"A STUDY OF SURGICAL MANAGEMENT OF INTERTROCHANTERIC FRACTURE OF FEMUR WITH DYNAMIC HIP SCREW"

By

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LIST OF ABBREVIATIONS USED

AVN : Avascular Necrosis

BA : Bronchial Asthma

DHS : Dynamic Hip Screw

HP : Hemiparasis

OA : Osteoarthritis

OPD : Out Patient Department

RTA : Road Traffic Accident

TAD : Tip Apex Distance

ABSTRACT

Background and Objectives:

Intertrochanteric fracture is a leading cause of hospital admissions in elderly people. The number of such admissions is a rise because of increasing life span & sedentary habits. Conservative methods of treatment result in malunion with shortening and limitation of hip movement as well as complications of prolonged immobilization like bed sores DVT and respiratory infections. This study is done to analyze the surgical management and traumatic fractures using Dynamic Hip screw.

Methods:

This is a prospective study of 30 cases of fresh intertrochanteric fractures admitted to R.L.Jalappa hospital attached to Sri DevrajUrs Medical College,Kolar, between September 2008 to September 2010. Cases were taken according to inclusion and exclusion criteria i.e., patients with intertrochanteric fracture above the age of 18yrs. Medically unsuitable and old malunited intertrochanteric fractures were excluded from the study. Operation was done keeping the Tip Apex Distance (TAD) into consideration.

Results:

The study shows sex ratio of 7:3 (M:F) with maximum presentation between 51 to 65yrs with an average of 54yrs. Mode of injury was more due to fall, 24(80%); followed by RTA, 6(20%). Right side was slightly more than Left side. R:L = 19 (63.3%):11 (36.6%). 13.3% of patients had associated injury. Type II fractures were maximum with 19 cases followed by Type III&I 5& 4 cases each. Post operative results were found to be excellent in 6(20%), Good in 13(43.3%), Fair in 10(33.3%) and poor in 1(3.3%).

Conclusion and Interpretation:

This study shows that intertrochanteric fracture is common in elderly population with male preponderance mainly occurring between 51-65 years. Common mode of injury being trivial fall, right side being slightly more involved in injury. Early operative intervention with Dynamic hip screw with 135^0 side plate with barrel gives good results, helps early mobilization of elderly patients decreasing morbidity & mortality and achieves rigid fixation even in osteoporotic bone.

MESH KEY WORDS:

Bone screws; Femoral Fractures/Surgery; Fracture Fixation; Hip Fractures/Surgery

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INTRODUCTION

Intertrochanteric fractures are common in the elderly people. The frequency of these fractures has increased primarily due to the increasing life span and more sedentary lifestyle brought on by urbanization. Intertrochanteric fractures occur in the younger population due to high velocity trauma, whereas in the elderly population it is most often due to blunt trauma.

The incidence of intertrochanteric fractures is more in the female population compared to the male due to osteoporosis. In a Swedish study of more than 20,000 patients, the incidence of hip fractures in women doubled every 5.6 years after the age of 30 years.

Inspite of the advances in anesthesia, nursing care and the surgical techniques. hip fractures remain a significant cause of morbidity and mortality in the elderly population.

The intertrochanteric fractures can be managed by conservative methods and there is usually union of the fracture. If suitable precautions are not taken the fracture undergoes malunion, leading to varus and external rotation deformity at the fracture site and shortening and limitation of hip movements. It is also associated with complications of prolonged immobilization like bedsores, deep vein thrombosis and respiratory infections.

Since this fracture is more common in the elderly patients, the aim of treatment should be prevention of malunion, and early mobilization. Taking all the factors into consideration surgery by internal fixation of the fracture is ideal choice.

There are various forms of internal fixation devices used for intertrochanteric fractures ; Of them the most commonly used device is the Dynamic Hip Screw with Side Plate assemblies. 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.

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

AIMS & OBJECTIVES

- To analyze the union of intertrochanteric fracture, internally fixed with dynamic hip screw.

- To study the outcome of the procedure with respect to early mobilization and return to prefracture ambulatory status.

- Assessment of results based on subjective parameters (like pain, ability to squat or sit cross legged and walking), objective parameters (like deformity, range of movements of the hip and limb length) and radiological findings (like fracture union, consolidation, neck shaft angle and position of the implant), after clinical and radiological union, and comparison with previous studies.

REVIEW OF LITERATURE

HISTORICAL REVIEW

Till the third decade of the twentieth century intertrochanteric fractures were treated conservatively. Conservative treatment regimes included simple support with pillows or splinting to the opposite limb, Buck's (skin) traction, well-leg traction, plaster spica immobilization, Russell's balanced traction and skeletal traction through the lower femur or upper tibia.

The first recorded case of internal fixation of a fresh fracture is thought to be that of brass cerclage wiring of the humerus in 1775.[1]

Von Langenbeck [1] first used an advanced form of stabilization with the use of a hip nail in 1850.

In 1875, **Konig**[1] reported the use of ordinary wood screws for the fixation of femoral neck fractures.

In 1916, **Heygroves**[1] introduced the quadriflanged nail, which was designed to obtain better fixation of the femoral head and prevent cutout.

In 1931, **Smith-Peterson**[1] reported their series of open nailing with the triflanged nail. They advocated open reduction, impaction and internal fixation of the fracture.

Johansson[1] in 1932 and **Westcott**[l] in 1934 introduced the cannulated hip nail for more accurate placement in the femoral head. This technique was the precursor for the current techniques of using guide pins for accurate placement of fixation devices in the stabilization of hip fractures.

In 1937, **Lawson Thornton**[2] developed a plate to be attached to the Smith Peterson nail, called the **Thornton plate.** This was a breakthrough in the history of operative treatment of trochanteric fractures.

In the 1940s **Gerhard Kuntsher**[1] developed the double nail to treat complex fractures of the hip and femoral shaft.

In 1941, **E. L. Jewett**[3] devised a single piece angled nail plate called **Jewett nails** and used it for internal fixation of intertrochanteric fractures.

In 1947, **Mc Laughlin**[4] introduced the adjustable nail plate combination. He used triflanged nail with its lateral end having a slot to which a plate is fixed with a washer and bolt.

In 1949, **Merwyn Evans**[5] devised a classification dividing intertrochanteric fractures into stable and unstable types. He presented 101 cases treated conservatively and 22 cases treated by internal fixation with Capener Neufeld nail plates and suggested that internal fixation of trochanteric fractures has the advantages of early mobility of the patient and lowered mortality.

In 1950, **Earnest Role**[6] in Germany was the first to use a sliding device for internal fixation of intertrochanteric fractures.

The Zickel nail was introduced by **Dr. Robert Zickel**[l] in the 1950s and is a descendent of Kuntscher's Double nail.

In 1955, **Pugh and Badgley**[7] introduced a sliding device with trephine tip in USA. In the same year, **Schumpelick**[8] described the use of a sliding nail device.

In 1958, **Massie**[9] introduced a sliding nail plate fixation, which caused impaction.

In 1959, **Cleveland**[10] reported an overall failure rate of 20% after fixation of 229 fractures with a Jewett nail plate.

In 1962, **Massie**[11] modified the sliding nail plate device to allow collapse and impaction of the fragments, which lead to improved results in the treatment of intertrochanteric fractures.

In 1964, **Clawson**[12] reported the treatment of intertrochanteric fractures using Sliding Compression Screw and Jewett nail. In 39 stable fractures treated with sliding screws there were only 5.2% failure rate. In the 26 unstable fractures treated with sliding screws there was a failure rate of 11.5%. In the fractures stabilized with jewett nail plate device, most of which were stable fractures failure rate was about 32%. The **Richards Manufacturing Company** and **Mr. Ian McKenzie** of the Royal National Orthopaedic Hospital developed the Sliding Compression Screw used. **Clawson** made several modifications, and in its current form the device is known as the Richards Compression Screw.

In 1966, **Kuntscher G**[13] introduced the 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.

Mulholland and Gunn [14] in 1972 reviewed 350 intertrochanteric fractures treated with a sliding hip screw. They confirmed that stable fractures could be treated satisfactorily with virtually any rigid internal fixation device. They also pointed out that recognition of the unstable fracture was often difficult. The overall failure rate was 4.8%. They also noted that there would be an impaction of about 2 cm in stable fractures.

Augusto Sarmiento[l5] in 1973 emphasized that the reduction of the medial cortex determines the efficiency of the metallic appliances. Improper reduction of medial cortex resulted in collapse into varus with migration of the nail out of the neck. Fractures nailed after accurate reduction of the medial cortex can withstand stresses several times greater than the nail itself. Osteotomy gives maximum stability and in addition would change the angle of inclination of the fracture to a less vertical degree and introduces a valgus attitude to the proximal femur. Sarmiento also mentions that in some fractures medial comminution is so extensive that osteotomy will not create enough bony contact to ensure stability.

Sahlstrand T[I6] in 1974 reported the results of using the Richards Compression Sliding Hip screw system, in the treatment of 48 intertrochanteric fractures. He noted that this system could stabilize the fracture to such an extent that it is possible to mobilize the patient to walking with full weight bearing on the operated leg within a few days. The results were also compared with those previously obtained when Mac Laughlin plate was used, and the advantages were in the form of better fixation, easy rehabilitation, and a shorter length of hospital stay.

Jacobs[17] in 1976, reviewed 72 patients with Jewett nail and 101 with Richards Compression Hip Screw and noted that both the devices maintained adequate reduction. Loss of fixation, symptomatic joint penetration, aseptic necrosis, malunion and non-union occurred in 25% of Jewett nail cases and 6% of Richards screw cases.

Jensen[18] in 1978, reported 80 unstable fractures stabilized with compression screw, and the overall rate of joint penetration and cutting out of the device was 5.3%.

Doherty John H and Lyden John P[19] in 1979, reported 75 patients treated with hip compression screws. There were 4 cases in which the lag screws were inserted twice into the femoral head. They concluded that central placement of the screw in the femoral head with its tip 10-13 mm. from the subchondral bone is ideal and the design of the compression screw allows increased stability and impaction of the bone fragments in an intertrochanteric fracture.

Cameron and Graham[20] in 1980, reported two cases of disengagement of sliding screw from the side plate and re-emphasized that compression screw should not be removed when this device is used in the treatment of unstable intertrochanteric fractures.

Gary L. Wolfgang, Michael H. Bryant and James P. O'Neill[21] in 1982, in a retrospective study of 295 hips in 287 patients noted that the average time in achieving full weight bearing in 179 hips with available films was 13.6 weeks, stable fractures averaging 11.7 weeks and unstable fractures averaging 19.1 weeks. Specific fracture complications included five mal-unions, three delayed unions, three non-unions and two disengagement of lag screw. They concluded that sliding hip screw has been shown to be a reliable means of internal fixation of intertrochanteric fractures.

Juluru P. Rao, Manuel T. Banzon, Andrew B. Weiss[22] in 1983 reviewed 162 cases of unstable intertrochanteric fractures treated by anatomic reduction and compression hip screw fixation. The average age of the group was 74 years. 110 patients were women and 52 were men. 124 patients were followed by radiological examination and clinical evaluation for an average of 19.2 months. The average time from surgery to full weight bearing was 3 weeks and average healing time was 18 weeks. Loss of fixation occurred in 5 cases with the nail cutting out and the fracture going into varus position. 84% of the patients were ambulatory and the average range of hip motion was 80%. The authors report that the advantage of DHS technique is that weight bearing can be started early.

Kulkarni GS[23] in 1984, reported 140 cases of intertrochanteric 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.

Juluru P. Rao, Mark Hambly and John King[24] in 1988, compared the results of compression screw fixation and Ender's rod in intertrochanteric fractures of the hip. A retrospective analysis of 77 cases of both stable and unstable intertrochanteric fractures showed a higher incidence of complications in the Ender's group. The complications included implant backing out, distal femoral fractures, need for a secondary procedure, external rotation deformity and knee pain. Indications for the use of Ender's rod may be found among the patients with burns, soft tissue injuries of the proximal thigh. The authors report that the most popular method of internal fixation of both stable and unstable intertrochanteric fractures is the sliding compression hip screw, with high union rates. The disadvantages are wide exposure and infection.

Marc Mariani E. and Rand JA[25] in 1989 reported 3 cases , in which the position of the sliding screw was in the superior aspect of the femoral head with subsequent sub capital fracture. They reported that placement of screw tip to within 1 cm of subchondral bone avoiding the antero-superior quadrant of the femoral head may prevent this complication.

In 1990 , **Medoff** [26] modified the side plate and designed a modular side plate that allow collapse and impaction along the axis of the femoral shaft known as the **Medoff Sliding Plate.**

Davis T., Sher JL and Horsman A [27] in 1990 in a prospective study assessed the causes of mechanical failure in a series of 230 intertrochanteric fractures which were internally fixed with either a sliding hip screw or a Kuntsher Y- nail. The overall failure rate of mechanical failure was 16.5% with sliding device and reported that the implant should be centrally placed within the head to reduce these complications.

Bryan D ,Den Hartog[28] in 1991, in a study conducted on fresh frozen femora from cadaver concluded that re-establishment of medial cortical contact,use of a high angle plate and placement of the lag screw in the center of the head as seen on the anteroposterior and lateral roentgenograms significantly increases the mean load to failure and decreases the rate of failure of fixation of unstable intertrochanteric fractures.

Bridle SR, Patel AD and Bricher M[29] in 1991, in their study prospectively compared the fixation of 100 intertrochanteric fractures in the elderly patients with random use of either a dynamic hip screw or a new intramedullary device, the gamma nail. They found no difference in the operating time, blood loss, wound complications, and stay in hospital or the patient's mobility at final review. But in 4 cases, fractures of the femur occurred close to the gamma nail requiring further major Surgery.

Martyn J. Parker[30] in 1992 studied the screw position in 25 patients, In whom the screws later cut-out was compared with the position in 200 cases in which there was radiographic evidence of bone union without cut-out. They defined cutting out as projection of the screw from the femoral head by more than I mm. The femoral head is divided into superior, central and inferior segments for AP view and anterior, central and posterior segments for lateral view. The measurement of the position of the screw allowed statistical evaluation of the results, showing that cutout was more frequent when screws were placed superiorly or posteriorly. The aim should be to place the screw centrally or inferiorly on the AP view and centrally on the lateral view.

O'Brien PJ, Meek RN, Blachut PA and Sabharwal S[31] in 1995, compared the fractures treated with DHS and Gamma nail. There was no significant difference between the two groups with respect to intra-operative blood loss, days of hospital stay, time to union and eventual functional outcome. The length of the procedure and fluoroscopy time was longer for the gamma nail group and the DHS was associated with a lower risk of local complications. Hence the DHS is still considered to be the implant of choice for intertrochanteric fractures.

Butt MS, Krikler SJ and Nafie S[32] in 1995, in their study DHS was used in 48 patients and the Gamma nail in 47 patients. Clinical and radiological outcomes were similar, but gamma nail was associated with a higher incidence of complications, in particular fracture of the femur below the implant in 8 cases. The authors do not recommend the use of gamma nail for the treatment of peritrochanteric fractures.

Baumgaertner Michael R[33] in 1995, studied the value of tip apex distance in predicting the failure of fixation of peri trochanteric fractures of the hip in a study of 198 fractures in the AP and Lateral radiographs. They concluded that the average tip-apex distance should be 24mm. for successful fixation of peritrochanteric fractures.

Parker MJ and Pryor GA[34] in 1996 compared Gamma nail with DHS. Results showed that the gamma nail had a significantly increased risk of fractures of the femoral shaft and an increased re-operation rate. The gamma nail cannot be recommended for routine use in trochanteric fractures, until the problem of femoral shaft fracture is resolved.

Wagner R, Weckbach A, Sellmair V and B1attert T[35] in 1996, treated 119 peritrochanteric fractures using dynamic hip screw. They stabilized 112 per, sub and intertrochanteric fractures by means of intramedullary hip screw or gamma nail. The complications encountered infection 5% in DHS group and 2.7% in IMHS/GN group, tom plate 1.7% and 0%, intra-operative shaft perforation 0% and 0.9% respectively. They recommended DHS as an ideal implant.

Baumgartner MR, Curtin SL and Lindskog DM[36] in 1998, assigned 131 patients with trochanteric fractures to treatment with either a sliding hip screw or an intramedullary hip screw. In patients with unstable trochanteric fractures, the intramedullary device was associated with 23% less surgical trauma and 41 % less blood loss. Intra-operative complications occurred exclusively in patients with intramedullary hip screw. There were no differences in the rates of functional recovery between the two fixation groups.

Dominique C. Hardy, Descamps PY and Krallis P[37] in 1998, carried out a prospective randomized study of 100 patients who had an intertrochanteric fracture. They were treated with a compression hip screw with a plate [50] or an intramedullary hip screw [50]. They found that the Compression Hip Screw has better telescoping displacement and impaction of the fracture fragments compared to Intramedullary Hip Screw.

Tracy Watson J, Burton R. Moped, Kathryn E.[38] in 1998. in a randomized prospective study, compared the fixation of 160 stable and unstable intertrochanteric fractures with Medoff sliding plate and standard Compression hip screw, with an average follow-up of 9.5 months. No difference was observed between the two groups with respect to length of hospitalization, return to ambulatory status, post-operative living status or post-operative pain. They concluded that Medoff plate was associated with a significantly higher amount of blood loss and operating time.

Kenneth J. Koval[39] 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[40] in 1999, in a meta-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.

