of hip).

True hip pain has to be differentiated from sacroiliac pain and lumbar pain, trochanteric bursitis, pubic ramus fracture or intra-abdominal problem by clinical examination.

Per-rectal examination was carried out if required.

Investigations

X-ray of the pelvic with both hips, anteroposterior view was taken with both the lower limbs in 15° internal rotation and lateral view was also taken. Thickness of the cortex of the femur, width and bone stock, type of fracture (Boyd and Griffen classification), amount of calcar present, level of femoral neck cut to be made, pre operative size of the lag screw (magnification deducted) .

Laboratory investigations

- Complete blood count
- Mini-renal, Blood sugar level
- Urine analysis
- HIV, HBsAg
- Chest X-ray
- Electrocardiogram

Liver function tests, renal function test and analysis of cardiac enzymes were done if required.

In the study, Trochanteric fractures were classified according to the ***Boyd* and *Griffin*** classification as follows –

***Type* 1:** Fractures that extend along the intertrochanteric line from the greaterto the lesser trochanter.

***Type* 2:** Comminuted fractures, the main fracture being along the intertrochanteric line but with multiple fractures in the cortex. Is a deceptive fracture in which an anteroposterior linear intertrochanteric fracture occurs as in type 1, but with an additional fracture in the coronal plane, which can be seen on the lateral roentgenogram.

***Type* 3:** Fractures that are basically subtrochanteric with at least one fracture passing across the proximal end of the shaft just distal to or at the lesser trochanter. Varying degrees of comminution are associated.

***Type* 4:** Fracture of the trochanteric region and the proximal shaft, with fracture in at least two planes.

Preoperative Treatment

For fresh fractures, Buck's traction with 3 kg weight was applied to relieve the pain and muscle spasm. For fractures older than 1 week and with gross proximal migration, an upper tibial skeletal traction with 5 kg weight was applied till the limb lengths could be equalized.

Preoperative anaesthetic assessment was done.

The following training was given to the patients pre-operatively, so that the same was carried out post operatively like-

- Deep breathing exercises
- Static quadriceps exercises
- Ankle and toe movements
- Active hip exercises (of the normal hip to familiarize the exercise)
- Building of muscle power in the upper extremities.

A written consent of the patient and relatives was taken.

Inj. Ceftriaxone 1 gm I.V was given 8 hours prior to surgery.

OPERATIVE PROCEDURE

Anesthesia:

The patients are taken up for surgery under General, Spinal or Epidural Anesthesia.

Patient Positioning:

The patients are positioned supine on the fracture table with a radiolucent padded counter-traction post placed between the patient's legs.

The uninjured leg is held in wide abduction by a boot attached to one of the leg extensions of the fracture table.

The injured leg is held in slight abduction, by a boot attached to the other leg extension of the fracture table.

The C-arm image intensifier is positioned between the patient's legs and the adequacy of both the antero-posterior and true lateral views are verified, before surgical preparation.

Reduction Technique:

Closed reduction of fracture by manipulation is performed.

After the anesthetized patient is positioned on the fracture table, and the extremity is secured in the traction foot piece, traction is exerted longitudinally on the slightly abducted injured leg until reduction is achieved.

The degree of rotation required for rotation is variable, depending on the degree of comminution. In non-comminuted fractures without displacement, the limb was fixed in neutral or slight internal rotation. In comminuted fractures, 15° to 20° of

external rotation is required to close the defect posterolaterally.

Reduction is checked in the antero-posterior and lateral views in an image intensifier, paying special attention to the posterior and medial cortical contact.

If reduction is not achieved by closed manipulation Open Anatomical reduction is done.

Draping:

The skin over the hip is scrubbed with betadine scrub, for 10 minutes and painted with betadine and spirit.

The lateral aspect of the hip is squared off from the iliac crest to the distal thigh, with towels and drapes. A plastic transparent, adherent, isolation drape is directly applied to the skin at the proposed incision site.

Exposure:

The incision of exposure is the standard lateral approach.

The incision begins 5cms, proximal and anterior to the greater trochanter, curving distally and posteriorly over the posterolateral aspect of the trochanter and then distally along the lateral surface of the thigh, parallel with the femur for about 10cms.

The dissection is deepened in the line of the incision down to the fascia lata. The fascia lata is incised with a scalpel in the distal part of the wound and split proximally with scissors. In the proximal part of the wound, the fascia is divided just posterior to the tensor fascia latae muscle.

By retraction of the dissected fascia the vastus lateralis muscle and its origin from the inferior border of the greater trochanter is viewed. The muscle fascia is split laterally; the muscle is dissected from its deep surface posteriorly, and divided near the linea aspera. The body of the vastus lateralis is retracted anteriorly, and the perforating arteries are coagulated, if they are divided. After dividing the muscle along the femur, it is elevated with a periosteal elevator and the lateral and anterolateral surface of the femoral shaft is exposed. By further subperiosteal elevation, of the proximal part of vastus lateralis and intermedius, the intertrochanteric line and the anterior surface of the femur, just below this line is exposed.

Alternatively, Vastus lateralis is divided at its origin from the greater trochanter transversely, down to the posterolateral surface of femur. Then the muscle and its fascia is divided longitudinally with scissors beginning on the posterolateral surface, 0.5 cm from its attachment to the linea aspera.

Guide Pin Insertion:

The level of insertion of the pin is approximately 2cms below the vastus lateralis ridge. It is the level of entry of a 135° angle plate. If a higher angle side plate is used, the entrance is moved 5mm distally for each 5° increase in barrel angle.

A fixed angle guide is placed midway between the anterior and posterior cortex of the femur on the lateral cortex. The guide pin with 3.2mm tip is aimed towards the apex of the femoral head, confirming the central placement of the pin on both anteroposterior and lateral views; the guide pin is passed to with in 10mm of the joint.

The length of the guide pin inserted is measured, and the guide pin is advanced to an additional 5mm into the subchondral bone to avoid guide pin pullout while reaming.

Reaming the Femur for Lag Screw and Plate Barrel:

The cannulated, power combination reamer is set to the length of the lag screw measured.

The reamer is slided over the guide pin, and femur is reamed coaxial to the guide pin, to avoid binding of the guide pin. Spot image intensification is used to know the advancement of the reamer.

The reaming is stopped when the short barrel notch indicator on the barrel reamer reaches the lateral cortex.

Tapping of Femoral Head:

Tapping is done to avoid excessive torque on the insertion wrench and to minimize risk of inadvertent malrotation of the femoral head fragment during final seating of the screw.

The T-handle is connected to the lag screw tap and it is set for the appropriate lag screw length and inserted into the reamed portion over the guide wire. The cortex guide is slided into the lateral cortex of the femur. Tapping is done until the advancing portion of the positive stop rests against the cortex guide.

Insertion of Lag Screw:

The appropriate lag screw and plate are assembled onto the insertion wrench. The entire assembly is placed over the guide pin and introduced into the reamed hole.

The lag screw is advanced into the femoral head to the predetermined level and its position is verified with image intensification in both planes. When the screw insertion, is complete, the handle of the insertion wrench is perpendicular to the axis

of the femoral shaft, which allows proper keying of the lag screw to the plate barrel.

Then the side plate is advanced onto the lag screw shaft, lag screw retaining rod is unscrewed and the insertion wrench is removed from the back of the lag screw. Then the guide pin is removed.

Attachment of the Side Plate:

The plate is secured to the shaft of femur with a plate clamp.

With a 3.2mm drill, holes are drilled into the lateral cortex, through the bone screw holes of the side plate. The holes are tapped with a 4.5 mm tap. The appropriate cortical screw length is measured with a bone screw length gauge. The screws are inserted using a screwdriver.

Compression of the Fracture:

Inter fragmentary compression is obtained using the barrel compression instrument.

The 19mm compression screw is threaded into the distal end of the lag screw shaft. The traction on the leg is released and compression screw is tightened to compress the fracture. The position of the lag screw, side plate and fracture compression is confirmed by image intensification in both antero-posterior and lateral views.

Closure of the Wound:

The vastus lateralis muscle is approximated and sutured with an absorbable suture material. Fascia lata and sub-cutaneous tissue is sutured with, over a suction drain.

Skin is sutured with non-absorbable suture material. Sterile dressing is put after removing the plastic isolation drape.