Olsson 0, Ceder L, Hauggaard A[41] in 2001, in a prospective randomized study, compared 54 patients treated with Medoff Sliding plate with 60 stahilized with a Compression hip Screw. They noted that the mean femoral shortening, four months after the operation determined from radiographs of both femora was less in the group treated with the Compression hip screw.

Christopher IA, Robinson CM, et al[42] in 2001 in a prospective study compared 400 patients treated with dynamic hip screw and short gamma nail and followed up for 2 years. They concluded that short gamma nail still poses higher risk of reoperation when compared to dynamic hip screw.

In 2002, **Marc Saudan et al**[43] compared the results between a dynamic hip screw and an intramedullary nail in the treatment of intertrochanteric fractures, in 206 patients. They did not find any advantage to an intramedullary nail over a dynamic hip screw.

Alobaid A, Harvey EJ[44]in 2004 , in a prospective surgeon randomized blinded outcome clinical study compared a minimally invasive hip screw with conventional method. They noted that the minimally invasive technique had significantly less blood loss,operative time and a trend to use less analgesics.

In 2004, **Dodds SD & Baumgaertner MR**[45], in a review article on intertrochanteric fractures treated with different modalities have stated that despite innovative developments, dynamic hip screw continue to be the implant of choice for stable intertrochanteric fractures.

In 2005, **Utrilla LA, Reig JS**[46] compared the results between a new intramedullary nail and dynamic hip screw in the treatment of intertrochanteric fractures in 200 patients older than 65 years. The results showed that the new intramedullary nail has no added advantage over dynamic hip screw.

In a prospective randomized study, in 2005 , comparing dynamic hip screw with external fixation for treatment of osteoporotic trochanteric fractures in 40 elderly patients, **Moroni A., Faldini C,et al**[47] found that there was no significant difference between both methods and external fixator can be an effective treatment for this patient population but needs further study.

In 2006, **Subramanian KN., Puranik G**[48], in a random cohort study of 102 patients assessed radiographically the dynamic hip screw fixation by assessing Tip Apex Distance(TAD) and type of reduction. They found that TAD of 25mm or less is considered good and the quality of reduction is good if alignment was normal on AP & maximum of 20^0 angulation on lateral radiograph and less than 4mm of displacement of any fragment.

Svenson O., Anderson M., et al[49] ,in 2006, in a prospective randomized study comparing Trochanteric Gamma Nail (TGN) and the dynamic hip screw (DHS) in 146 patients concluded that operation time was longer in TGN Group and recommended DHS as the standard implant.

In 2006, **Kulkarni GS et al**[50] in a review article concluded that dynamic hip screw is still the gold standard for treating intertrochanteric fractures.

Arun Kumar, Thong[51], in 2006, in a prospective study of 80 patients with intertrochanteric fractures were treated with dynamic hip screw and dynamic condylar screw. Satisfactory reduction was achieved in 92% of dynamic hip screw group when compared with 83.3% of dynamic condylar screw group. They concluded by stating that dynamic hip screw is stil the best treatment option for intertrochanteric fractures.

In 2008 , **Brian A., Anna NA., et al[52] ,** compared dynamic hip screw with IM Nailing in a cohort study of 43,659 patients and found that patients treatment with IM Nail had higher rates of revision surgery during the 1st year than those treatment with DHS.

Dionysios AJV., Panos I[53], in 2010 , compared the systematic effects of surgical treatment of trochanteric fractures treated with DHS and IM Nailing in 120 elderly patients. They came to a conclusion that there was no significant difference between the 2 methods of stabilization regarding their systematic effects(pre-operative status, ADL, mental condition, pulmonary function) perioperatively and concluded that DHS is still the preferred choice in treating trochanteric fractures in elderly patients.

ANATOMY

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

THE HEAD : The head is slightly more than a half a sphere. It is directed medially upwards and slightly forwards. 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 circumference of the head is sharply defined, except anteriorly where the cartilage covered surface extends onto the front of the neck.

THE NECK : The neck connects the head of the femur with the shaft. It is about 1.5 inches long. As the neck inclines upwards and medially, it makes an angle with the shaft, **The Neck Shaft Angle**, which is about 125^{o} in adults. This facilitates movement at the hip joint, enabling the limb to swing clear of the pelvis. The neck is also tilted forwards as it passes upwards and medially from the shaft. As an account of this the transverse axis of the neck and head makes an angle with the transverse axis of the lower end of the femur, known as the **Angle of Anteversion**, which is approximately 15^{o}.

The femoral neck has two borders and two surfaces. The upper border is concave and horizontal; it meets the shaft at the greater trochanter. The lower border is straight and oblique; it meets the shaft near the lesser trochanter. The anterior surface is flat, entirely intra-capsular; meets the shaft at the intertrochanteric line. The posterior surface is convex from above downwards and concave from side to side, only little more than its medial half is intra-capsular; meets the shaft at the rounded intertrochanteric crest.

The neck is ridged particularly on the anterior aspect, indicating the attachment of retinacular fibers of the hip joint capsule, which are reflected proximaJly from the distal attachment of the capsule. 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 inturned apex. Posteriorly the apex continues down as the intertrochanteric crest to the lesser trochanter. The medial surface of the upper border of the greater trochanter has the attachment of the piriformis and is known as, the **piriformis fossa**. The' anterior surface shows a J shaped ridge for the attachment of the gluteus minimus tendon. The medial surface anteriorly provides attachment for the common tendon of obturator intemus and gamelli and at the bottom is the rough **trochanteric fossa,** for the attachment of the obturator externus. The lateral surface shows an oblique strip sloping downwards and forwards providing attachment for the gluteus medius. There is a trochanteric bursa of the gluteus medius in front of the ridge and of the gluteus maximus behind the ridge.

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 marks the junction of the anterior surface of the neck with the shaft of the femur. It is a prominent roughened ridge, which begins proximally at the anterosuperior angle of the greater trochanter as a tubercle, and runs downwards and medially continuing below with the spiral line in front of the lesser trochanter. The spiral line winds round below the lesser trochanter to the posterior surface of the shaft.

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 marks 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: 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.**

Calcar Femorale is a dense vertical plate of bone extending from the posterior medial portion of the femoral shaft under the lesser trochanter and radiating laterally to the greater trochanter, reinforcing the femoral neck posteroinferiorly. The calcar is thickest medially and gradually thins as it passes laterally. It serves to counteract the compressive loads in this region.

Singh M.[54] 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's 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:

The arterial supply of the proximal end of the femur has been studied extensively. The description of **Crock H.V.**[55] seems to the most appropriate. The arteries of the proximal end of femur are described in three groups:

1. Extracapsular arterial ring located at the base of the femoral neck.

2. Ascending cervical branches from the extracapsular arterial ring on the surface of the femoral neck.
3. The arteries of the round ligament.

Extracapsular Arterial Ring: is formed posteriorly by a large branch of the medial circumflex artery and anteriorly by branches of the lateral femoral circumflex artery. The superior and inferior gluteal arteries also have minor contributions to this ring.

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. These branches pass upward under the synovial reflections and fibrous prolongations of the capsule toward the articular cartilage. These arteries are known as **retinacular arteries,** described by **Weitbrecht.** They send many small branches to the metaphysis of the femoral neck. The neck receives additional blood supply from the extracapsular arterial ring and may also include the anastamosis with the intramedullary branches of the superior nutrient artery.

The ascending cervical arteries can be divided into four groups [anterior, medial, posterior, lateral], based on their relationship to the femoral neck. The lateral group provides most of the blood supply to the head and neck of femur. At the margin of the articular cartilage on the surface of the femoral neck these vessels fonn a second ring, the **Subsynovial Intra-articular Arterial Ring of Chung**[55]• This ring was initially termed the **Circulus Articuli Vasculosis** by **William Hunter** in 1743. **Treuta and Harrison**[56] mentioned an incomplete ring in 1953. From the subsynovial ring, epiphyseal arterial branches arise that enter the head of the femur.

The artery of the Ligamentum Teres (foveolar medial epiphyseal artery) is a branch of the obturator or the medial circumflex artery. They are responsible only for a small area of subsynovial circulation.

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 $2/5^{th}$, pubis forms the anterior $1/5^{th}$, and the ischium forms the Posterior $2/5^{th}$. 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:

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.

Ligaments of the Hip Joint:

1)The Fibrous Capsule

The fibrous capsule is exceedingly strong anteriorly, and surrounds the joint on all sides. Proximally, it is attached to the margin of the acetabulum and its transverse ligament. It passes laterally, like a sleeve. Distally, it is attached anteriorly to the whole length of the intertrochanteric line and to the root of the greater trochanter. Posteriorly, it falls short of the intertrochanteric crest by about a fingerbreadth, and its attachment to the neck of femur is weak. From these attachments the fibres of the capsule are reflected back along the neck of the femur to the articular margin of the femoral head. This reflected part constitutes the **retinacular fibres,** which bind down the nutrient arteries.

The fibre bundles, which comprise the fibrous capsule, run in two different directions. The majority runs **obliquely** from the acetabulum to the femur and is best seen on the anterior surface. The other bundles encircle the capsule more or less parallel to the margin of the acetabulum. These form the **zona orbicularis,** best seen on the posterior and inferior parts of the fibrous capsule. The zona orbicularis is responsible for the hourglass constriction of a normal arthrogram.

The fibrous membrane has three main thickenings.

2) The Iliofemoral Ligament

It is also known as the **ligament of Bigelow.** It is the thickest and the most powerful part of the articular capsule. Proximally. it is attached to the inferior part of the anterior inferior iliac spine and to the surface of the ilium immediately lateral to the spine. Distally, it widens to be attached to the intertrochanteric line of the femur. It is thicker at the sides than in the middle giving the ligament the appearance of an inverted Y.

The iliofemoral ligament is more than O.5cm thick. It is one of the strongest ligaments in the body. A stress varying from 250 to 750 lb is required to rupture it. The tendency of the body to fall backwards in the erect posture is resisted by the iliofemoral ligaments without muscular activity.

3)The Pubofemoral Ligament

It is attached to the superior ramus and the obturator crest of the pubic bone. It passes distally deep to the iliofemoral ligament, and blends with the fibrous capsule. When the bursa deep to the iliopsoas is continuous with the cavity of the hip joint, the communication lies between this band and the iliofemoral ligament.

4) The Ischiofemoral Ligament

It is the weakest of the three ligaments. It arises from the posteroinferior margin of the acetabulum, and its fibres, passing laterally to the capsule, spiral upwards and blends with the circular fibres of the capsule, the zona orbicularis.

5) The Transverse Ligament of the-Acetabulum

It is a strong band of fibres bridging the acetabular notch. It completes the rim of the acetabulum, and converts the notch into a foramen through which vessels and nerves enter the acetabular fossa and the ligament of the head of the femur.

6)The Labrum Acetabulare

It is a fibrocartilaginous ring, attached to the rim of the acetabulum and the transverse ligament, deepening the cavity of the acetabulum and slightly narrowing its mouth by sloping inwards. The labrum is a tight fit on the head of the femur and, sealing it in the acetabulum, exercises an important function in retaining the head within the acetabulum. The labrum is triangular in cross section, the free margin being relatively thin and the attached margin much thicker. Both the surfaces of the labrum are covered by synovial membrane.

7)Ligamentum Teres

This is a relatively weak band of connective tissue surrounded by synovial membrane. Its narrow, cylindrical end is implanted into the pit on the head of the femur; its broad, flattened end is attached to the transverse ligament and adjacent margins of the acetabular fossa.

This ligament is too weak to play any mechanical part in the hip joint. It may help to spread synovial fluid on the head of the femur and act as part of the soft pad, which can adjust the acetabular volume during movement by extrusion beneath the transverse ligament. It transmits a small blood vessel to the head of the femur.

Synovial Membrane:

The synovial membrane lines the inner surface of the fibrous capsule and covers the neck of the femur as far as the margin of the articular cartilage of the head and is attached to the articular margin. The haversian fat pad and the ligament of the head are likewise invested in a sleeve of synovial membrane that is attached to the articular margins of the concavity of the acetabulum and of the fovea on the femoral head. In about 10% of the individuals, a perforation in the anterior part of the capsule, between the iliofemoral and the pubofemoral ligaments, permits communication between the synovial cavity and the iIiac bursa.

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:

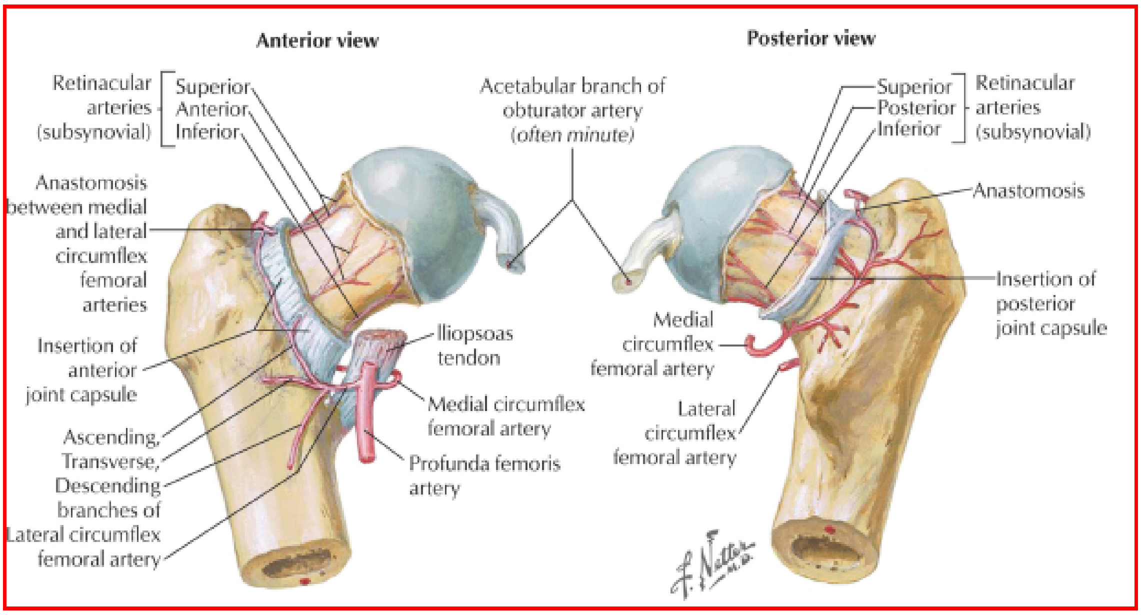
a)The femoral nerve, via the nerve to rectus femoris.

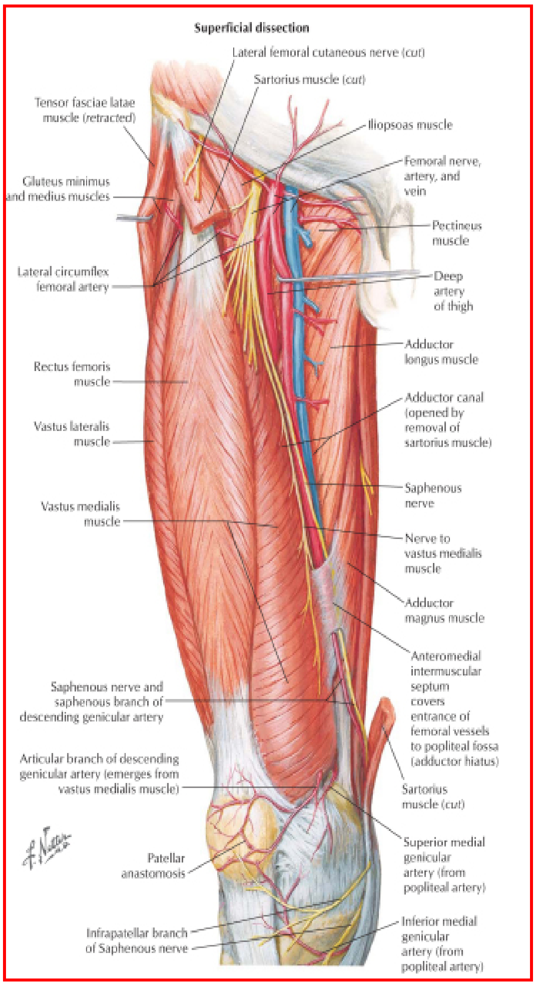
b)The obturator nerve, directly from its anterior division.

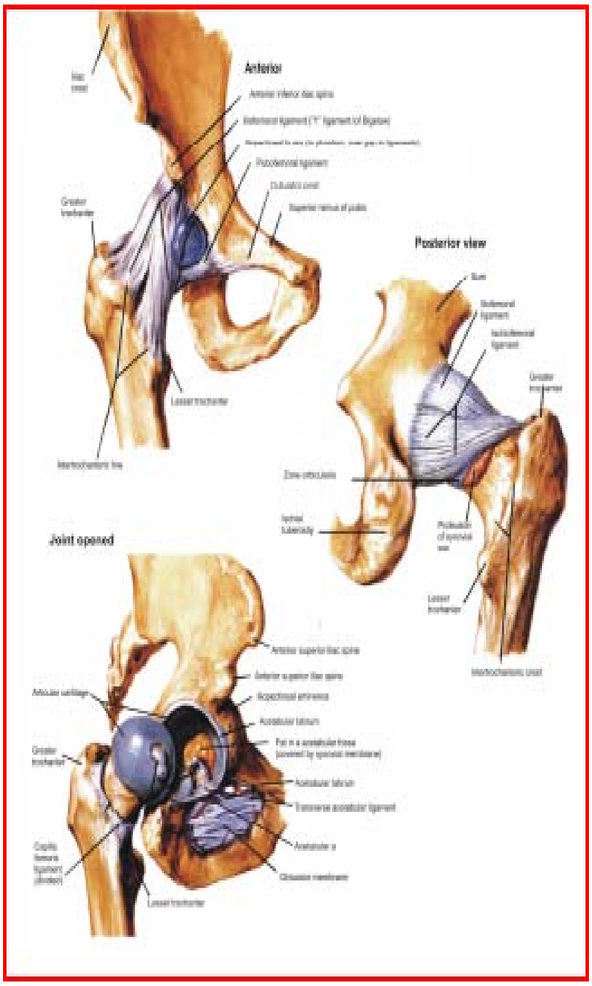
c)The nerve to quadratus femoris.

d)The articular twigs from the sciatic nerve.

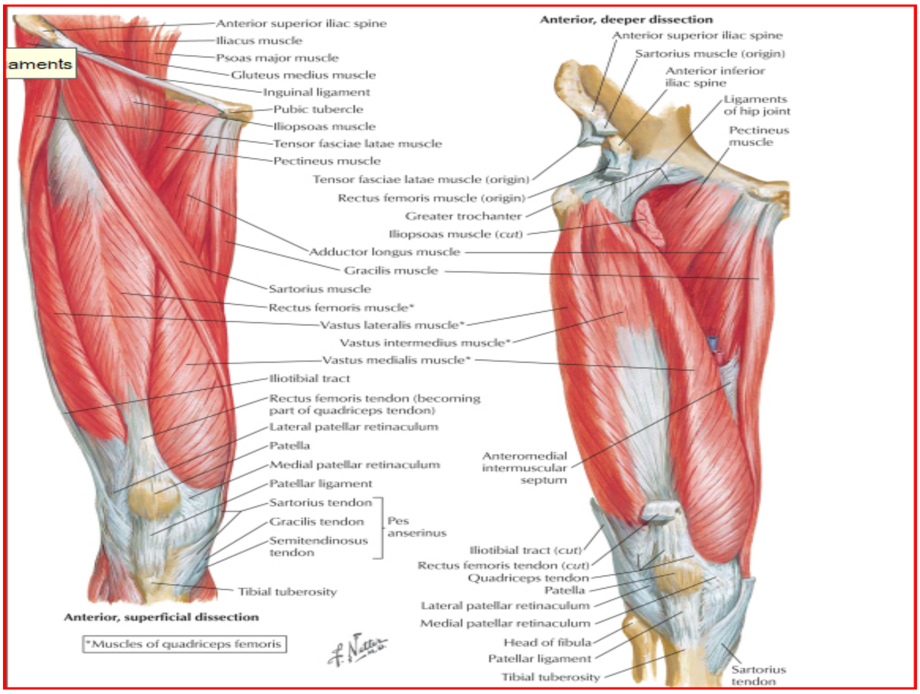
e)The accessory obturator nerve.

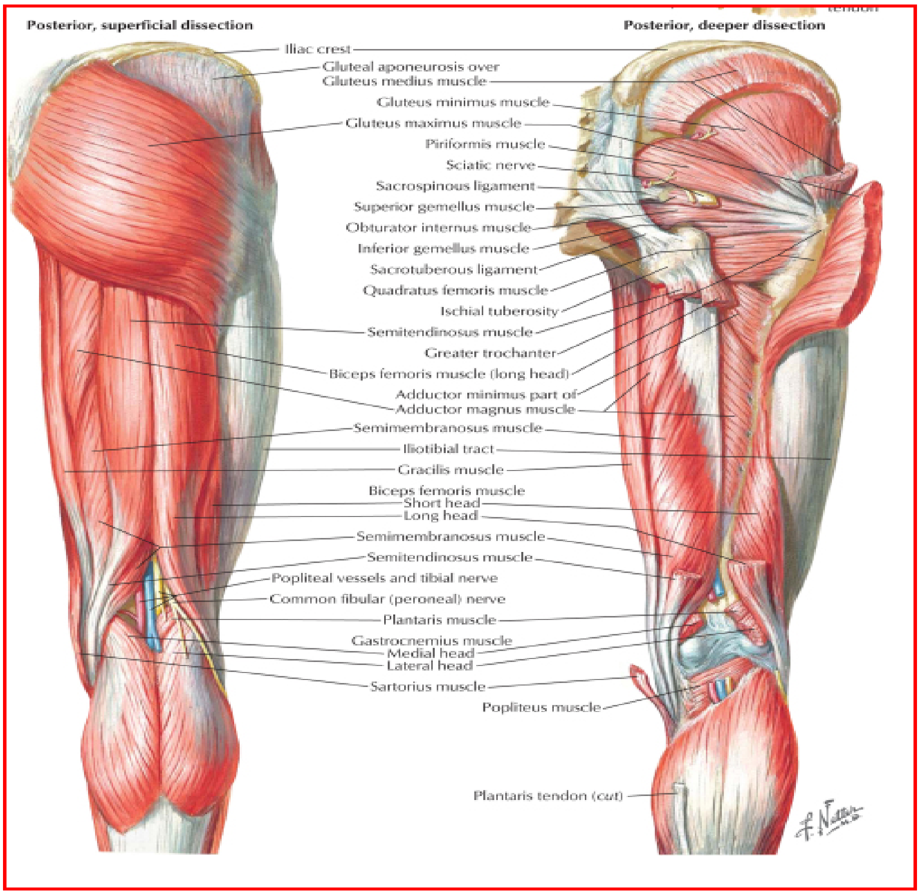

Anterior view
Posterior view
Retinacular arteries (subsynovial)
Superior
Anterior
Inferior
Acetabular branch of obturator artery (often minute)
Superior
Posterior
Inferior
Retinacular arteries (subsynovial)
Anastomosis between medial and lateral circumflex femoral arteries
Anastomosis
Insertion of posterior joint capsule
Insertion of anterior joint capsule
Iliopsoas tendon
Medial circumflex femoral artery
Medial circumflex femoral artery
Lateral circumflex femoral artery
Ascending, Transverse, Descending branches of Lateral circumflex femoral artery
Profunda femoris artery


Superficial dissection
Lateral femoral cutaneous nerve (cut)
Sartorius muscle (cut)
Tensor fasciae latae muscle (retracted)
Iliopsoas muscle
Femoral nerve, artery, and vein
Gluteus minimus and medius muscles
Pectineus muscle
Lateral circumflex femoral artery
Deep artery of thigh
Adductor longus muscle
Rectus femoris muscle
Adductor canal (opened by removal of sartorius muscle)
Vastus lateralis muscle
Saphenous nerve
Vastus medialis muscle
Nerve to vastus medialis muscle
Adductor magnus muscle
Anteromedial intermuscular septum covers entrance of femoral vessels to popliteal fossa (adductor hiatus)
Saphenous nerve and saphenous branch of descending genicular artery
Articular branch of descending genicular artery (emerges from vastus medialis muscle)
Sartorius muscle (cut)
Superior medial genicular artery (from popliteal artery)
Patellar anastomosis
Infrapatellar branch of Saphenous nerve
Inferior medial genicular artery (from popliteal artery)


Anterior
Posterior view
Joint opened

Musculature around the hip joint and thigh region





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 : the 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 intemus, the obturator nerve and vessels and the peritoneum.

Intertrochanteric fractures

Intertrochanteric fractures are the most frequent fractures of the proximal femur and occur predominantly in geriatric patient and are among the most devastating injuries in the elderly. Several epidemiological studies have suggested that the incidence of fractures of the proximal femur is increasing since the general life expectancy of the population has increased significantly during past few decades. Most proximal femoral fractures occur in elderly individuals as a result of only moderate or minimal trauma. In younger patients these fractures usually result from high energy trauma.

Clinical features:

The limb is usually markedly shortened with external rotation deformity. The external rotation deformity is usually greater than that seen in patients with intracapsular fractures of the neck of femur. There may be swelling in the hip region and ecchymosis over the greater trochanter may be seen later.

- Tenderness over greater trochanter .
- Bitrochanteric compression test positive .
- Palpatory bryands triangle shifted up .
- Broadening and irregularity of greater trochanter.

Radiographic and Other Imaging Studies:

1)Standard radiographic examination of the hip includes

a)Anteroposterior view of the pelvis

b)Cross table lateral view of the involved proximal femur

Anteroposterior view is useful in know fracture obliquity, quality of the bone, and allows comparison of the involved side with the contralateral side to identify non displaced and impacted fracture. The lateral view help to assess size, location and comminution of posterior fracture fragment and helps to determine the presence of absence of fracture stability.

2)Technetium bone scan - when a hip fracture is suspected but not apparent to standard radiographs, it requires 2-3 days to become positive.

3)MRI - has shown to be least as accurate as bone scanning in identifying occult fractures of the hip, it will reveal a fracture within 24 hours of injury.

Classification:

"A classification is useful only if it considers the severity of tile bone lesion and serves as a basis for treatment and for evaluation of the results".

- Maurice E Muller.

Boyd and Griffin (1949) classification:

This classification includes all the fractures from the extracapsular part of the neck to a point 5cm distal to the lesser trochanter.

Type I : Fractures that extend along the intertrochanteric line from the greater to the lesser trochanter. Reduction usually is simple and is maintained with little difficulty.

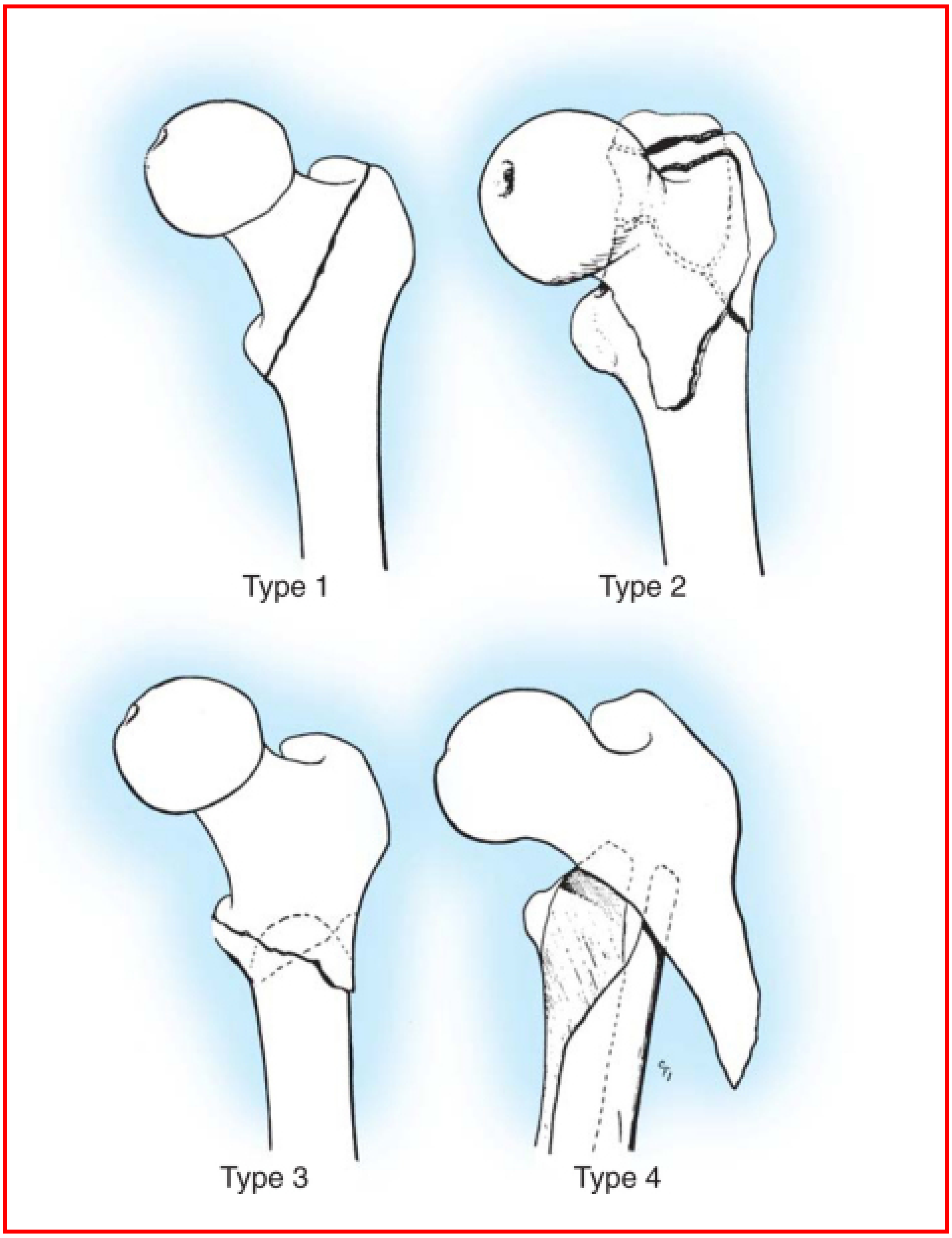
Type II : Comminuted fractures, the main fracture being along the intertrochanteric line but with multiple fractures in the cortex. Reduction of these fractures is more difficult because the comminution can vary from slight to extreme.

Type III : Fractures that are basically subtrochanteric with at least one fracture passing the proximal end of the shaft just distal to or at the lesser trochanter. Varying degree of comminution are associated. These fractures are usually more difficult to reduce and result in more complications.

Type IV : Fractures of the trochanteric region and the proximal shaft, with fracture in at least two planes. If open reduction and internal fixation is used two plane fixation is required.

Type 3 and 4, most difficult types to manage account for only one third of the intertrochanteric fractures

Boyd and Griffin (1949) classification



Evans classification

Type I : The fracture line extends upwards and outwards from the lesser trochanter.

Type II : The fracture line is of reversed obliquity, the major fracture line extends outward and downward from the lesser trochanter and are unstable.

A widely used classification system based on the stability of the fracture pattern and the potential to convert an unstable fracture pattern to a stable reduction.evans observed that the key to a stable reduction is restoration of posteromedial cortical continuity.

Orthopaedic Trauma Association (OTA) Alphanumeric Fracture Classification

31 - A Femur, proximal trochanteric

A I pertrochanteric simple

A 1.1 Along intertrochanteric line

A 1.2 Through greater trochanter

A 1.3 Below lesser trochanter

A2 pertrochanteric multifragmentary

A 2.1 with one intermediate fragment

A 2.2 with several intermediate fragments

A 2.3 extending more than 1 cm below lesser trochanter

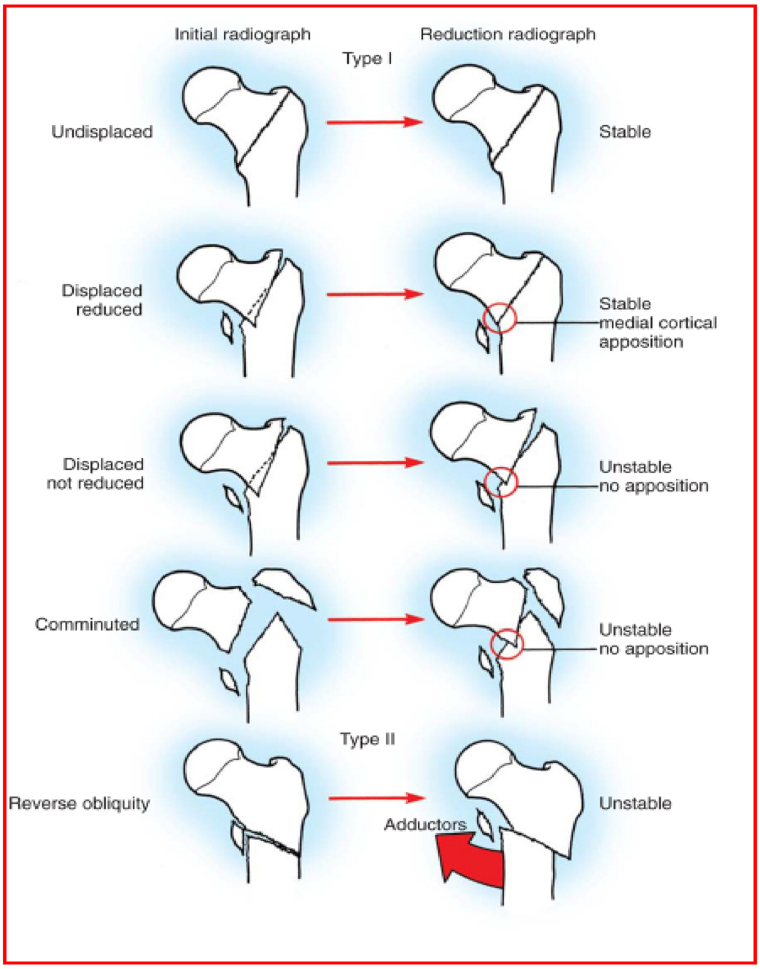
A3 Intertrochanteric

A 3.1 Simple oblique

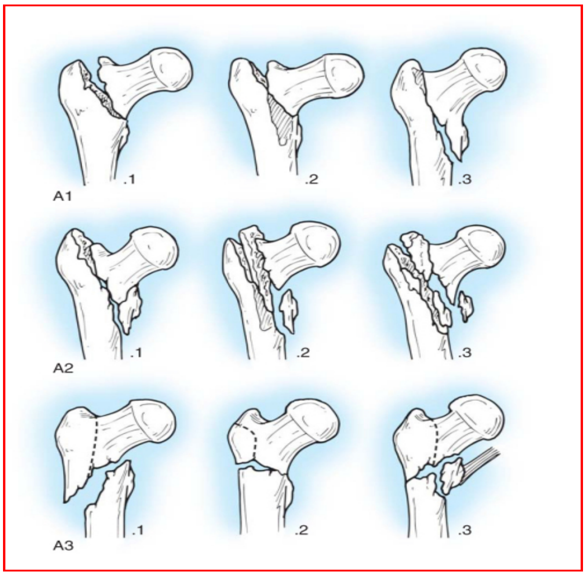
A 3.2 Simple transverse

A 3.3 Multifragmentary

Evans classification



Orthopaedic Trauma Association (OTA) Alphanumeric Fracture Classification



MANAGEMENT OF INTERTROCHANTERIC FRACTURES

Watson-Jones[4] states that "fractures through the intertrochanteric line of the' upper end of the femur, and peri trochanteric 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 recumbency 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.**[2] are-

a.The terminal patient.

b.A patient with an old fracture.