Fixation of Intertrochanteric Fractures with a Dynamic Hip Screw – The Do's and Don'ts: [26]

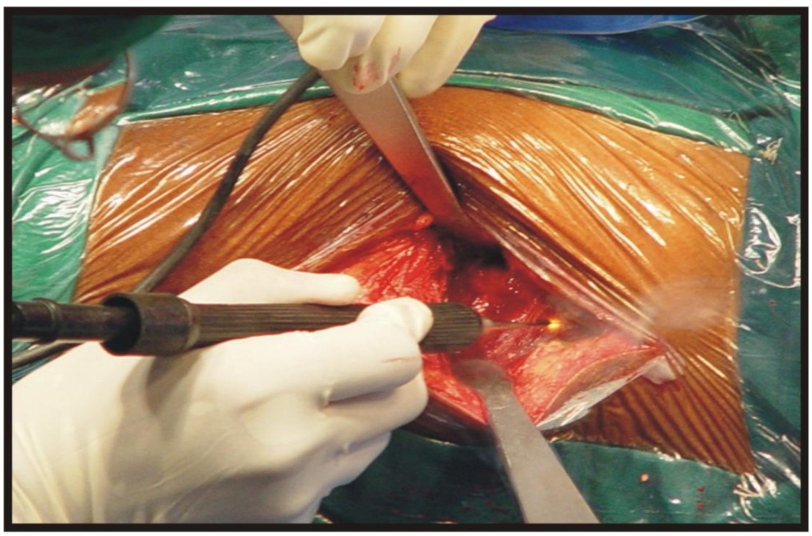
- Use image intensification if available. It makes reduction and placement of the hardware faster and more accurate.
- A fracture table is essential.
- Always try to obtain cortical contact along the calcar femorale. If this cannot be achieved in the very comminuted fractures, medial displacement and valgus reduction may be necessary.
- If there is a large posterior fragment that cannot be reduced, do not hesitate to use additional screws in the anteroposterior plane.
- Avoid excessive internal rotation of the femoral shaft at the time of reduction.
- After reduction, manually impact the fracture prior to measuring for screw length to avoid choosing too long a screw.
- Check equipment before starting. Make sure that the cannulated pieces are free of debris to avoid binding on the guide wire, causing it to advance into the pelvis or pull out.
- If the guide wire does not pull out after reaming the channel for the screw, the wire can be placed in the same hole by using a screw inserted backward as a guide.
- Do not ream beyond the point where the tip of the screw should end to reduce any tendency for migration of the screw toward the subchondral bone. The tip of the screw should be about 1.0 cm from the subchondral bone.

- When tapping, the guide wire should be in place to avoid tapping a false channel.
- In osteoporotic patients, always use at least a 4-hole side plate.
- When using a sliding screw with self-tapping cortical screws in the osteoporotic patient, an 8/64 or 7/64 inch drill can be used rather than the recommended 9/64 inch drill to provide better purchase of the screws.
- If the proximal fragment is short, do not use a screw with a longer threaded tip, since the shorter shank may not allow full impaction.
- Do not use too short a screw. This too may not provide a long enough shank on the screw to allow adequate impaction and is less effective in resisting varus angulation.
- Do not use methylmethacrylate to help stabilize routine fractures. It may be used for some pathologic fractures.
- Avoid being casual about treating hip fractures; always anticipate further impaction.