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

Rowe[57] 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 151b (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 Traction[2]:

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[2]:

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[2]:

Hamilton Russell of Melboume 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[58] 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[2] 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 requlflng 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[59] 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 fracture were **Fixed Angle Nail Plate devices** (e.g., Jewett nail, Holt nail) consisting of 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 najls, 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.[23] 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 dital end. This makes the procedure simpler.

b. The distal shaft thread junction is made tapering to prevent the dital 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 untable trochanteric fractures in patients with severely osteoporotic bone some authors have suggested the use of **Polymethylmcthacrylate (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.

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**[13] 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 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 ofthe 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.

Prosthetic Replacement[60]:

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.

External Fixators:[61]

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.

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DYNAMIC HIP SCREW

The Dynamic Hip Screw and Barrel Plate assembly remains the implant of the 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° 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° 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° 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 135° and 150° plates. For these reasons a 135° side plate is used in most fractures.

The major force acting in a intertrochanteric 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 intertrochanteric 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 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 osteoporotic 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.

Baumgaertner[33] 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° plates are preferable because the angle of the lag screw more closely parallels the compressive forces within the femoral neck. The 135° devices are easily placed and because their clinical results are similar to those of the 150° plates. Hence the 135° 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 INTERTROCHANTERIC 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 achieve. Therefore, a non-anatomical but stable reduction is indicated in the 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 intertrochanteric intermediate fragments 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.

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

External Rotation: 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.

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[62] 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.

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[63] and Riska[64] 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.

Non-Anatomical Stable Reduction:

Internal Fixation of the fracture in the Varus position:

Cram[2] and Evans[65] 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 thereby seek its own stability.

Wayne County or Valgus Reduction

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**[66] 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.

Sarmiento's Valgus Osteotomy(1973)[18]:

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.

Augmentation with Polymethylmethacrylate:

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

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

METHODOLOGY

The clinical material for the study of surgical management of Intertrochanteric Fracture of Femur with Dynamic Hip Screws consists of 30 cases of intertrochanteric Fracture of traumatic etiology meeting the inclusion and exclusion criteria, admitted to R.L. Jalappa Hospital and Research Centre attached to Sri Devraj Urs Medical College from SEPTEMBER 2008 TO SEPTEMBER 2010.

Inclusion Criteria:

1.All patients with Intertrochanteric fractures.

2.Age - Patients above the age of 18 years.

3.Sex - Both male and female.

Exclusion Criteria:

1.Patients below the age of 18 years.

2.Patients with malunited Trochanteric fractures treated elsewhere.

3.Medically unstable patients who are an extremely poor anesthetic risk.

4.Patients with pathological fractures.

As soon as the patient was admitted, a detailed history was taken and a meticulous examination of the patient was done. The required information was recorded in the proforma prepared. The patient's radiographs were taken in the Antero-Posterior and Lateral views; The diagnosis was established by clinical and radiological examination.

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

Type I : Fractures that extend along the intertrochanteric line from the greater to the lesser trochanter.

Type II : 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 I, but with an additional fracture in the coronal plane, which can be seen on the lateral roentgenogram.

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

Skin or skeletal traction was applied till the patient was taken up for surgery. Medical evaluation and stabilization of the patient was begun in consultation with the Physician and, the Cardiologist if necessary.

Hygiene of the skin was maintained with regular betadine scrub wash. The operative site (lateral aspect of the thigh) was shaved, scrubbed with savlon and betadine scrub, and painted with betadine and spirit, and draped in a sterile towel three days prior to the surgery.

The patients were taken up for surgery after obtaining written and informed risk consent of the nature and complications of the surgery.

All patients were started on antibiotics prophylactically. Cephalosporins were used. It was administered in the dosage of 1gm IV, prior to induction of anesthesia, and continued at 12 hourly intervals for 3-5 days, and switched over to oral form till the 14^{th} day post-operatively, i.e. until suture removal.

Implants:

The dynamic hip screw, the barrel slide plate, the compression screws and' cortical screws for fixation of the side plate is made of stainless steel.

The Hip screw is blunt and has broad threads at the proximal end, which' 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 3mm . The diameter of the shaft of the lag screw is 8 mm. The inner surface of the distal end is threaded for the application of the compression screw.

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

The Side plate has a barrel measuring 38mm, fixed at an angle of 135 degree, through which the screw glides. The side plate has oval slots for fixation to the shaft of the femur.

Operative Technique:

Anaesthesia:

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

Patient Positioning:

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

The uninjured leg was held in wide abduction by a boot attached to one of the leg extensions of the fracture table. The injured leg was held in slight abduction, by a boot attached to the other leg extension of the fracture table.

The C-arm image intensifier was positioned between the patients' 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 under image intensifier control was performed.

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

The degree of rotation required for reduction was 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 was required to close the defect posteromedially.

Reduction was checked in the antero-posterior and lateral views, paying special attention to the posterior and medial cortical contact.

If reduction was not achieved by closed manipulation **Open Anatomical reduction** was done by opening the fracture site.

If anatomical reduction, was not achieved by either closed or open techniques, a **Stable reduction** was achieved by opening the fracture site and pegging the medial spike in the proximal fragment into the medullary cavity of the distal fragment.

If there was a deficiency in the posteromedial cortex even after stable reduction, cancellous bone grafting was done.

Draping

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

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

Exposure:

The incision of exposure was the standard lateral approach.

The incision began 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 was deepened in the line of the incision down to the fascia lata. The fascia lata was incised with a scalpel in the distal part of the wound and split proximally with the scissors. In the proximal part of the wound, the fascia was 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 was viewed. The muscle fascia was split laterally; the muscle was dissected from its deep surface posteriorly, and divided near the linea aspera. The body of the vastus lateralis was retracted anteriorly, and the perforating arteries were coagulated, if they were divided. After dividing the muscle along the femur, it was elevated with a periosteal elevator and the lateral and anterolateral surface of the femoral shaft was exposed. By further subperiosteal elevation of the proximal part of vastus lateral is and- intermedius, the intertrochanteric line and the anterior surface of the femur, just below this line was exposed.

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

Guide Pin Insertion:

The level of insertion of the pin was approximately 2cms below the intertrochanteric ridge.

An opening was made with a perforation drill in the lateral cortex, midway between the anterior and posterior cortex of the femur. A fixed angle guide was placed on the lateral cortex. The guide pin with 3.2mm tip was aimed towards the apex of the femoral head, confirming the central placement of the pin on both antero-posterior and lateral views using C-arm the guide pin was passed with in 10mm ofthe joint.

The length of the guide pin inserted was measured, and the guide pin was 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, combination reamer was set to the length of the lag screw measured. The reamer was slided 'over the guide pin, and femur was reamed coaxial to the guide pin, to avoid bending of the guide pin.

Image intensifier was used to know the advancement of the reamer. The reaming was stopped when the short barrel notch indicator on the barrel reamer reaches the lateral cortex.

Tapping of femoral head:

The lag screw tap was set for the appropriate lag screw length and inserted into the reamed portion over the guide. Tapping was done under image intensification till the previously reamed portion.

Insertion of Lag Screw and Barrel Side Plate:

The appropriate lag screw was assembled onto the insertion wrench. The assembly was placed over the guide pin and introduced into the reamed hole. The lag screw was advanced into the femoral head to the predetermined level and its position was verified with image intensification in both planes.

When the screw insertion was complete, the handle of the insertion wrench was perpendicular to the axis of the femoral shaft, which allowed proper keying of the lag screw to the plate barrel. The lag screw retaining rod was unscrewed and the insertion wrench was removed from the back of the lag screw. Then the side plate was advanced onto the lag screw shaft. Later the guide pin was removed.

Attachment of the side plate:

The length of the plate was selected depending on the extension of the fracture into the shaft of the femur. The plate was secured to the shaft of femur with a plate clamp. With a 3.2mm drill, holes were drilled into the lateral cortex, through the bone screw holes of the side plate. The appropriate cortical screw length was measured with a bone screw length gauge. The holes were tapped with a 4.5 mm tap. The screws were inserted using a screwdriver.

Compression of the fracture:

Inter fragmentary compression was obtained using the barrel compression instrument. The compression screw was threaded into the distal end of the lag screw shaft. The traction on the leg was released and compression screw was tightened to compress the fracture. The position of the lag screw, side plate and fracture compression was confirmed by image intensification in both antero- posterior and lateral views.

Closure of the wound:

The vastus lateralis muscle was approximated and sutured with an absorbable suture material. Fascia lata and sub-cutaneous tissue was sutured with absorbable after placing a suction drain. Skin was sutured with non-absorbable suture material. Sterile dressing was put after removing plastic isolation drape.

Post-Operative Management:

Post- Operative radiographs were taken on the following day. Quadriceps exercises was started on the following day.

The patients were encouraged to do active hip and knee movements as soon as the pain and inflammation subsided.

Suture removal was done on the 10^{th} – 14^{th} day. Patient was discharged after suture removal.

After suture removal active mobilization of the hip and knee was started with non-weight bearing with crutches or a walker until 2 weeks.

Partial weight bearing with walking aids was begun from 2^{nd} week onwards. Full weight bearing was started after 12 weeks.

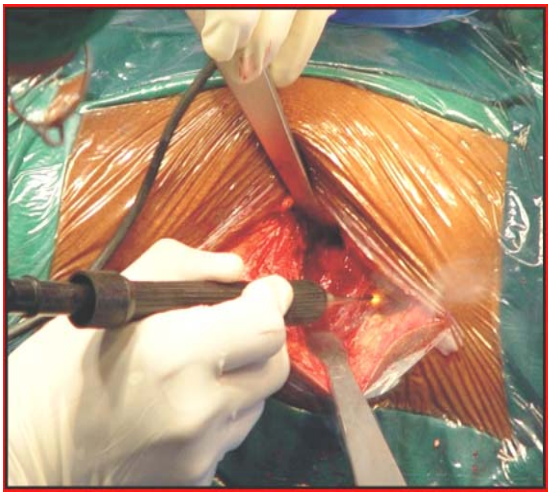
Follow up X-Rays were taken at 1 month, 3months,6 months and after 1 year and 2 years.

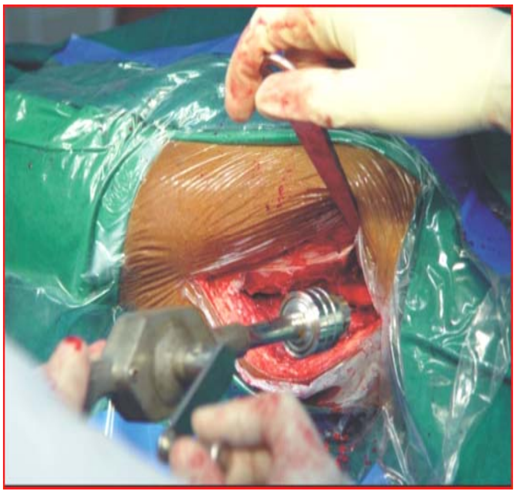
Follow up was done on OPD basis. The follow up was done by clinical and radiological evaluation, and the results were assessed based on:

1. Pain.
2. Swelling in the trochanteric region.
3. Deformity.
4. Movements at the hip and knee joints.
5. Limb length.
6. Sitting cross-legged and squatting.
7. Walking.
8. Fracture union.
9. Patient satisfaction.

Instrumentation

Skin incision



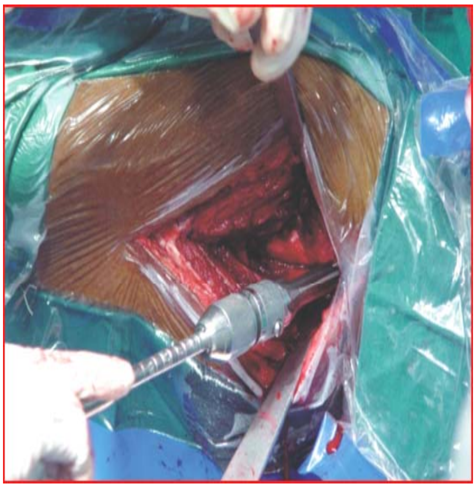


Deep dissection

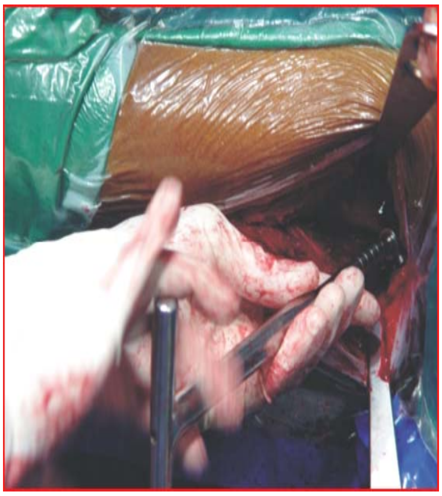
Entry point

Guide pin insertion

Guide pin under C-Arm



Reaming



Tapping

Screw insertion

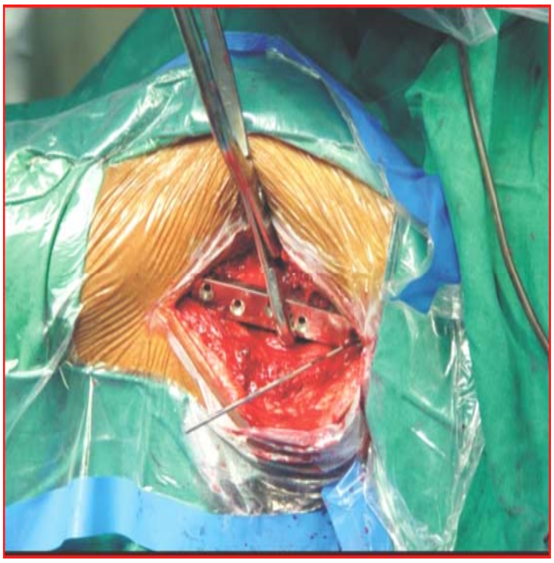


Plate fixation

Fixation of Intertrochanteric Fractures with a Dynamic Hip Screw – The Do's and Dont's :[67]

- 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 communited 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 bending 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 1cm 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 methyl methacrylate to help stabilize routine fractures. It may be used for some pathologic fractures.
- Avoid being casual about treating hip fractures; always anticipate further impaction.

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[68] 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.

The prolonged operating time that may occur in unstable fractures.

- A disoriented patient, who may remove the bandage and contaminate the wound.
- Proximity of the wound to the perineum.

Barr[68] 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 postoperatively, 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.

c.Cutting out of the head.

d. Pulling off the femoral shaft.

Taylor[69] 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 -

I. 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[69] 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

Rotational Deformity:

It is common in unstable fractures.

Massie[70] stressed avoidance of internal rotation in reducing intertrochanteric fractures to prevent rotational deformity post-operatively.

Dimon and **Hughston**[66] also stressed the need for correct interpretation of rotational alignment at the time of nailing to prevent post-operative deformity.

Non union:

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:

1. Repeat attempts at open reduction and internal fixation with bone grafting. The open reduction and internal fixation may be done in a valgus position.
2. Endoprosthetic replacement.
3. 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[2] have reported that osteonecrosis should be included in the differential diagnosis in patients developing hip pain following surgery for intertrochanteric fractures.

• **Stress Fracture:**

Tronzo[62] 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**[25], 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[65] 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[71] 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[72]report that in one third of all patients operated on for fracture of the hip an effusion of the ipsilateral knee developed.

OBSERVATION AND RESULTS

In the present study, 30 cases of intertrochanteric fractures of femur treated with Dynamic Hip Screw between September 2008 to September 2010 at R.L.Jalappa Hospital and Research Centre attached to Sri Devraj Urs Medical College, Kolar were involved, with a minimum follow-up of 6 months.

Age:

The age of the patients in the study ,ranged from twenty three to eighty eight, average being 54.7

Table 1 : Showing Age Distribution

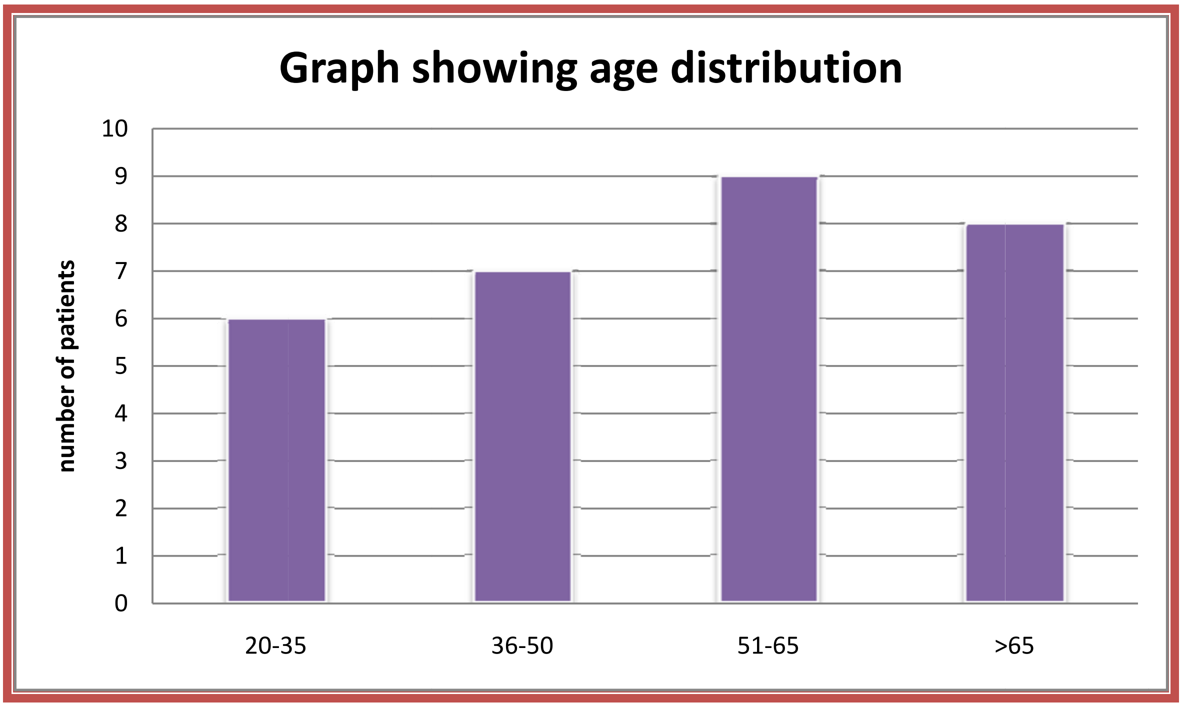
Age in yrs	**Number of patients**	**Percentage**
20-35	6	20
36-50	7	23.3
51-65	9	30
>65	8	26.6

sex :

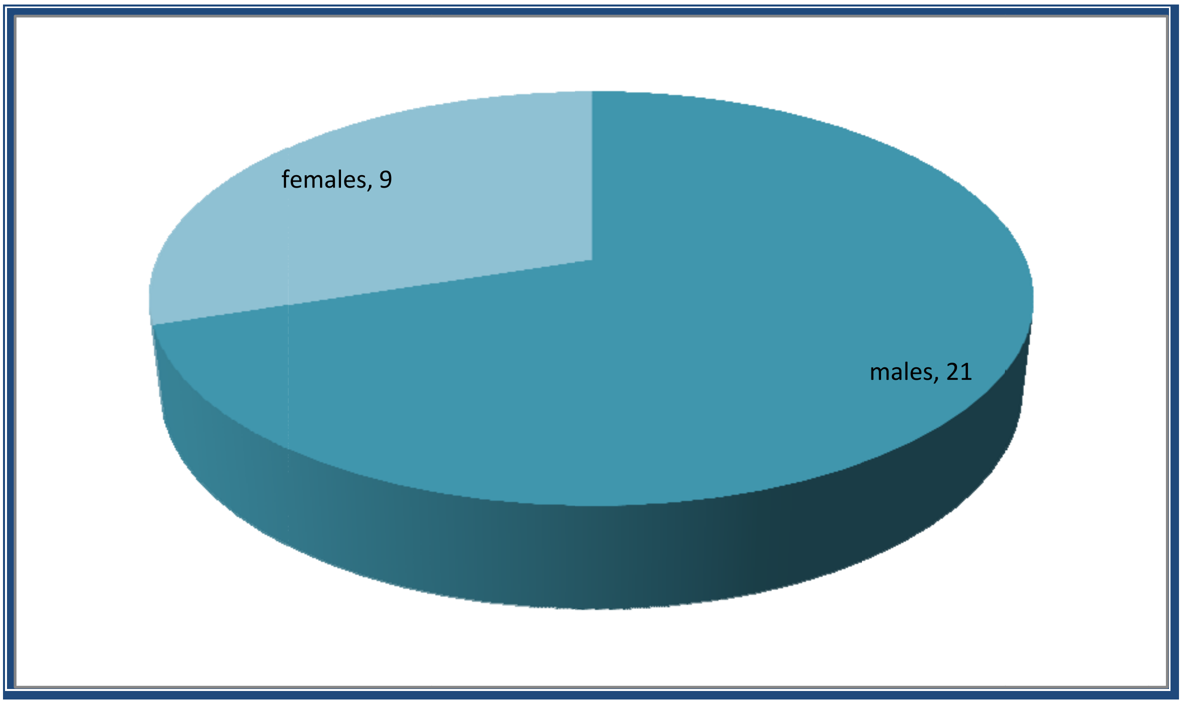
In the study, out of thirthy patients,nine were females and twenty one were males.

Table 2 : Showing Sex Distribution

Sex	Number of patients	Percentage
Females	09	30
Males	21	70



Graph showing Sex distribution



Mode of Injury :

Table 3 : Showing Mode of Injury

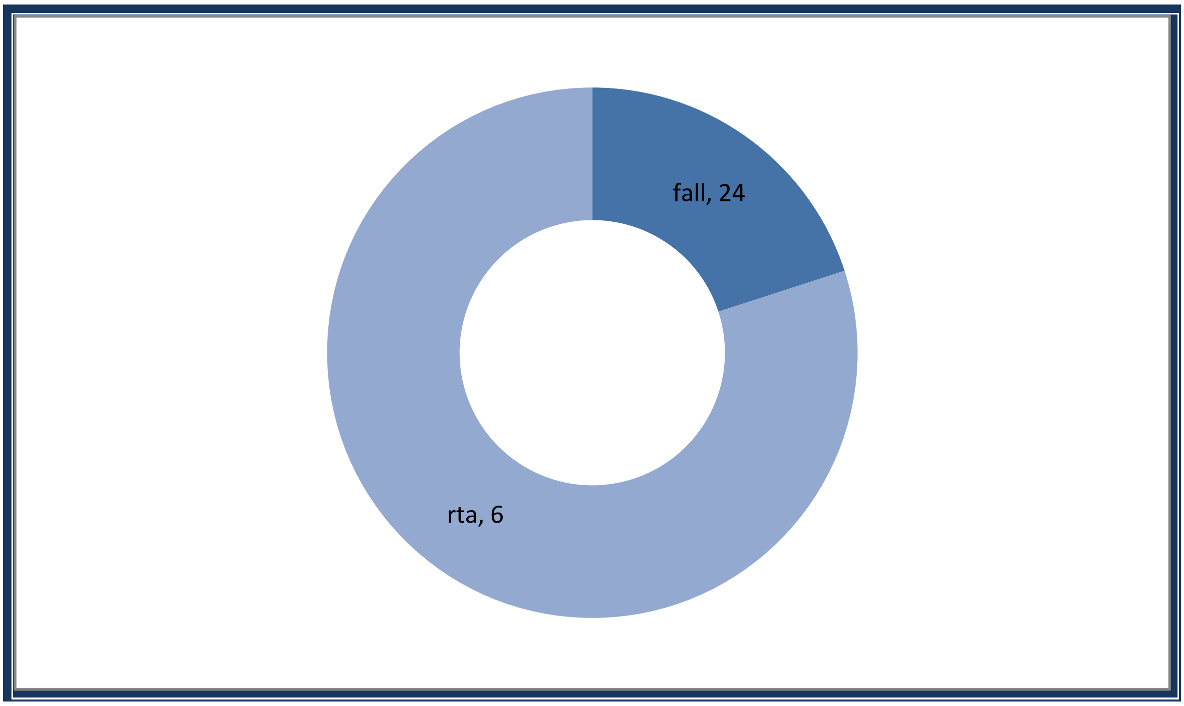
Mode of Injury	Number of patients	Percentage
Fall	24	80
RTA	06	20

Side Affected :

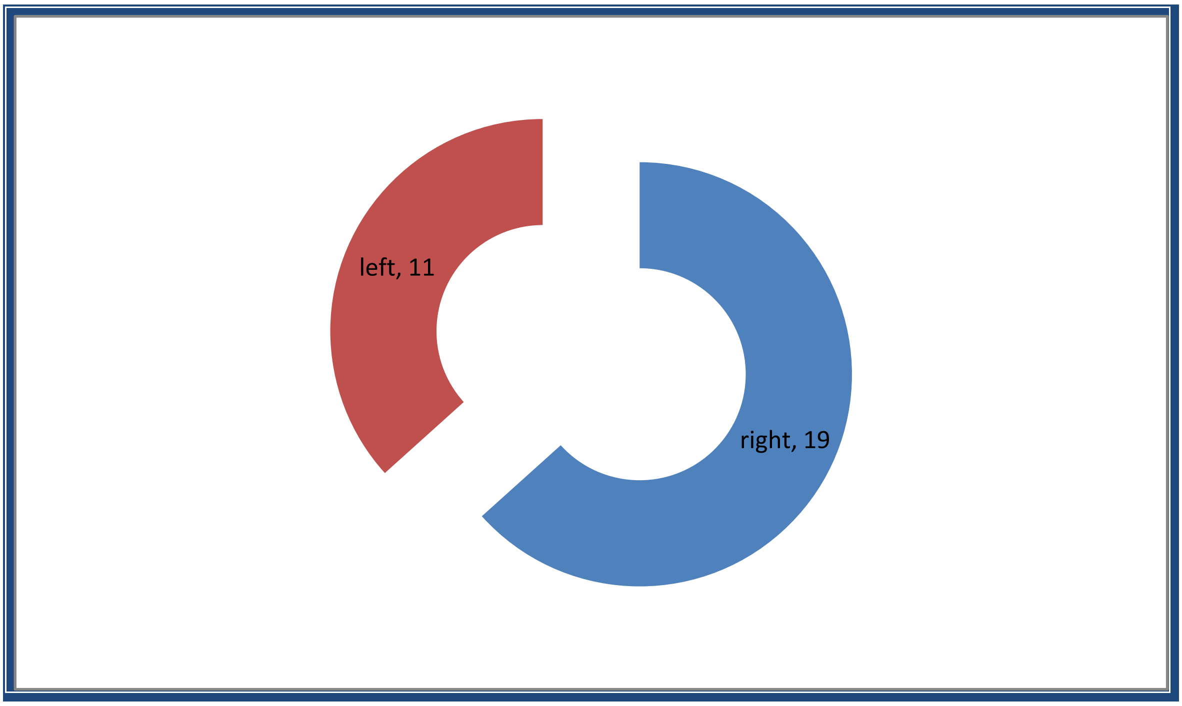
Table 4 : Showing Side Affected

Side Affected	Number of patients	Percentage
Right	19	63.33
Left	11	36.33

Graph showing Mode of Injury



Graph Showing Side Affected



Associated injuries :

Table 5 : Showing Associated injuries

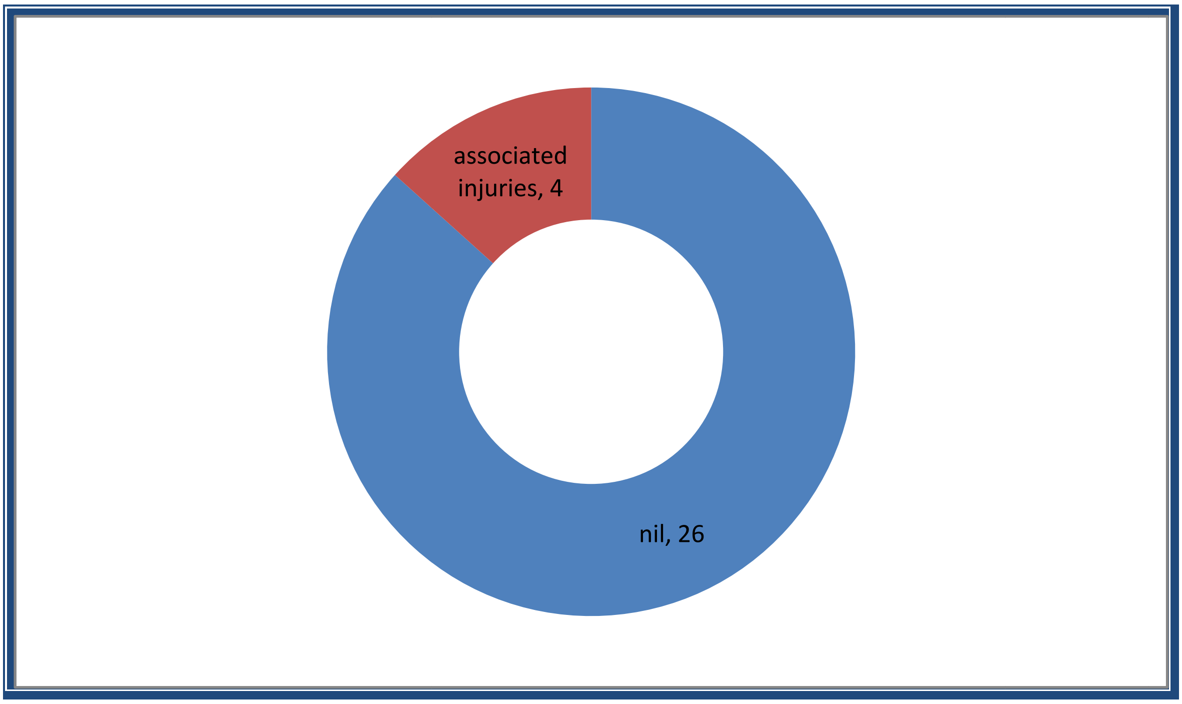
Mode of injury	**Number of patients**	**Percentage**
Nil	26	86.66
Associated injuries	04	13.33

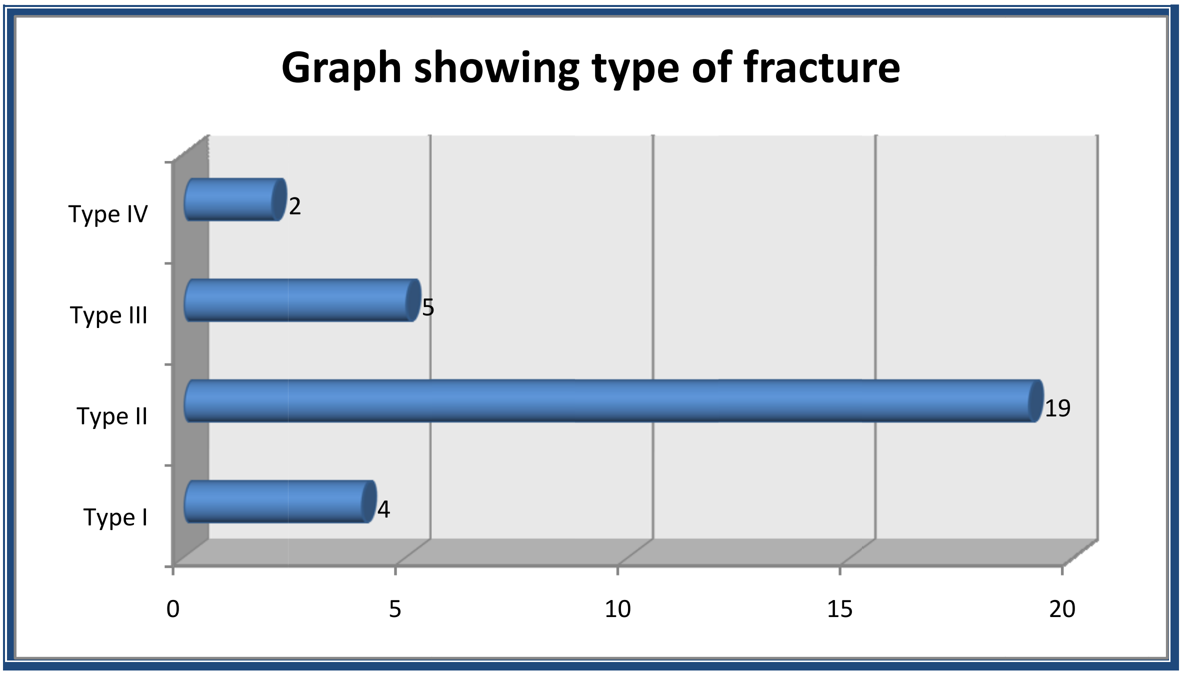
Type of fracture :

Table 6 : Showing Type of fracture

Type of fracture	**Number of patients**	**Percentage**
Type I	04	13.33
Type II	19	63.33
Type III	05	16.66
Type IV	02	06.66