DHS instrumentation

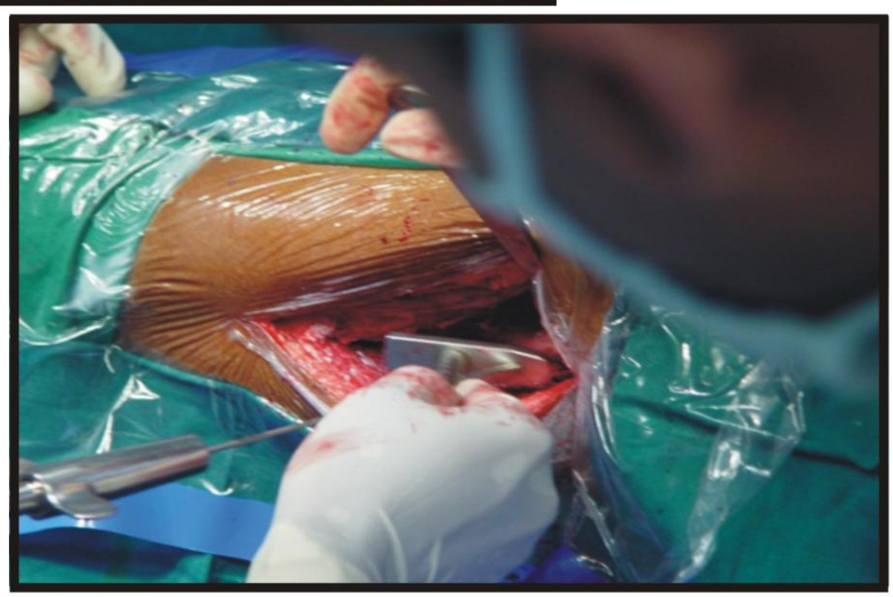
Patient position on OT table

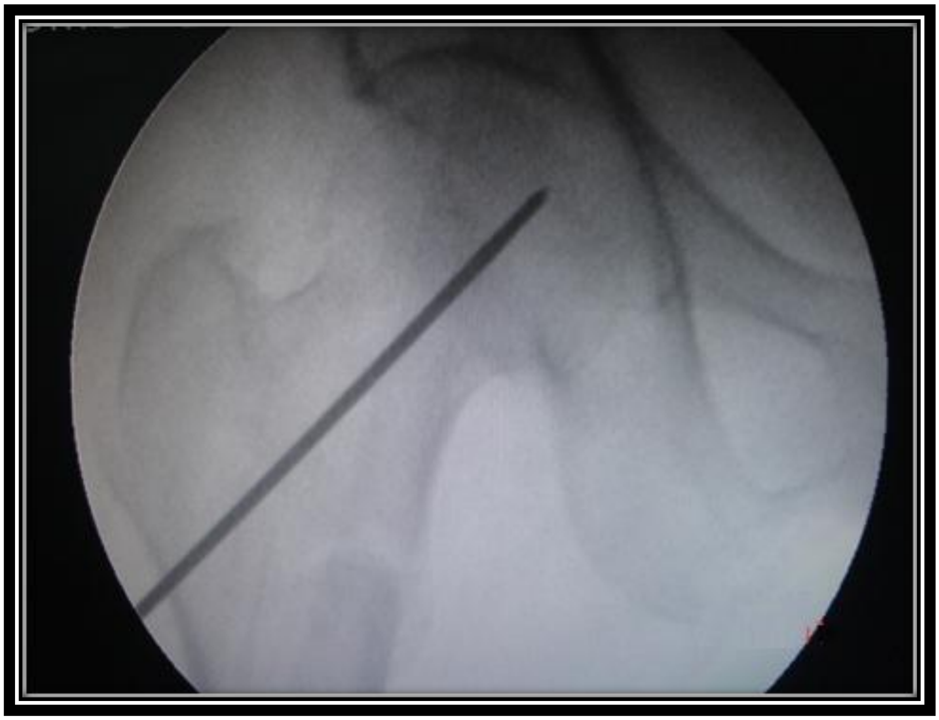
Skin Incision

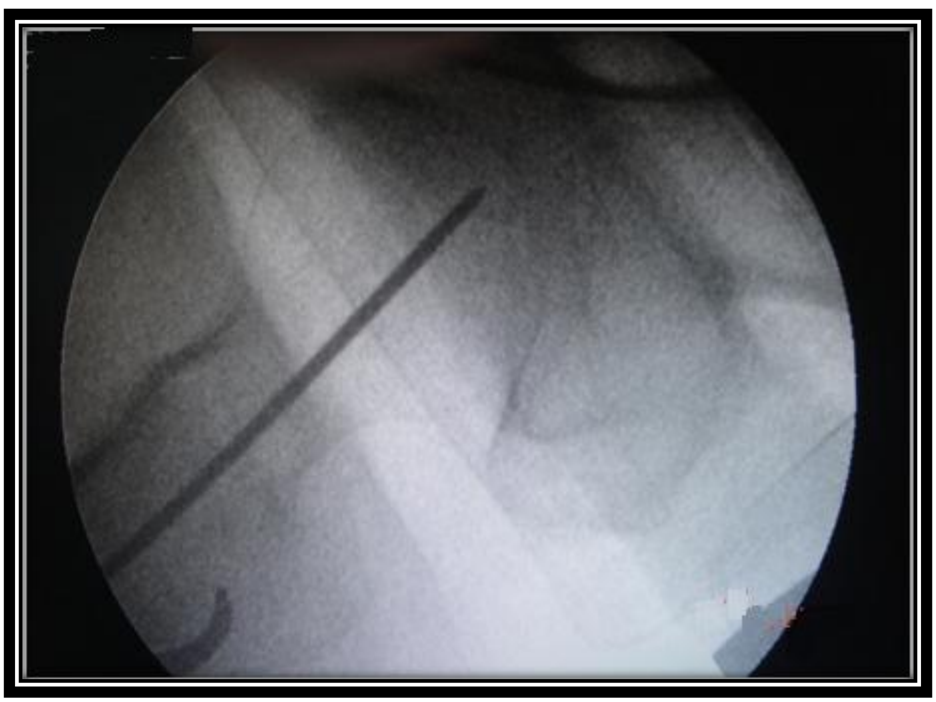


Deep Dissection

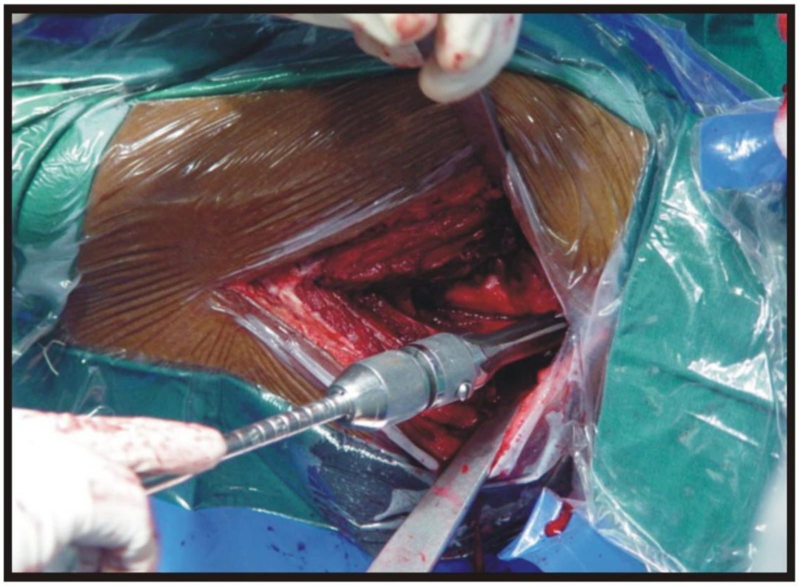
Guide wire placement





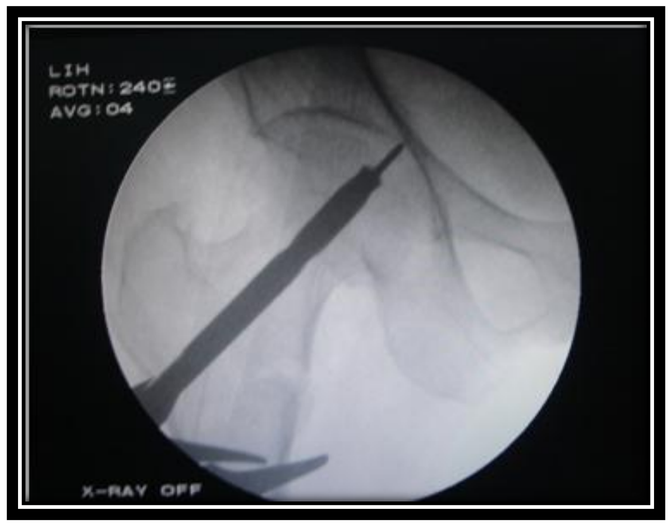


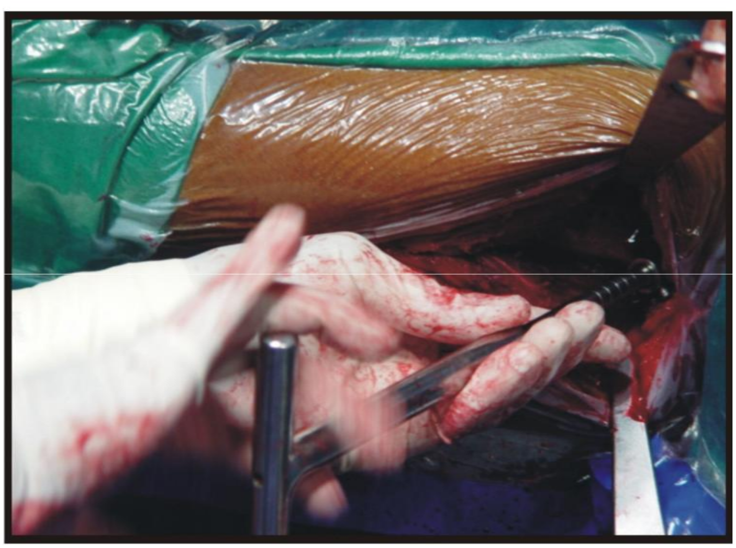
Under C Arm Guidance



Reaming

Under C Arm Guidance





Tapping

Screw insertion

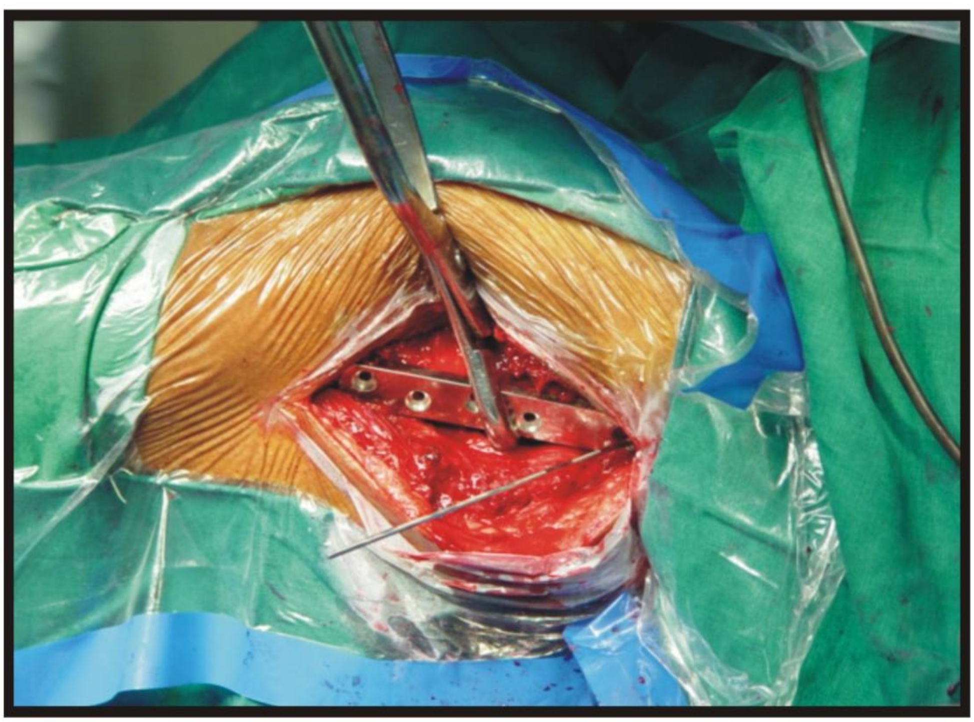
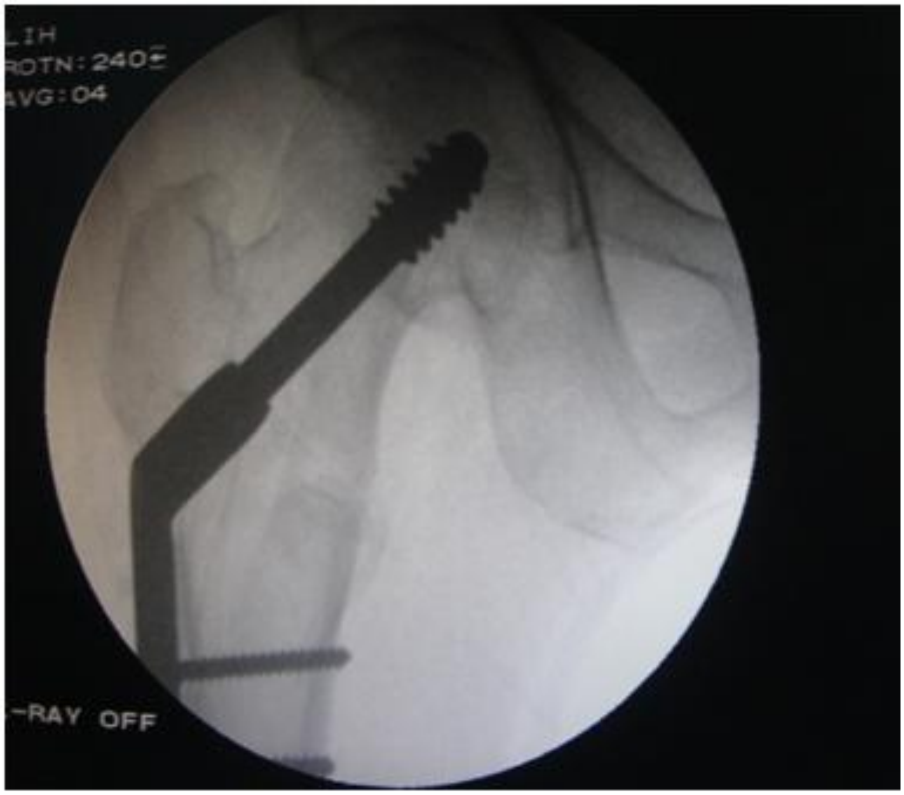
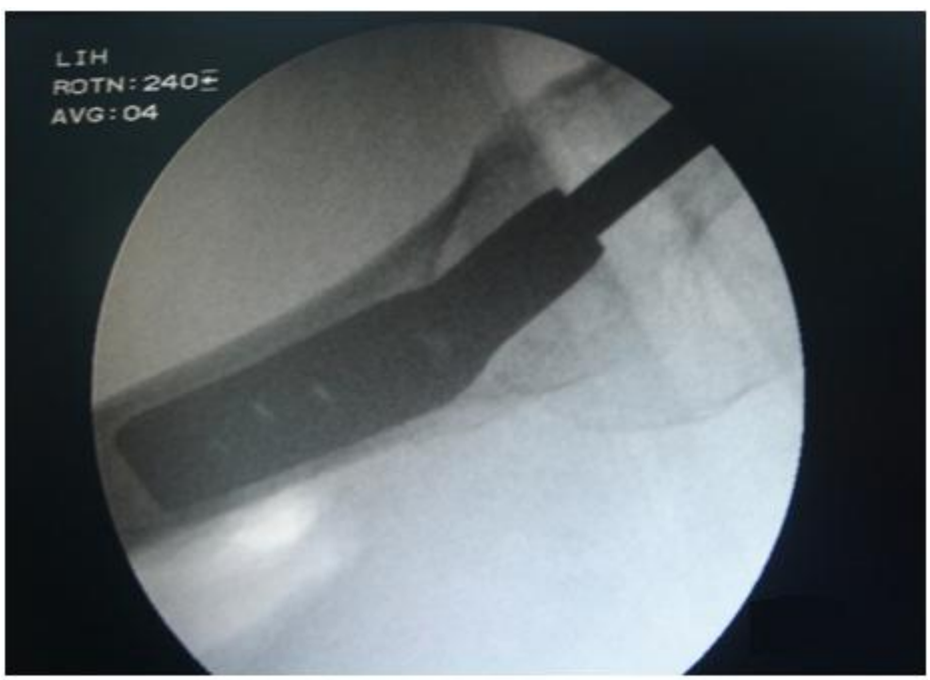