Graph Showing Associated injuries

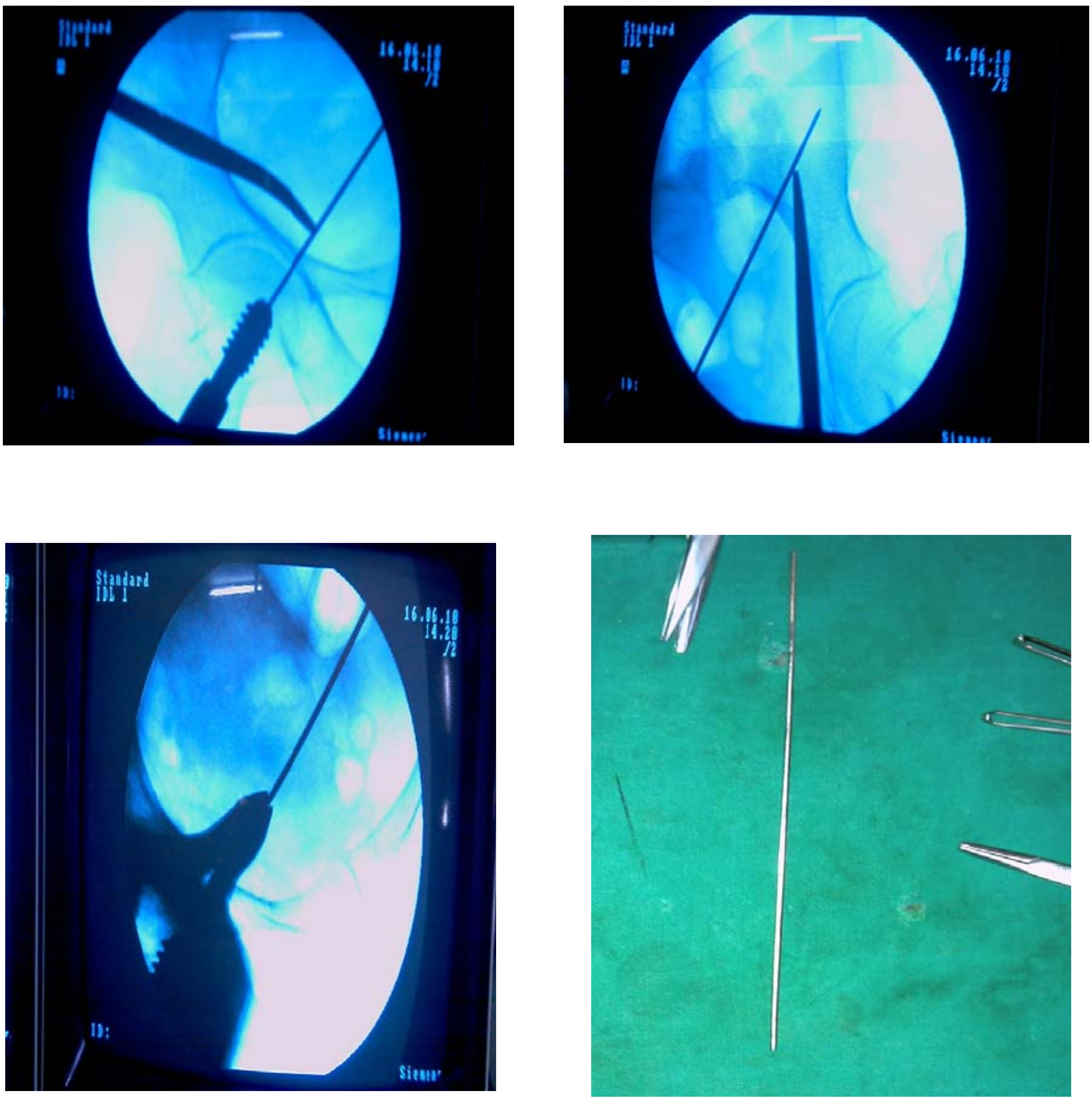




Intra – operative complication :

In the study of thirty cases there was 2 cases of intra- operative complications. In 1 case there was breakage of guide wire and in another case the guide wire had penetrated into the pelvic cavity. There was no visceral injury.

Guide wire penetration into pelvic cavity



Total duration of hospital stay

In the study, the total duration of hospital stay of the patients ranged from 2 weeks to 4 weeks. 10 patients stayed for 2 weeks, 14 patients stayed for 2-3 weeks, 4 patients stayed for 3-4 weeks,2 patients stayed for > 4weeks, average being 3.07 weeks.

Table 7 : Showing total duration of hospital stay

Total duration of stay	**Number of patients**	**Percentage**
< 2 weeks	10	33.33
2 – 3 weeks	14	46.66
3 – 4 weeks	04	13.33
> 4 weeks	02	06.66

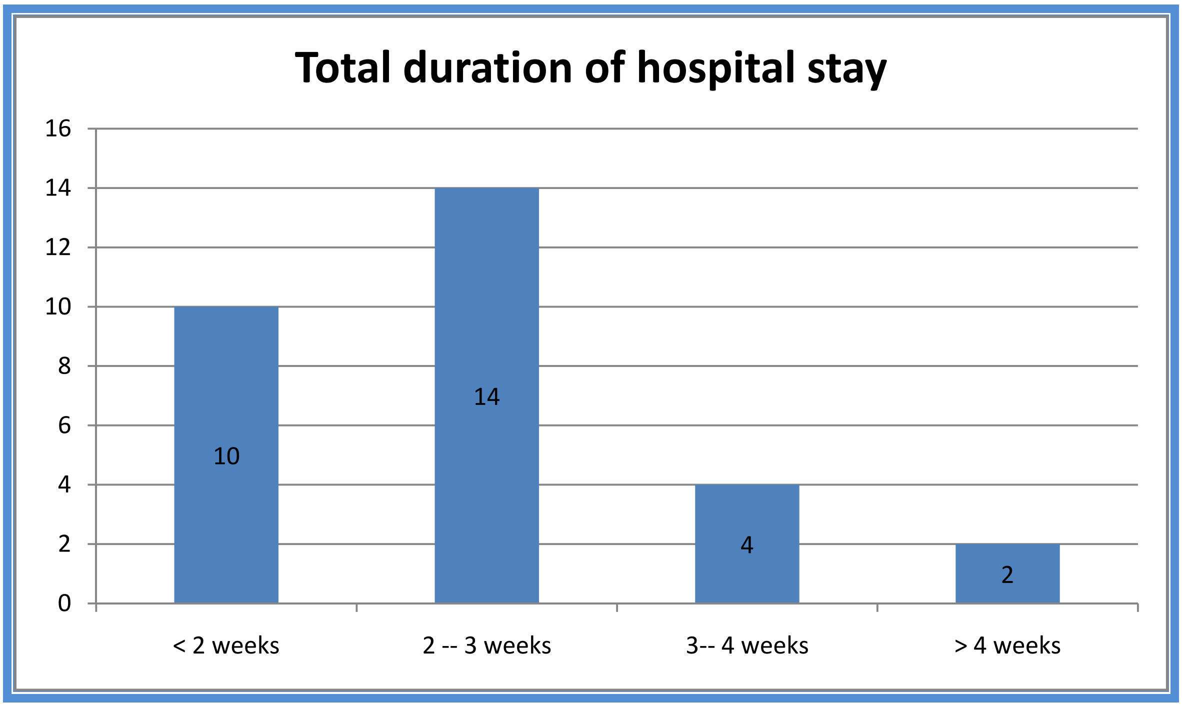
Functional Evaluation:

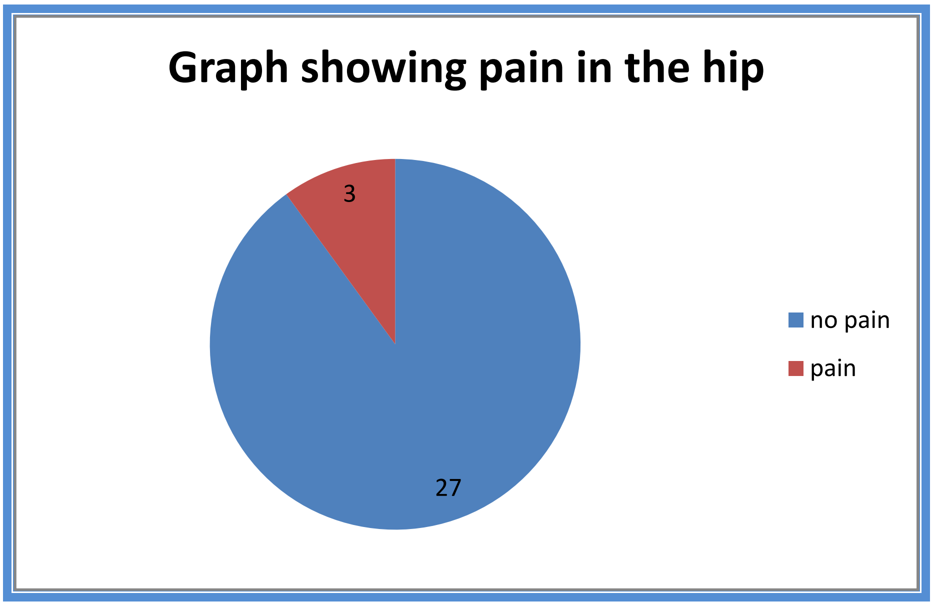
Pain:

In the present study of the thirty patients only three patients had pain in the hip region at the end of six months. It was due to implant cut through in one patient and trochanteric prominence in the other patient. The other patient was an elderly patient who had not compiled with the rehabilitative protocol.

Table 8: Showing Pain in the hip

Pain in the Hip	**Number of Patients**	**Percentage**
No pain	27	90
Pain	3	10


Total duration of hospital stay
16
14
12
10
8
6
4
2
0
10
14
4
2
< 2 weeks
2 -- 3 weeks
3-- 4 weeks
> 4 weeks


Graph showing pain in the hip
3
27
no pain
pain

Swelling:

Only two patients had swelling in the trochanteric region at the end of six months, one due to adduction deformity and prominence of trochanter and the other patient due to prominenceof trochanter due to malunion of trochanter.

Table 9: Showing Swelling

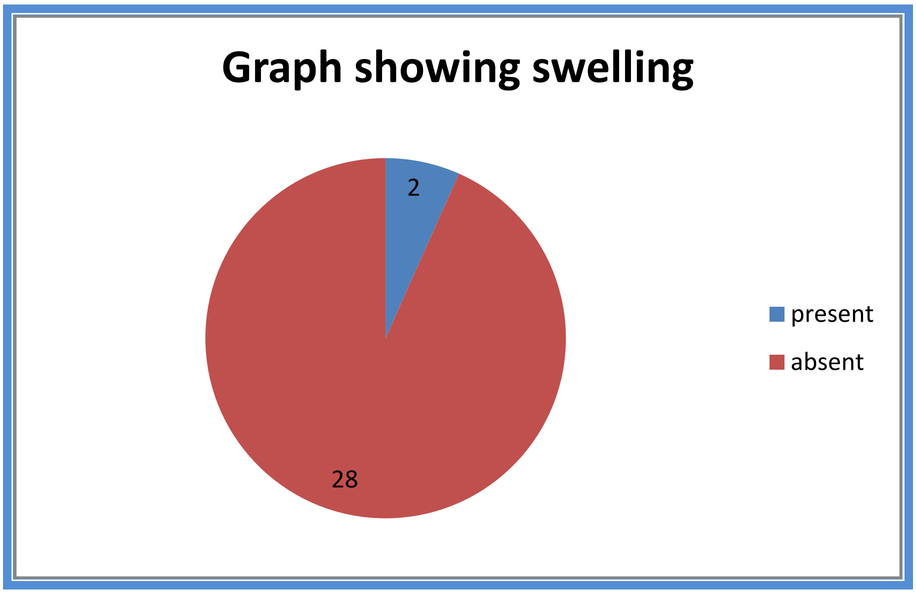
Swelling	Number of Patients	Percentage
Present	2	6.66
Absent	28	93.33

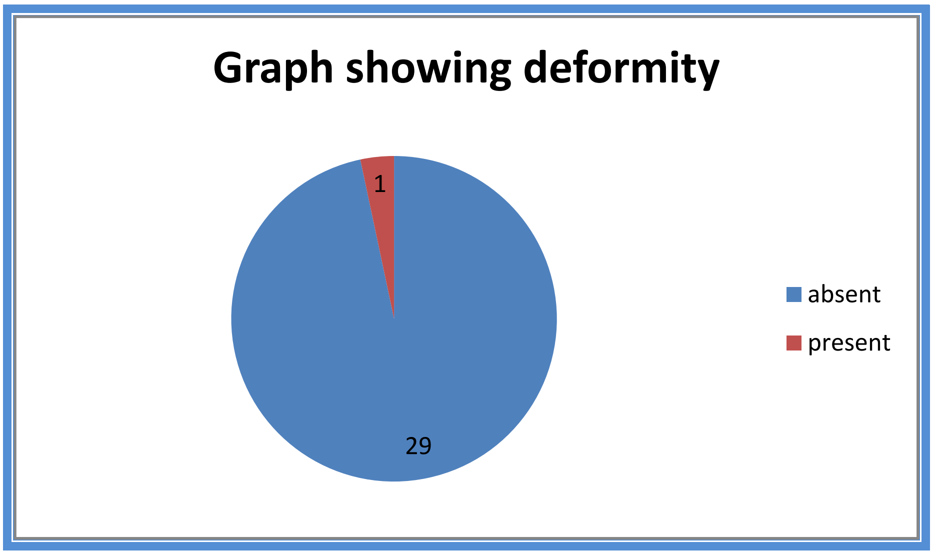
Deformity:

Of the thirty patients only one patient had an adduction deformity due to implant cut through.

Table 10: Showing Deformity

Deformity	Number of Patients	Percentage
Present	1	3.33
Absent	29	96.66


Graph showing swelling
2
28
present
absent


Graph showing deformity
1
29
absent
present

Range of movements

At the end of 6 months 4 patients had full ROM, 12 had restriction of terminal flexion and abduction , 8 patients had flexion upto 90^0 and abduction of 20^0, 1 patient had marked restriction of movements.

Table 11: Showing Movements

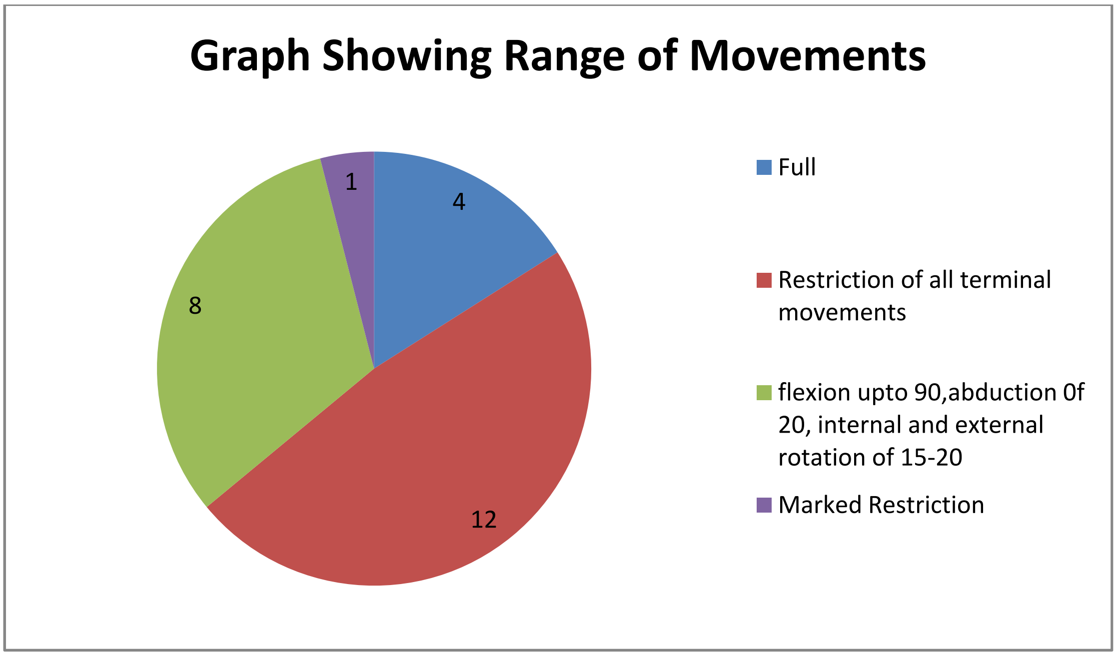
Range of movements	**Number of patients**	**Percentage**
Full	9	30
Restriction of all terminal movements	12	40
Flexion upto 90^0,Abduction of 20^0,internal and external rotation of 15-20^0	8	26.6
Marked restriction of all movements.	1	3.4

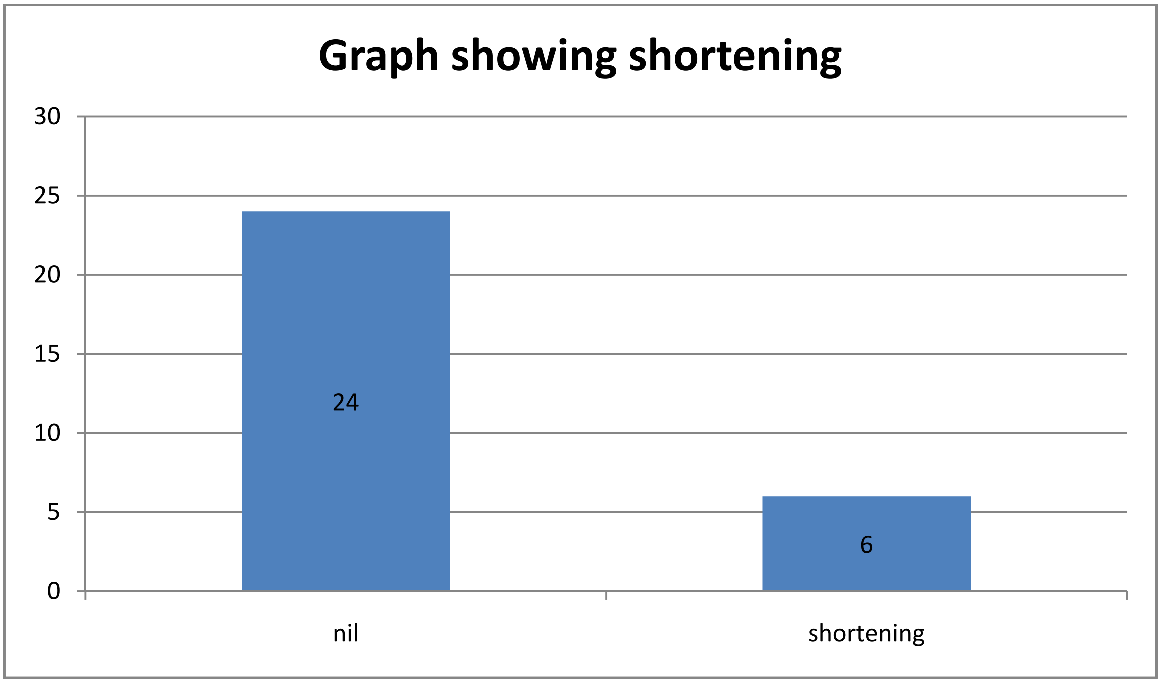
Shortening:

At the end of six months out of the thirty patients, 24 patients did not have any shortening, 6 patients had shortening. Shortening was due to fracture collapse as the patient started progressive weight bearing ambulation.

Table 12: Showing Shortening

Shortening	**Number of Patients**	**Percentage**
Nil	24	80
Shortening	06	20


Graph Showing Range of Movements
4
12
8
1
Full
Restriction of all terminal movements
flexion upto 90,abduction 0f 20, internal and external rotation of 15-20
Marked Restriction


Graph showing shortening
30
25
20
15
10
5
0
24
6
nil
shortening

Sitting Cross-Legged and Squatting:

At the end of six months, 8 patients were not able to sit cross-legged or squat and the remaining 22 patients were able to sit cross-legged and squat.

Table 13: Showing sitting cross legged and Squatting

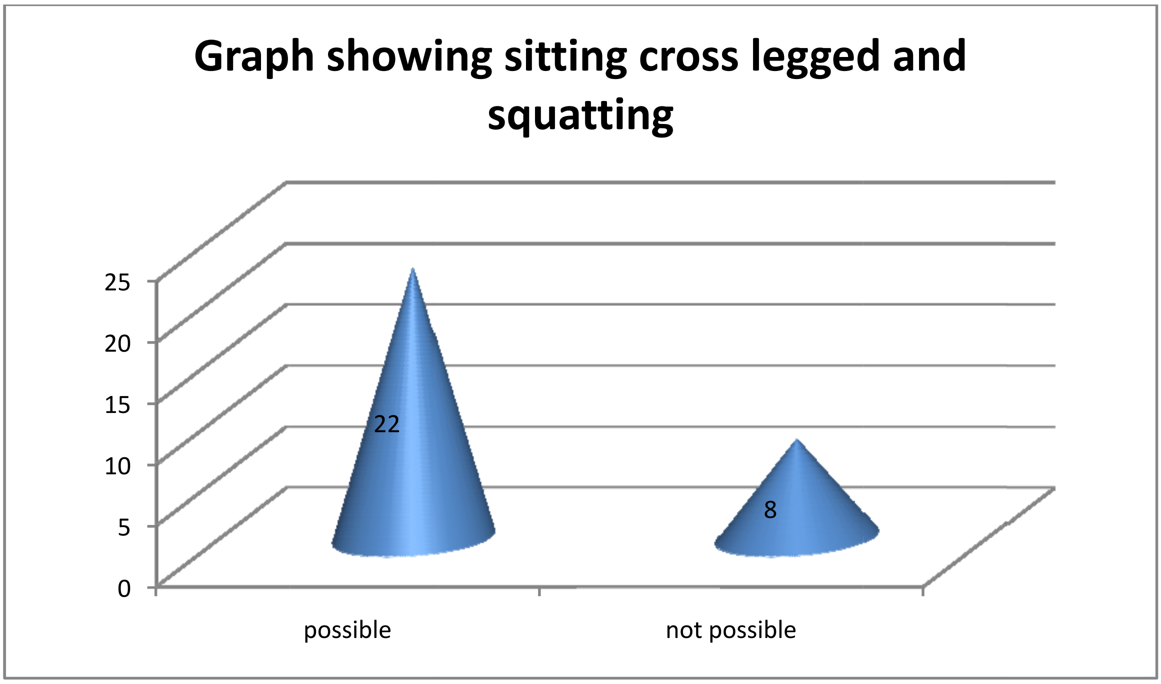
SCL and Sq	Number of Patients	Percentage
Possible	22	73.33
Not possible	8	26.66

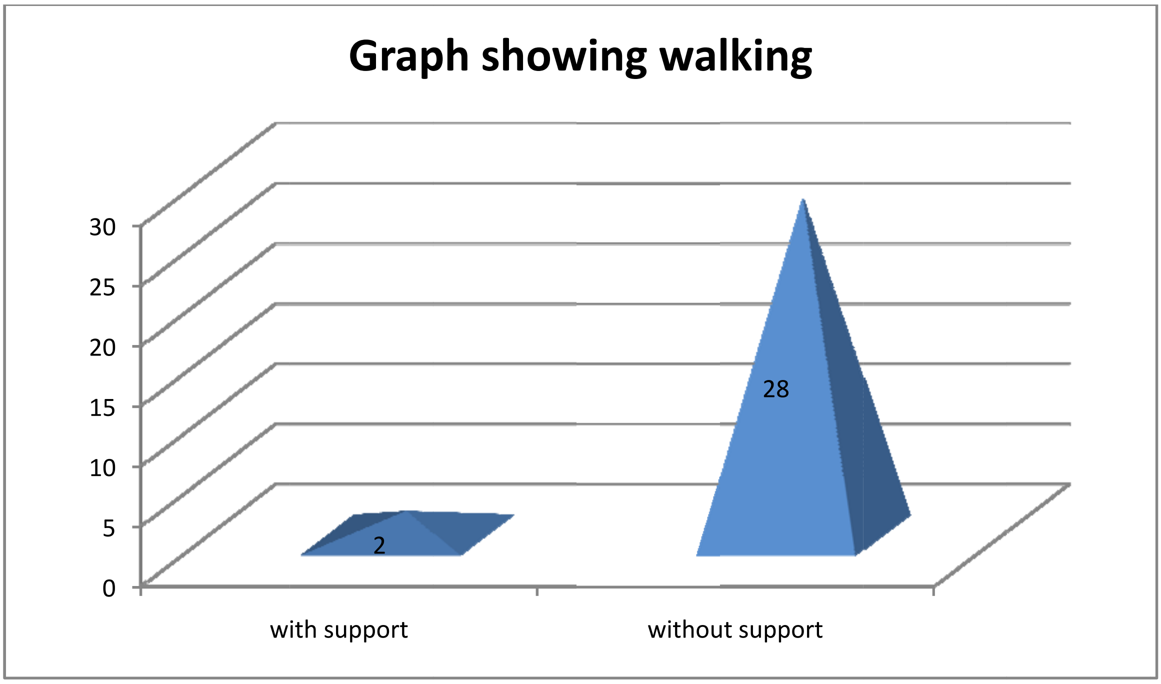
Walking:

At the end of six months, 2 patients were walking with support and the remaining 28 were walking without support.

Table 14: Showing walking

Walking	Number of Patients	Percentage
With support	2	6.66
Without support	28	93.33


Graph showing sitting cross legged and squatting
25
20
15
10
5
0
22
8
possible
not possible


Graph showing walking
30
25
20
15
10
5
0
2
28
with support
without support

Limp:

At the end of six months, 6 patients had an associated limp while walking and the remaining 24 did not have any associated limp while walking. The limp was because of shortening in the six patients.

Table 15: Showing limp

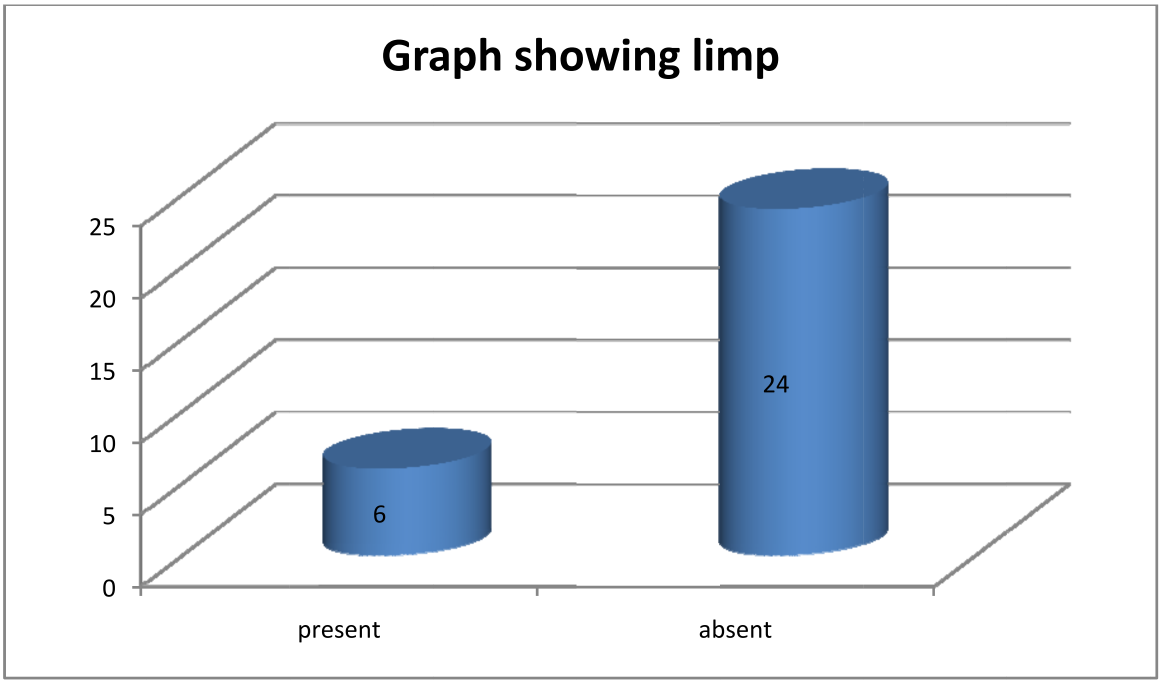
Limp	**Number of Patients**	**Percentage**
Present	6	20
Absent	24	80

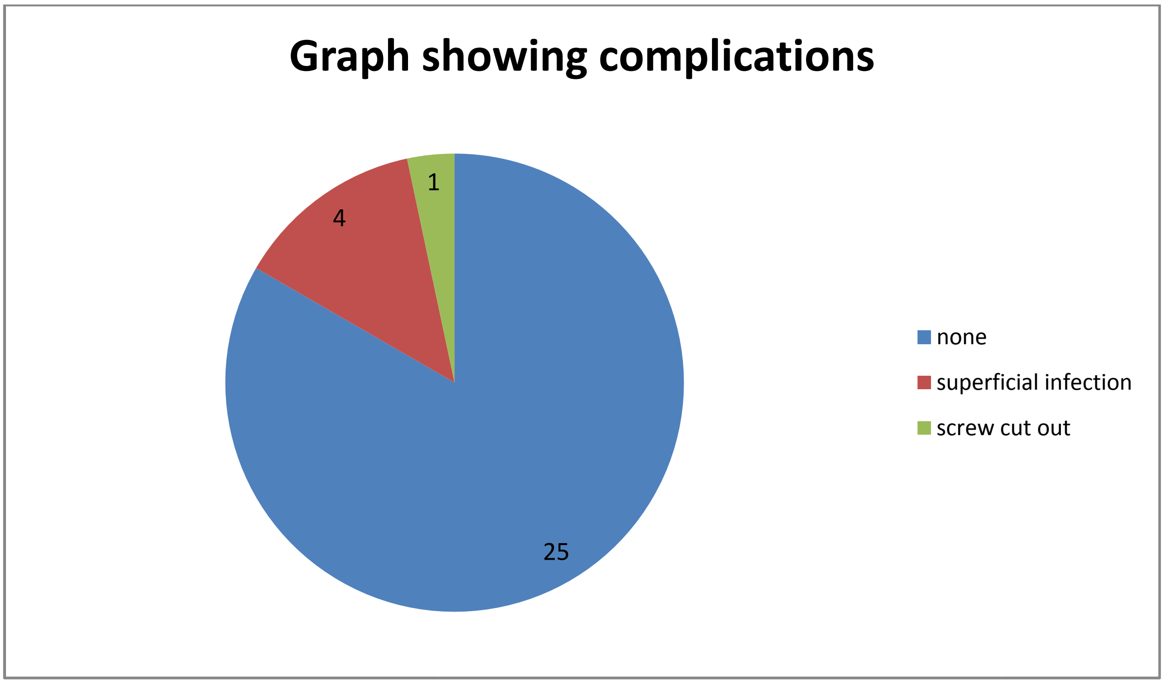
Complications:

Of the thirty patients in the study, four patients had a superficial wound infection post-operatively delaying wound healing, one patient had a cut-out of the Richard's screw from the head and the remaining patients had no complications.

Table 16: Showing complications

Complications	Number of Patients	Percentage
None	25	83.3
Superficial Infection	4	13.3
Screw Cut-out	1	3.3


Graph showing limp
25
20
15
10
5
0
6
24
present
absent


Graph showing complications
1
4
25
none
superficial infection
screw cut out

Radiological Evaluation:

The radiological evaluation was done based on the following criteria:

- Fracture Union.
- Sliding of the Dynamic Hip Screw.
- Neck Shaft Angle.
- Mechanical Complication -- Screw Cut- out.
- Implant Failure.
- Non-Union/Avascular Necrosis of Femoral Head/ Secondary Osteoarthritis of the hip joint.

The observations in the present study are as follows

Union:

In the present study, in 18 (60%) cases the fracture had united by twelve weeks and in the remaining 11 (40%) cases the fracture united by the sixteenth week.

The average time for radiological union is 16.2 weeks.

Table 17: Showing Union

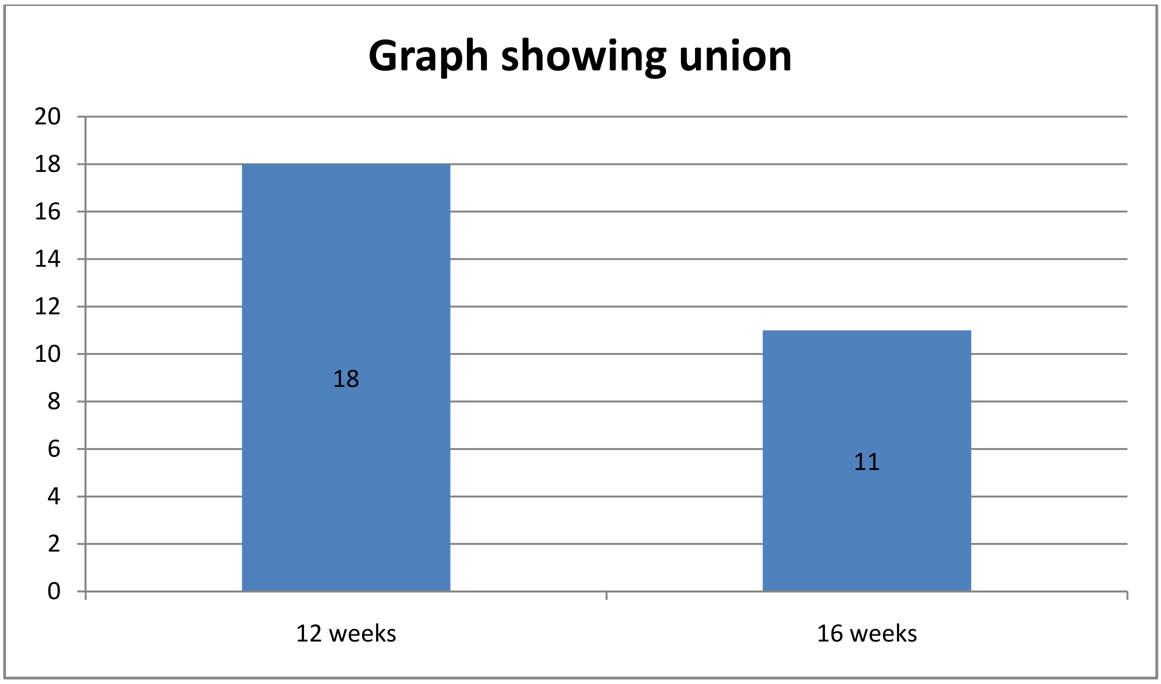
Union	Number of Patients	Percentage
12 weeks	18	60
16 weeks	11	40

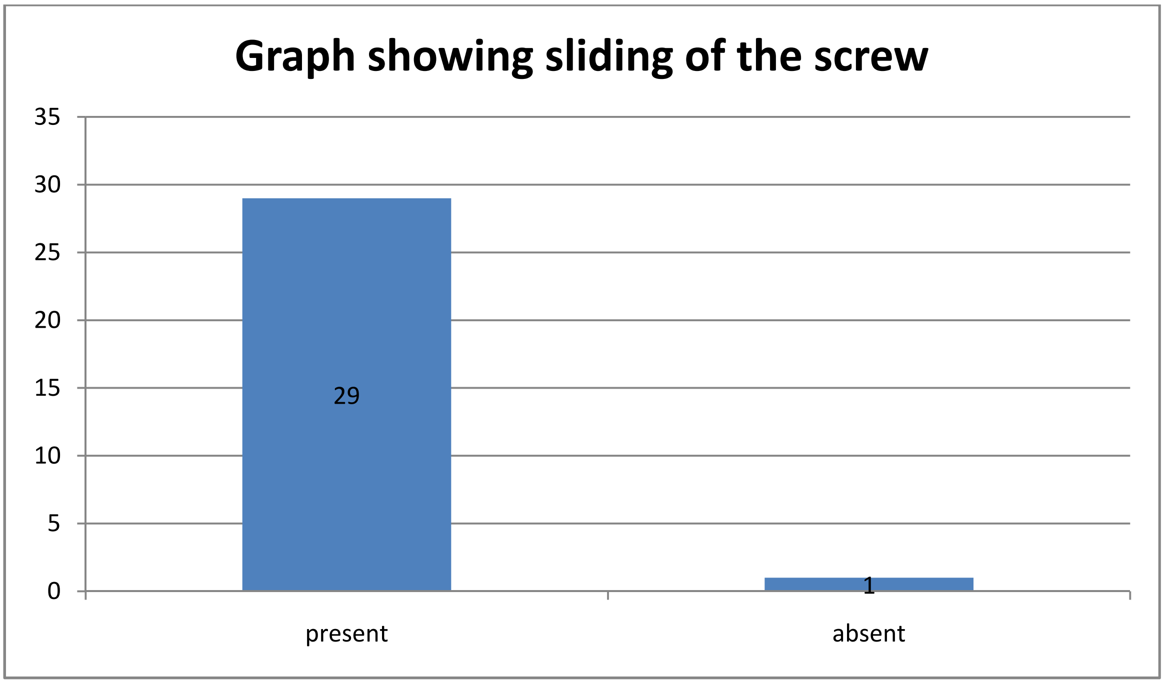
Sliding of the Dynamic Hip Screw:

In the present study in 29 cases, the Dynamic Hip Screw backed out due to the fracture site collapse resulting in union of the fracture. The remaining 1 case had implant failure(screw cut out).