Plate fixation

Inplant position noted on the C Arm





Sutured Skin with Drain

OBSERVATIONS

In this series 50 patients with intertrochanteric fractures of femur admitted in B.L.D.E.U'S SHRI B.M.PATIL MEDICAL COLLEGE HOSPITAL & RESEARCH CENTER, Bijapur, during OCT. 2009 TO SEPT. 2011 were studied. Of these, 4 were excluded as they were lost in follow up.1 patient died intra-operatively. Following are the observations which were made.

Age and Sex Incidence:

The average age for the whole group was 55.46 years. The youngest patient was 25 years. In this study, 34 cases were males and 16 were females. Male to female ratio for the whole series was 2.12:1. The age and sex incidence is shown in table no.1 & table no 2

TABLE NO. 1

Age in years	No of patients	%
<50	12	24
50-59	14	28
60-69	15	30
70-79	4	8
80-89	3	6
> 90	2	4

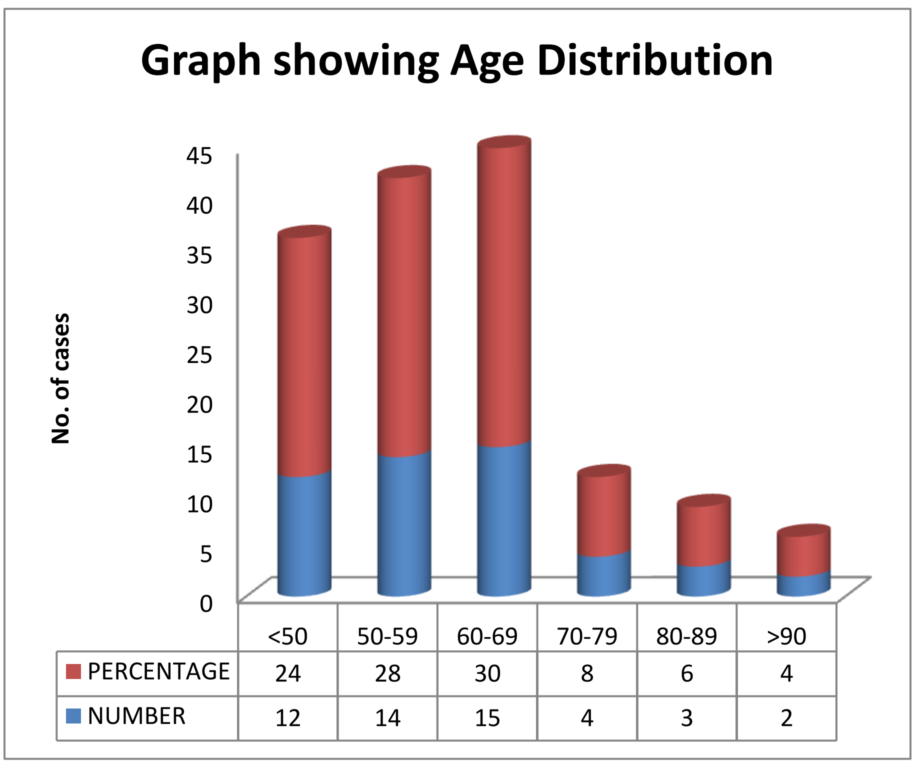
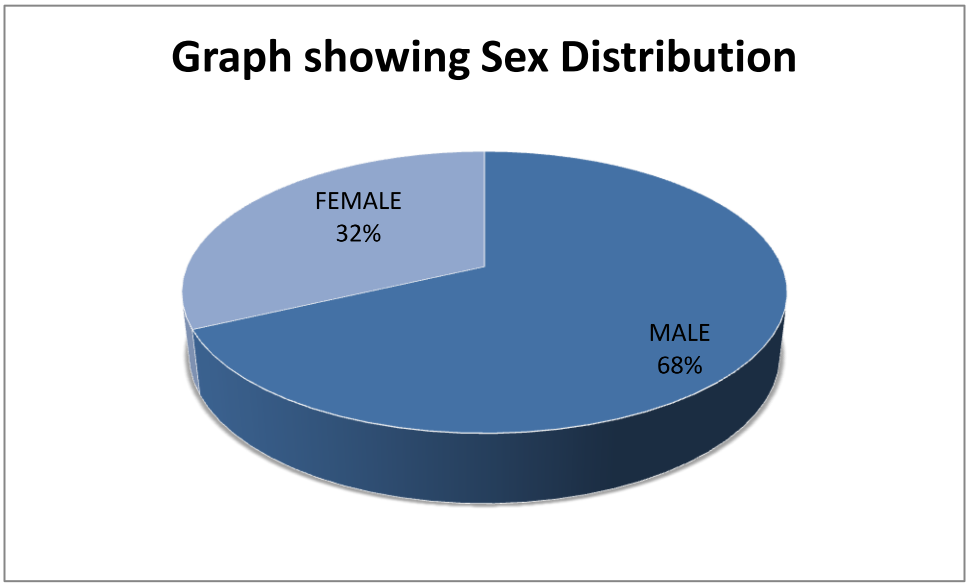


TABLE NO. 2

SEX	NO OF CASES	PERCENTAGE
MALE	34	68
FEMALE	16	32



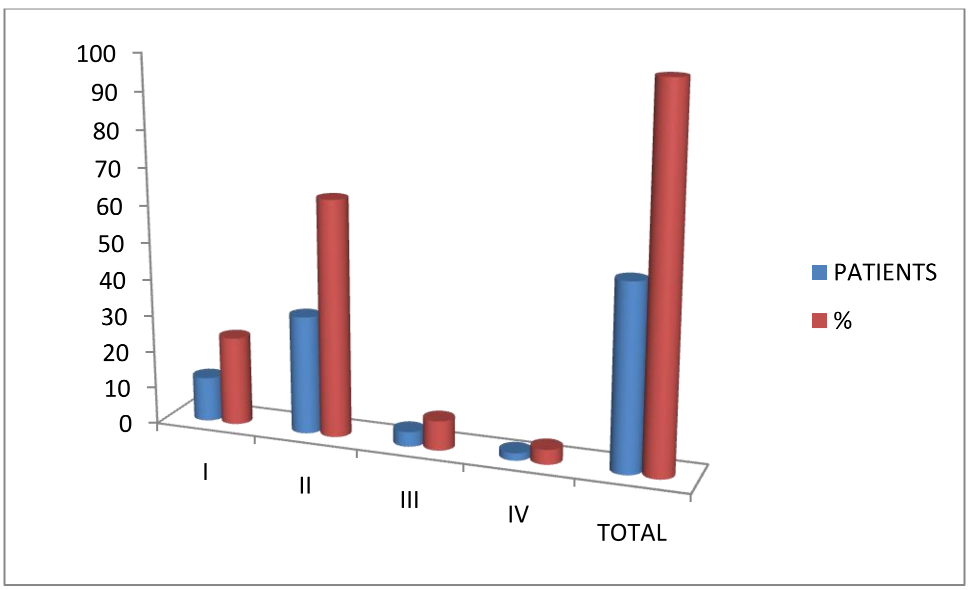
Maximum patients were in the age group of 60-69 & 50-59. There were 12 patients in the age group of <50 yrs .Trivial trauma was the cause in the elderly age group.These findings confirm that these are essentially fractures of elderly but number of young patients involved is increasing because of high velocity road traffic accidents.

Distribution of fracture according to Boyd and Griffins classification

Most of the patients in our study group were in grade II classification of Boyd and Griffin

TABLE NO. 3

GRADE	NO OF PATIENTS	%
I	12	24
II	32	64
III	4	8
IV	2	4
TOTAL	50	100

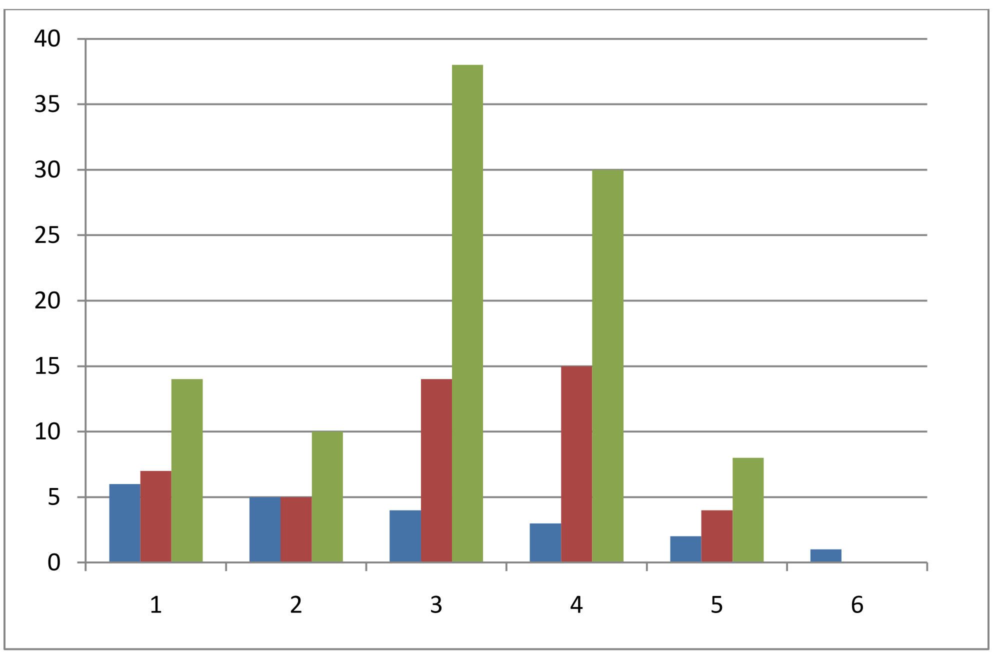


Distribution according to Singh's Index

In most of the patients level of osteoporosis was either 3 or 4 confirming that intertrochanteric fractures usually occur in osteoporotic bone.

TABLE NO. 4

	No of	**%**
6	7	14
5	5	10
4	19	38
3	15	30
2	4	8
1	0	0



Type of fracture and treatment availed:

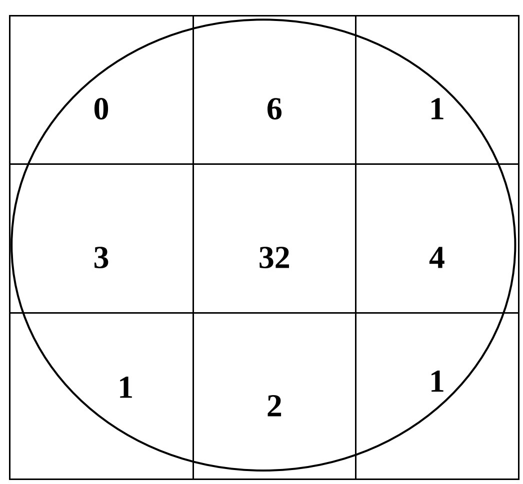
All fractures were classified according to Boyd and Griffin's classification. All the patients underwent operative treatment. of the 50 patients, 35 were stable fracture patterns and 15 were unstable, i.e. 70% stable and 30% unstable fractures

SCREW PLACEMENT

Assessment of screw placement was done by dividing femoral head into nine columns based on anterioposterior and lateral views,i.e. superior,middle and inferior in AP and anterior ,middle and posterior in lateral views.For the purpose of study screw placement were divided into central and off central groups.

TABLE NO

TYPE OF SCREW PLACEMENT	NO.
CENTRAL	32
OFF CENTRAL	18



TECHNIQUE OF FIXATION

All the fractures were fixed with Dynamic Hip Screw.

ANAESTHESIA

All the patients were operated under spinal anesthaesia/Epidural Anaesthesia.

AVERAGE HOSPITAL STAY:

The average hospital stay in the study group was 19.3.days. In most of the cases delay occurred due to associated medical illness, for arrangement of blood, & because of strictly allocated days to operate the patients in general ward.

MODE OF DISCHARGE:

Patient is allowed to sit up on bed on 2nd and 3rd day,

Static quadriceps exercises started from 2nd day, Hip and knee flexion exercises from 6 or 7 day,

Patient allowed non weight bearing walking from 10th day,

Suture removal done on post-op 12 th day

Partial weight bearing started on when radiological signs of union were present average 6th week post operative,

Full weight bearing after clinical and radiological union.

CAUSE OF LONG DURATION OF HOSPITAL STAY:

Superficial Infection in two cases was treated by usage of intravenous antibiotics based on culture sensivity.

TABLE NO. 6

COMPLICATIONS DURING AND AFTER OPERATIVE TREATMENT:

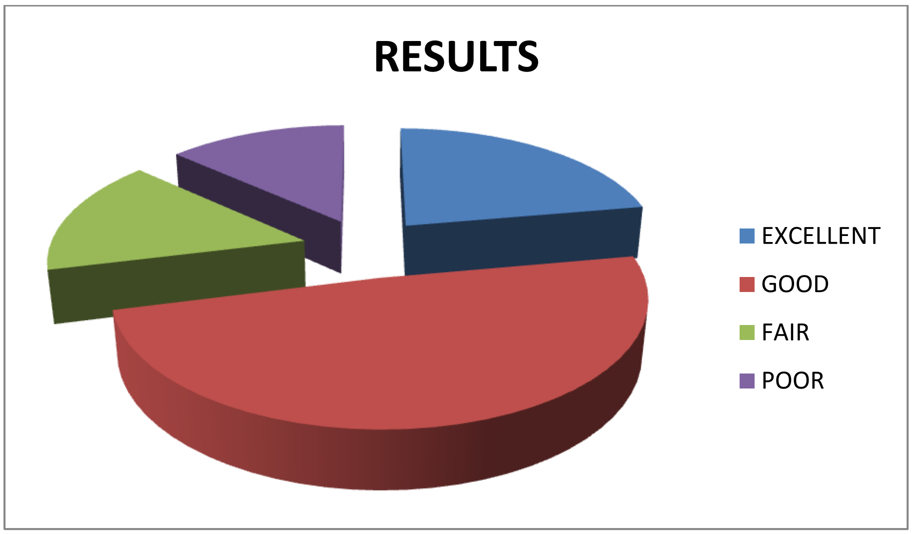
Complications.	No. of cases	Percentage
Technical error over driven screw.	0	0
Cut through neck.	0	0
Loss of fixation/penetration of screw into hip	0	0
Device into pelvis.	0	0
Superficial wound infection.	2	4
Deep sepsis.	0	0
Delayed union.	0	0
Non-union.	0	0
Cardiac arrest on operation table.	0	0
Foot drop due to neuropraxia of lateral popliteal	0	0
Mortality.	1	2
Bed sore.	0	0
Uremia.	0	0
Thread failure of screw with plate coming off postoperatively (implant failure).	0	0

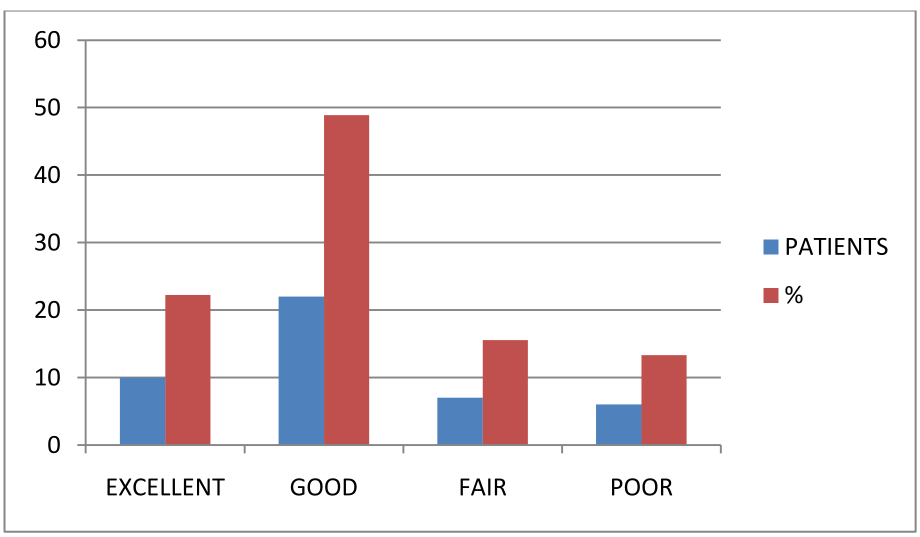
RESULTS

RESULTS OF 45 PATIENTS FOLLOWED UP

TABLE NO.6

RESULTS	NO OF PATIENTS	%
EXCELLENT	10	22.23
GOOD	22	48.89
FAIR	7	15.56
POOR	6	13.34





CRITERIA FOR EVALUATION AND RESULTS [KYLE'S CRITERIA 1976]

All patients after union or after 6 months were grouped and the anatomical and functional results evaluated as follows.

1.EXCELLENT

a. Fracture united
b. No pain
c. No infection
d. Full range of motion at hip.
e. No shortening.
f. Patient able to sit crossed legged and squat.
g. Independent

2. GOOD

a. Fracture united
b. Occasional pain
c. No infection
d. Terminal restriction of hip movements
e. Shortening up to half inch.
f. Patient able to sit crossed legged and squat.
g. Use of cane back to full normal activity.

3. FAIR -

a. Fracture united
b. Moderate hip pain
c. No infection
d. Flexion restricted beyond eighty degrees.
e. Noticeable limb shortening up to one inch.
f. Patient not able to sit crossed legged.
g. Patient walks with support of walker.
h. Back to normal activities with minimal adjustments.

1. POOR -

a. Fracture not united.

b. Pain even with the slightest movement at hip or rest.

c. Infection

d. Range of movements at hip restricted,Flexion restricted beyond sixty degrees.

e. Shortening more than one inch.

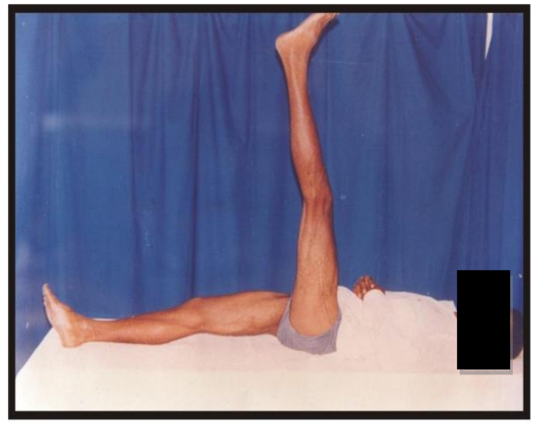
f. Patient not able to sit crossed legged or squat.

g. Patient cannot walk without walking aid.

h. Normal activities not resumed.

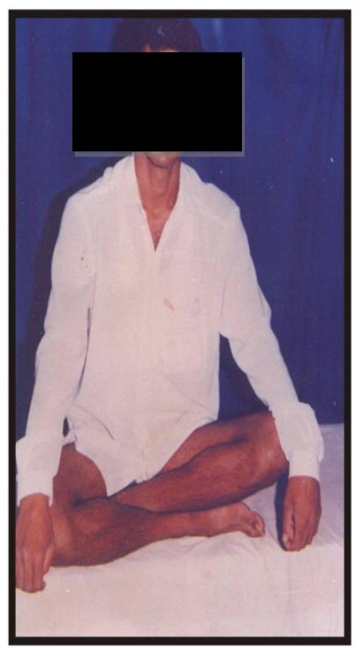
RESULT : EXCELLENT

Patient in squatting position



Patient lifting the leg on operated side

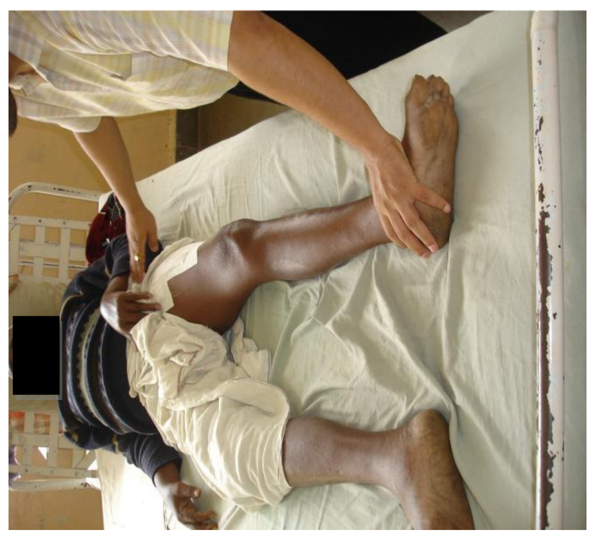
Patient standing full weight bearing



Patient sitting cross legged

RESULT: GOOD

RESULT: FAIR



RESULT: POOR

DISCUSSION

At present it is generally believed that, all intertrochanteric fractures should be internally fixed to reduce the morbidity and mortality by early ambulation, but differences still exist regarding the type of implant to be used, hence in this stud y results after treatment with DHS are analyzed.

In the present study, the average age 55.46 yrs was comparable to those of other Indian authors, and most of the western authors. We had more male to female ratio2.12:1, like male preponderance in most of Indian authors, unlike female in most western authors.

In the present study, type II fractures were the most common 64% and type III and IV fractures comprised 12% and are comparable to Boyd and Griffins[12], but are in contrast to Pathak[48]. We did not encounter pathological fractures in our study which were seen in other series between 20 to 25% Waddell[51]

Ecker[107] in their study stated operative treatment is the procedure of choice for intertrochanteric fracture if a skilled anesthetist and surgeon, adequate instruments operation theatre conditions are available and more debilitated the patient is, more the need for surgery. The goal of the treatment is to restore the patient to the preoperative status as early as possible with open reduction and stable internal fixation to allow early ambulation. Marty[121] in their study Quality adjusted life years and cost of several type hip fracture with various treatment options showed that operative treatment proved cost effective than conservative treatment for extra capsular fractures. In this study all cases were operated.

Dolk[115] in his study found no difference in mortality and hospital stay between those operated within 8 hrs of admission and those treated within 48 hrs of admission, indicating that there was no need to operate on those as emergencies.

It is important before treatment to distinguish using radiograph stable or unstable intertrochanteric fractures, based on fracture geometry and the ability to restore the cortical contact medially and posteriorly by reduction. Without posteromedial contact the proximal fragment remains unstable in varus and retroversion. The number one error in the treatment of intertrochanteric fractures is poor evaluation of fracture stability pre operatively, therefore proper tracing and planning based on roentgenograms is essential,which was strictly carried out in our study. Gustilo[122] reported an infection rate of 3 to 5 % without preoperative

prophylactic antibiotics. In our study only 2 cases of superficial infection occurred of 50 (4%) cases, the patients were given betadine local application before entering operation theater, all patients were given intravenous antibiotics 8 hours pre operatively and at the time of induction of anesthesia and for 48 hrs in the post operative period.

All the cases in this series were operated using fracture table we have found following advantages in using fracture table.

1. Reduction done with traction is easier
2. Less assistance is required
3. Manipulation is reduced to minimum
4. Trauma and shock are reduced
5. Roentgenograms may be used without changing the position of hip,

exposing the surgeons to radiation or contaminating the sterile field is minimized.

The goal of surgical treatment is strong stable fixation of the fragments; Kaufer[101] has listed the following variables that determines the strength of the fracture fragment and implant assembly 1.Bone quality 2.Fragment geometry 3.Reduction 4.Implant design and 5. Implant placement.

Most patients with intertrochanteric fracture have considerable osteopenia with quality of the bone for purchase of fixation within the head is less than desirable. It is therefore important that the lag screw is placed in that part of the head and neck where the quality of the bone is best. In 1938 the internal trabecular system of the femoral head was first described by Ward. The orientation of the trabecule is along the line of the stress. With thicker trabecule coming from the calcar and passing superiorly into the weight bearing dome of the femoral head, smaller trabacule extend from inferior region of the foveal area across the head and the superior portion of the femoral neck and into the trochanter and hence to the lateral cortex. The calcar is a dense vertical plate of bone extending from posteromedial portion of the femoral shaft under the lesser trochanter and radiating laterally into the greater trochanter, serving to reinforce the femoral neck posteroinferiorly. The calcar is thickest medially and gradually thins as it passes laterally. Therefore quality of the bone for purchase within the head and neck varies from one quadrant to another. Davis et al[53] favored the central portion on both views but according to Mainds[116] ventral or inferior portion in anteroposterior view is best. In our study, most of the cases were either 3 or 4 Singh's index confirming that these fractures are mainly pathological fractures.

According to Parker[63] screw should be placed centrally or inferiorly on anteroposterior view and centrally on lateral view. In this study the same principle of placement of screw was followed.

Cutting out of DHS related to its position according to Jensen[25] is 53% and that according to Davis[53] is 16.8%, in this study there was no cut through of lag screw.

Reduction of the intertrochanteric fracture may be carried out either by open or closed means. In either circumstance the objective is to achieve a stable reduction, be it anatomical or non-anatomical in configuration. Closed manipulation should be initially attempted with anaesthetized patient on fracture table securing extremities in the foot pieces and by traction on slightly abducted extremities to reduce the fracture. Depending on the fracture type, a position of neutral to external rotation is required. Usually more the comminution, especially when lesser trochanter is large and displaced, more the external rotation required to close the posterior defect. Image intensifier was used to assess the quality of reduction with special attention to cortical contact medially (anteroposterior view) and posteriorly (lateral view). If stable, fixation was done in this anatomical reduction. Otherwise open reduction to achieve an anatomical reduction of medial and posterior cortical support may be accomplished relatively easily by adjusting the traction and rotation if the fracture is not severely comminuted. If the fracture is severely comminuted, anatomical reduction even by open reduction may be difficult. If adjusting the rotation does not close posteromedial defect and the lesser trochanter remains significantly displaced, anatomic reduction is difficult. In such circumstances non-anatomic but stable reduction obtained by elective medial displacement of the femoral shaft has been used by Dimon Hugston[117]

to achieve stability followed by internal rotation. Sarmiento and Williams[120] have advocated an osteotomy to position the head and neck fragment in more valgus thus securing better medial stability than can be achieved by simple medial displacement. Most of the currently available internal fixation devices for treatment of intertrochanteric fractures can be exceeded to yield satisfactory results. Regardless of the device selected, fracture reduction and stability are most important factors.

The depth of insertion of the lag screw into the head is critical for maximum purchase on the proximal fragment. Most agree that it should be inserted within 1 cm of the subchondral bone. This principle has been followed in our series.

Sonstegard[118] studied the influence of type of implant (Jewett nail, DHS implant, Holt nail) and the geometry of reduction and they concluded that geometry of reduction has no effect on fixation. They think that most of the load is borne by the implant rather than the bone and that the strength of the dynamic hip screw appliance exceeds the normal load and results in few incidence of failure compared to other implants. Gurter reported a bio-mechanical evaluation of fixation of unstable fractures with Enders pins, Harris condylocephlic nails and compression hip screws. They found that the dynamic hip screw was five times more rigid than condylocephalic nails.

Esser[119] found no difference between dynamic hip screw and Jewett Nail plate regards to length of hospital stay, mortality and morbidity, but at the end of six months more patients treated with dynamic hip screw were mobile with significant radiological evidence of better compression without loss of fixation.

Moore[11] in a comparison of treatment with Richard's dynamic hip screw and Jewett Nail plate for intertrochanteric fractures found that reoperation rate with Jewett nail and plate was 13% compared to 6.5% with Richards dynamic hip screw. This was because of more frequent implant penetration in to the hip joint and superior cut through with Jewett nail and plate, as this is rigid implant compared to Richards screw, which is a dynamic implant. In our series, no case was operated for implant failure.

Chang compared the result of compression hip screw fixation with anatomic reduction versus fixation with medial displacement and found that in four parts intertrochanteric fracture, anatomic reduction with dynamic hip screw, regardless of the presence of a postermedial fragments, provided significantly higher compression across the calcar region and significantly lower tensile strain on the plate than did medial displacement osteotomy. In this study, anatomical reduction was done in 41 (82%) patients, Dimon Hughston ostetomy in only 9 (18%)cases. There was no significant difference in healing of the fractures between these two methods.

The common changes of the fracture fragments confirming instability of fracture are, shortening because of posterior collapse and varus of the neck shaft angle, because of increasing retroversion of the neck. When shortening occurs, fixation appliance extrudes out through the head into the acetabulum, this is especially common with the fixed nail plate devices such as Jewett nail plate or Enders pins. It does not occur with DHS if the lag screw has enough space in the barrel for sliding. Significant changes into varus and retroversion may result in the screw cutting through the anterosuperior part of the head, or appliance breakage at the screw plate junction or plate pulling away from the shaft of the femur if the plate does not break. None of these complications were noted in our series.

Compression hip screw plate system:

Sliding or telescoping nail plate combinations designed originally for subcapital fractures by Hunter[26] were used in intertrochanteric fractures, which allows settling of unstable fracture fragments but while maintaining neck shaft angle. Good results were reported by Charnley, Hunter[26], Hornby[52] Larson[54], Rao[45] with lesser complications such as breakage (strength is more than nail plate), nail cutout or intrusion than other devices .Kaufer[101], Clawson[106] Moore[11], Wolfgang[41] noted mechanical complications in 9% of stable and 19% of unstable fractures and shortening of 1.5 to 2.0 cms. Parameters of pain, mobility and fracture compression showed no difference between Jewett nail plate and Dynamic hip screw but at 6 months, showed in favor of Dynamic hip screw More[11]. Campbell’s clinic used this device for all intertrochanteric fractures. No difference in functional results compared with intramedullary devices as shown by Baumgaertner[64].Today’s best answer for stabilization of intertrochanteric fractures is Sliding compression screw according to Dopplet [114].

We feel that Dynamic hip screw system gives good results in stable intertrochanteric fractures, or unstable fractures, made stable by Dimon and Hughston/Sarmiento technique or anatomical reduction.

SUMMARY

Of the 50 cases, 70% (35 cases) were unstable and 30%(15cases) were stable cases (determined by posteromedial communition and placement of beak of proximal fragments).

- Anatomical reduction was achieved in 82% (41cases) of the patients and 18%(9cases) of the patients underwent Dimon and Hughston medialisation osteotomy.
- 38% cases had grade 4 osteoporosis and 30% had grade 3-osteoporosis rest of the patients were having grade 2(8%), grade 5(10%), grade 6(14%), and grade 1(0%), according to Singh's index.
- Average hospitalization period was found to be 19.3days. In cases associated with medical illness and arrangement for blood were the cause of delay and prolonged the duration of hospital stay.
- Infection rate was 4% (2 cases), both of them being superficial infection treated with daily dressing for days with betadine,spirit and antibiotics based on culture report.
- All the Patients were allowed to sit up on bed on 2^{nd} and 3^{rd} post operative day.

Static quadriceps exercises started from 2nd day. Hip and knee flexion exercises from 6 or 7 day. Patients were allowed non weight bearing walking form 10^{th} day,Suture removal was done on 12^{th} post-operative day. Partial weight bearing started on when radiological signs of union were present average 6^{th} week post operative. Full weight bearing after clinical and radiological union

- All patients were made to walk with support till the signs of healing were seen radiologically. Older patients were mobilized on walker support while younger patients were mobilized on axillary crutches or elbow crutches according to the comfort of the patients.
- Patients who had osteomalacia and whose bones were grossly osteoporotic were treated with vit -D and calcium substitutes. There were no cases of avascular necrosis of femoral head.
- Out of 45 cases followed up 22.23 % had excellent results. 48.89% had good results, 15.56% had fair results 13.34% had poor results. Poor results were due to improper implant positioning, infection and failure to follow the advice of surgeons

CONCLUSION

- Intertrochanteric fractures are essentially fracture of elderly, with osteoporotic bones but incidence among younger population increasing because of high velocity road traffic accidents.
- Most of the fractures belong to grade II classification of Boyd and Griffin
- Dynamic hip screw is the operative treatment of choice for the treatment of intertrochanteric fractures.

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ANNEXURE –I

INFORMED CONSENT FORM

BLDEU’S SHRI B. M. PATIL MEDICAL COLLEGE HOSPITAL AND RESEARCH CENTRE, BIJAPUR- 586103.

TITLE OF THE PROJECT - “ROLE OF DYNAMIC HIP SCREW IN THE MANAGEMENT OF INTERTROCHANTERIC FRACTURES OF FEMUR”

PRINCIPAL INVESTIGATOR - DR. AJAY KUMAR

P.G.GUIDE NAME - DR. ASHOK.R.NAYAK

PROFESSOR OF ORTHOPAEDICS

All aspects of this consent form are explained to the patient in the language understood by him/her.

I) INFORMED PART

1) PURPOSE OF RESEARCH:

I have been informed that this study is a surgical management of inter trochanteric fractures by Dynamic Hip Screw. I have also been given a free choice of participation in this study. This method requires hospitalization.

2) PROCEDURE:

I am aware that in addition to routine care received I will be asked series of questions by the investigator. I have been asked to undergo the necessary investigations and treatment, which will help the investigator in this study.

3) RISK AND DISCOMFORTS:

I understand that I may experience some pain and discomfort during the examination or during my treatment. This is mainly the result of my condition and the procedure of this study is not expected to exaggerate these feelings that are associated with the usual course of treatment.

4) BENEFITS:

I understand that my participation in this study will help to study the results of Dynamic hip screw in the management of intertrochanteric fracture by analysing the factors which influence post-operative mobility.

5) CONFIDENTIALITY:

I understand that the medical information produced by this study will become a part of Hospital records and will be subject to the confidentiality and privacy regulation. Information of a sensitive personal nature will not be a part of the medical records, but will be stored in the investigator's research file and identified only by a code number. The code-key connecting name to numbers will be kept in a separate location.

If the data are used for publication in the medical literature or for teaching purpose, no name will be used and other identifiers such as photographs and audio or videotapes will be used only with my special written permission. I understand that I may see the photographs and videotapes and hear the audiotapes before giving this permission.

6) REQUEST FOR MORE INFORMATION:

I understand that I may ask more questions about the study at anytime. Dr. Ajay kumar is available to answer my questions or concerns. I understand that I will be informed of any significant new findings discovered during the course of the study, which might influence my continued participation.

If during the study, or later, I wish to discuss my participation in or concerns regarding this study with a person not directly involved, I am aware that the social worker of the hospital is available to talk with me. A copy of this consent form will be given to me to keep for careful reading.

7) REFUSAL OR WITHDRAWAL OF PARTICIPATION:

I understand that my participation is voluntary and that I may refuse to participate or may withdraw consent and discontinue participation in the study at any time without prejudice to my present or future care at this hospital. I also understand that Dr. Ajay kumar may terminate my participation in the study after he has explained the reasons for doing so and has helped arrange for my continued care by my own physician or physical therapist, if this is appropriate.

8) INJURY STATEMENT:

I understand that in the unlikely event of injury to me resulting directly from my participation in this study, if such injury were reported promptly, the appropriate treatment would be available to me, but no further compensation would be provided. I understand that by my agreement to participate in this study I am not waiving any of my legal rights.

I have explained to ____________________________the purpose of the research, the procedures required and the possible risks and benefits to the best of my ability in patient's own language.

____________________ ____________________

Dr. Ajay kumar Date

(Investigator)

II) **STUDY SUBJECT CONSENT STATEMENT:**

I ,the undersigned have been explained by Dr. ASHOK NAYAK in the language understood by me. The purpose of research, the details or procedure that will be implemented on me.The possible risks and discomforts of surgery and anaesthesia have been understood by me. I have also been explained that participation in this medical research is solely the matter of my will and also that I have the right to withdraw from this participation at any time in due course of the medical research.

____________________ ____________________

Participant / Guardian Date

____________________ ____________________

Signature of Witness Date

ANNEXURE – II

SCHEME OF CASE TAKING:

Name: I P No:

Age/Sex: DOA:

Occupation: DOS:

Residence: DOD:

Presenting complaints with duration:

History of presenting complaints:

Family History:

Personal History:

Past History:

General Physical Examination

Pallor:	present/absent
Icterus:	present/absent
Clubbing:	present/absent
Generalized Lymphadenopathy:	present/absent
Build:	Poor/Middle /Well
Nourishment:	Poor / Middle / Well

Vitals

PR: RR:

BP: TEMP:

Other Systemic Examination:

- Respiratory System
- Cardiovascular System
- Central Nervous System
- Per Abdomen

Local examination

Gait:

Inspection:

- Deformity and Attitude
- Shortening
- Swelling
- Skin
- Wounds,if any
- Other fractures ,if any

Palpation:

- Tenderness
- Pain elicited on manipulation
- Local bony irregularities
- Swelling

<u>Movements</u> : (Post operative except in old malunion)

		Active	Passive
Hip	: Flexion		
	Extension		
	Internal rotation		
	External rotation		
	Adduction		
	Abduction		
Knee :	Flexion		
	Extension		

Measurements : Apparent length : Xiphisternum to Medial malleolus

True length : Anterior superior iliac spine to Medial malleolus

Anterior superior iliac spine to Medial Joint Line

Medial joint line to medial malleolus

Bryant's triangle

Nelaton's line

Stability test : Telescopic Test

Tredlenburg's test

Abnormal Mobility

Crepitus/Grating of fragments

Absence of transmitted movements

INVESTIGATION:

Blood: Urine:

Hb%	Albumin
TC	Microscopy
DC	Sugar
ESR	
BT	
CT	
BLOOD UREA	
SERUM CREATININE	
RBS	

X-Ray : Chest PA view

ECG:

Final Diagnosis:

Details of Surgery:

- Type of fixation used
- Stability on operating table
- Anatomical Reduction achieved Yes /No
- Intraoperative complications ,if any
- Blood Loss

Post operative Management:

- Mobilization:
- Wound healing and suture removal
- Complications:

Date of Discharge:

Condition at discharge:

- ➢ Clinical:
- ○ Shortening if any
- ○ Complications if any
- ○ Deformity
- • Flexion
- • Adduction/Abduction
- • Rotational
- ○ Range of movements:

	Active	Passive
• Flexion		
• Adduction		
• Abduction		
• Internal rotation		
• External rotation		

- • Follow up(4-6 weeks)
- ➢ Clinical
- • Patient complaints

1. Pain
2. Limp.
3. Any other.

- • Deformity

2. Flexion
3. Adduction/Abduction
4. Rotational

- Movements   Active   Passive

1.Flexion

2.Adduction

3.Abduction

4.Rotation

- Quadriceps

1.Wasting

2.Power

- Shortening

Radiological:

- Position of implants
- Position of fragments

FOLLOW UP:

(After 8-10 weeks)

➢ Clinical

- Patient complaints
    1. Pain
    2. Limp
    3. Any other
- Deformity
    1.Flexion
    2.Adduction
    3.Rotational

- Movements Active Passive

1.Flexion

2.Adduction

3.Abduction

4.Rotation

5.Squatting

- Easy
- Difficult
- Not possible

6.Sitting cross legged

- Easy
- Difficult
- Not possible
- Quadriceps
- Wasting
- Power
- Shortening compensation if any
- Walking distance
- Free
- Pain less
- Pain mild
- Pain severe
- With aid
- Pain less
- Pain mild
- Pain severe
- Job resumed

- Date of resuming duty

- Radiological
  - Fracture union and date
  - Position of implant
  - Position of fragments