Table 18: Showing sliding of the screw

Sliding of the screw	Number of Patients	Percentage
Present	29	96.6
Absent	1	3.3


Graph showing union
20
18
16
14
12
10
8
6
4
2
0
18
11
12 weeks
16 weeks


Graph showing sliding of the screw
35
30
25
20
15
10
5
0
29
1
present
absent

Neck Shaft Angle:

In the study, a 135^0 angled barrel side plate was used, hence the neck shaft angle was maintained in all the cases except in one case where the screw was placed in the superior part of the head leading onto screw cutout and causing a varus deformity and a decrease in the neck shaft angle.

Table 19: Showing Neck shaft angle

Neck shaft angle	Number of Patients	Percentage
Normal	29	96.6
Varus	1	3.4

Mechanical Complication:

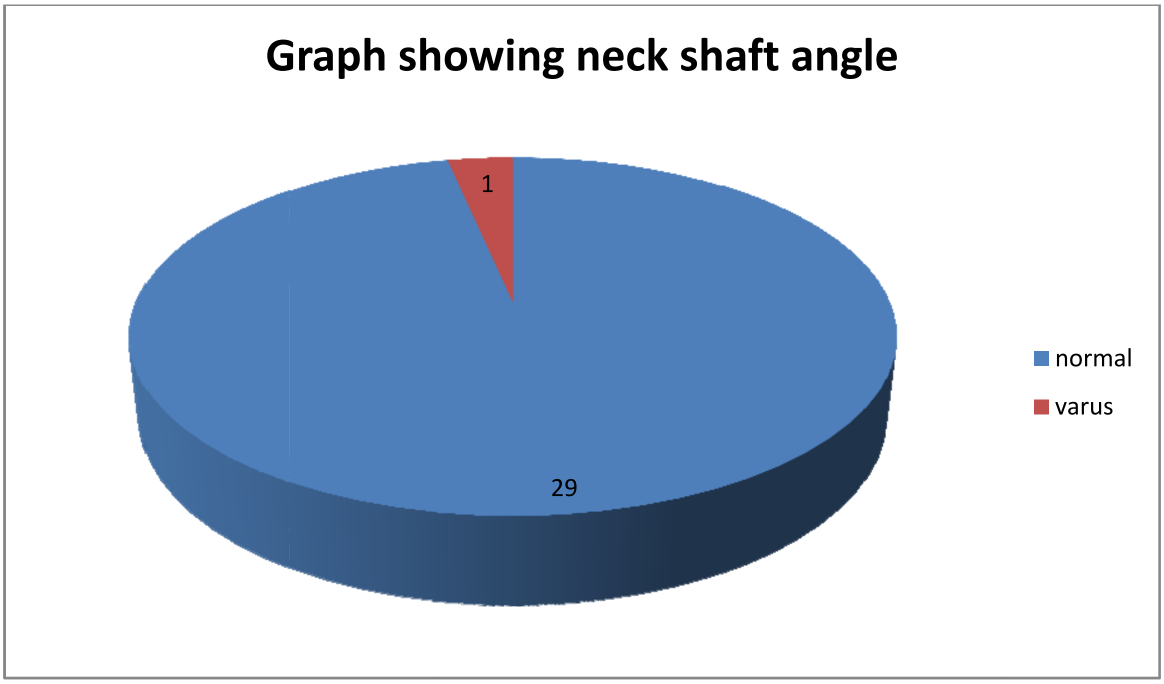
In the present study of the thirty cases there was only one case of mechanical complication. There was a cut - out of the screw from the femoral head due to the placement of the screw in the superior part of the head.

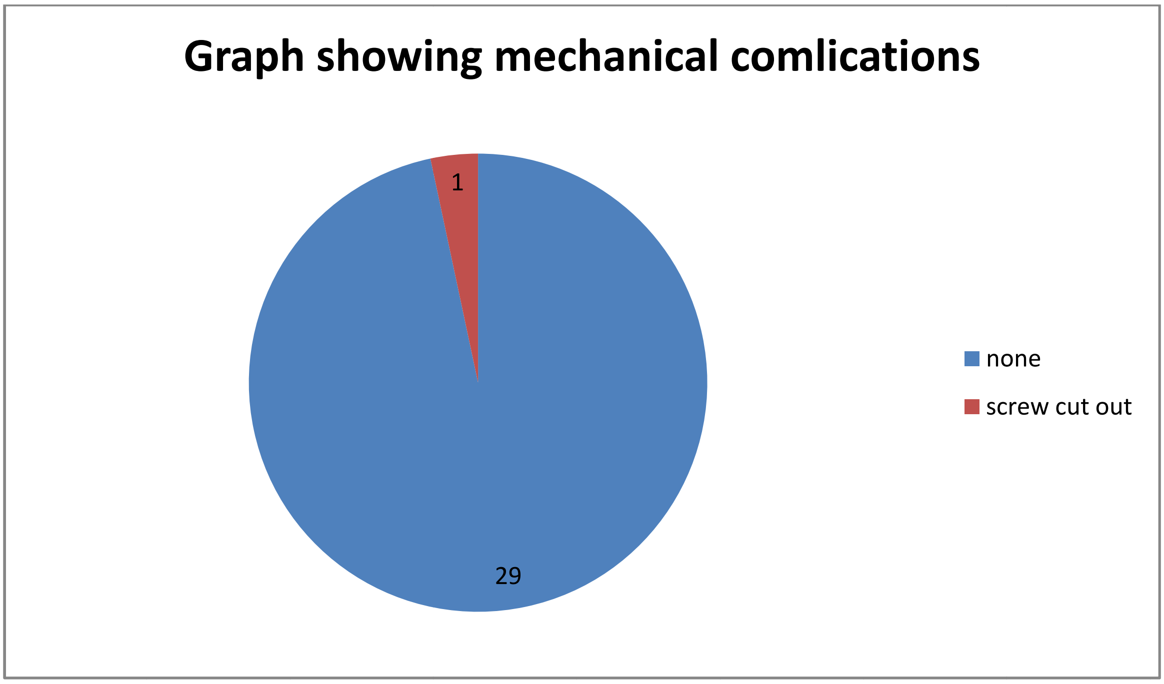
Table 20: Showing mechanical complication

Mechanical complication	Number of Patients	Percentage
None	29	96.6
Screw Cut-out	1	3.4

Implant Failure:

In the present study there was no incidence of implant failure, such as breakage of the plate, breakage of the screw or separation of the screw from the plate etc.


Graph showing neck shaft angle
1
29
normal
varus


Graph showing mechanical comlications
1
29
none
screw cut out

Non-Union/AvascularNecrosis/SecondaryOsteoarthritis:

In the study none of the cases developed Avascular Necrosis of the femoral head or Secondary Osteoarthritis of the hip joint following surgery during the period of follow-up.

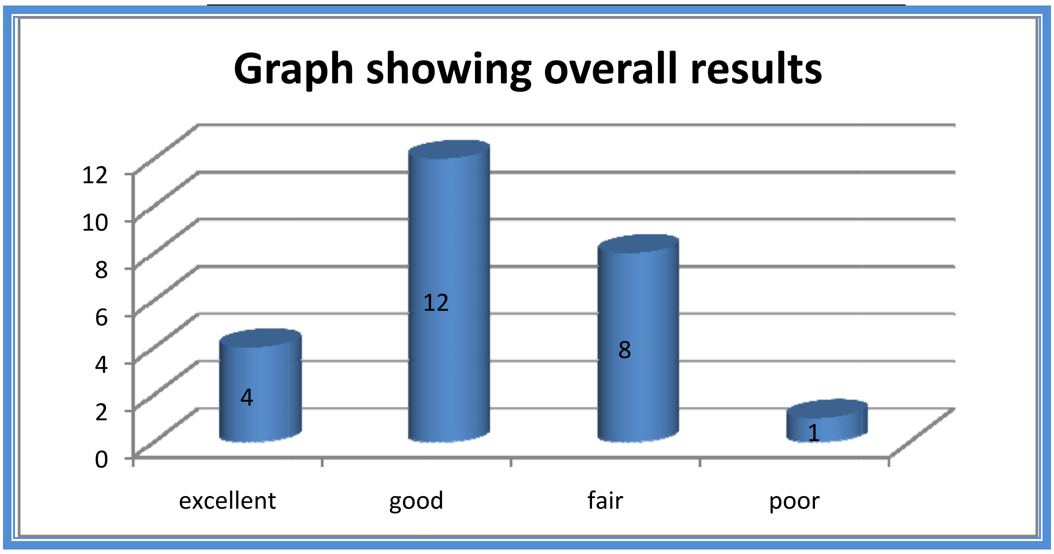
Results:

In the present study thirty cases of intertrochanteric fractures managed with dynamic hip screw with barrel side plate assembly, were assessed and evaluated using Babhulkar's criteria for evaluation of results of DHS fixations.

In the study there were six cases with excellent results, thirteen cases with good results, ten cases with fair results and one case with poor results.

Table 21: Showing overall results

Result	Number of Patients	Percentage
Excellent	6	20
Good	13	43.3
Fair	10	3.3
Poor	1	3.3



BABHULKAR'S CRITERIA FOR EVALUATION OF RESULTS OF DHS FIXATIONS

Sl.No	CRITERIA	EXCELLENT	GOOD	FAIR	POOR
1.	PAIN	Occasional pain in the hip joint	Little pain in the hip joint	Slight pain in the hip joint	Painful hip
2.	LIMP	Nil	Nil	Slight limp	Severe limp
3.	MOVEMENTS	Full range of movements	Restriction of terminal range of terminal degrees of flexion and abduction	Flexion upto 90 an d abduction upto 20 only	Marked restriction of movements of hip
4.	LIMB LENGTH DISCREPANCY	Nil	Nil	Less than 1 cm	More than 1 cm
5.	COXA VARA DEFORMITY	Nil	Nil	Nil	Present

Case 1

Pre-operative x-ray

Immediate post-op x-ray

After 3 months

After 6 months

After 1 year

After implant removal

Case 2

Pre-Operative X-Rays

Immediate post-op x-ray

After 3 months

After 6 months

After 1 year

Active hip flexion

active abduction

Patient in squatting position

Patient sitting in crosslegged position

Case 3

Pre-Operative X-Rays

Immediate post-op x-ray

After 3 months

After 6 months

After 1 year

Active hip flexion

active abduction

Patient in squatting position

Patient sitting in crosslegged position

DISCUSSION

Intertrochanteric fractures of the femur are relatively common injuries among the elderly individuals.

The Dynamic Hip Screw with Barrel Side Plate assembly is theoretically, practically and biomechanically more advantageous than other implants. It remains the best implant available for fixation of intertrochanteric fractures of the femur.

In the present study, thirty cases of intertrochanteric fractures were surgically managed by dynamic hip screw with a barrel side plate assembly. The purpose of the study is to evaluate the outcome of the management of intertrochanteric fractures with dynamic hip screw with barrel side plate assembly.

The data collected in this study is assessed, analyzed, compared with other series and the results were evaluated.

Age Incidence:

In the present study, the average age for intertrochanteric fractures was 54.7 years ranging from 22 to 88 years. Intertrochanteric fractures are common in the elderly. The average age incidences reported in other series are as follows:

Showing age incidence

Series	**Year**	**Average Age (years)**
G.S. Kulkarni[23]	1984	62
Kenzor et.al.[74]	1984	73
Parker et.al.[30]	1992	79
T.S. Sethi et.al.[75]	1993	61
Watson et.al.[38]	1998	76
Christopher IA et.al[42]	2001	80.8
Marc Sudan et.al[43]	2002	83.7
Utrilla LA[46]	2005	80
Arun Kumar[51]	2006	52.5
Brian[52]	2008	83.8
Dionysios et.al[53]	2010	79.2
Present Study	2010	63

Sex Incidence:

In the present study, 12 patients (30%) were females and 28 patients (70%) were males. Intertrochanteric fractures are more common in females because of metabolic changes. The female preponderance in our study is not similar to the female preponderance observed by various other authors

The sex incidences reported in other series are as follows.

Sex incidence

Series	Year	Female (%)	Male (%)
JohnH. Doherty et.al.[76]	1979	60 (75%)	20 (25%)
JuluruP.Rao et.al.[22]	1983	110 (67.9%)	52 (32.1%)
Mohanty and Chacko[73]	1984	65 (56%)	51 (44%)
G.S. Kulkarni[23]	1984	76 (55%)	64 (45%)
Davis T. et.al.[27]	1990	190 (83%)	40 (17%)
MartynJ. Parker et.al.[30]	1992	112 (57.7%)	82 (42.3%)
Tracy Watson et.al.[38]	1998	117 (60.6%)	76 (39.4%)
Christopher IA et.al[42]	2001	312(78%)	88(22%)
Marc Sudan et.al[43]	2002	160(77.6%)	46(23.4%)
Utrilla LA[46]	2005	144(72%)	66(28%)
Arun Kumar[51]	2006	51(63%)	29(37%)
Brian[52]	2008	31,898(78.1%)	8930(21.9%)
Dionysios et.al[53]	2010	85(70%)	35(30%)
Present Study	2010	09(30%)	21(70%)

Mode of Injury:

In the present study in the elderly patients, 80% of the cases were due to a fall, such as at home, slipping in the bathroom or missing a step. In 6 patients the mode of injury was RTA.

The higher incidence of intertrochanteric fractures in the elderly due to a trivial trauma is varies from other series. The incidence of intertrochanteric fractures due to a trivial trauma reported in other series are as follows:

Mode of injury

Series	Year	Incidence of Trivial Trauma
Gupta R. C. [77]	1974	79.4%
Kuderna et.al.[78]	1976	69%
Ganz et.al.[79]	1979	70%
Hornby et.al.[85]	1989	80%
Christopher IA et.al[42]	2001	82%
Kulkarni GS[50]	2006	90%
Present study	2010	80%

Side Involved:

In the present study 11 of the fractures were on the left side and 19 were on the right side.

In the studies by **Wade P.A. et.al.[80] and R.C. Gupta[77]**right-sided fractures were more common. In the studies made by **Kenzor et.al.[74]and Cleveland et.al.[12]**left sided fractures were common.

In the present study none of the cases had a bilateral intertrochanteric fractures, whereas in **Cleveland's[12]**series two patients had sustained bilateral trochanteric fractures and in **R.C. Gupta's[77]**series only one patient had bilateral trochanteric fractures.

Associated Injuries: In the present study only 4 patients had an associated injury.

Associated Diseases: In the present study, 6 patients were known hypertensives, 2 patients were known diabetics,4 patients had both diabetes and hypertension and1 patient was suffering from bronchial asthma.

From the above findings that are common diseases in the elderly, it can be inferred that intertrochanteric fractures are more common in the elderly patients.

Type of Fracture:

In the present study the intertrochanteric fractures were classified according to Boyd and Griffin's classification, which is a widely accepted classification. There were 4 type I fracture, 19 type II fracture, 5type III fracture and 2 type IV fracture.

In the study majority were type II fractures, which is the same as that observed by many other authors in the literature. The degree of comminution depends on the quality of bone; in the elderly individuals as the bone is osteoporotic the incidence of comminution is more.

Total Duration of Hospital Stay:

In the present study, ten (33.3%) patients stayed for <2 weeks, fourteen(46.6%) patients stayed for 2-3 weeks, four(13.3%) patients stayed for 3- 4 weeks and two (6.6%) patient stayed for> 4 weeks.

The average period of hospitalization was 3.07 weeks.

The patients were discharged two weeks after the surgery if there were no complications post-operatively.

The total duration of hospital stay in few cases was more than 2 weeks, due to delay in acceptance and consent for surgery, medical evaluation in cases of patients with associated medical diseases.

Two patients stayed for more than four weeks due to pain in the hip as a result of screw cutout in one case and due to superficial infection in other.

Functional Evaluation:

Pain:

Pain is an important criterion for the evaluation of intertrochanteric fractures.

Following surgery pain in the hip joint may be due to mechanical complications like screw cutout, joint penetration or infection, or due to avascular necrosis of the femoral head or secondary osteoarthritis of the hip joint.

In the present study, only three patients had pain in the hip joint at the end of six months.

In one patient the pain was due to a mechanical complication, i.e. screw cutout. In the other two patients there was no mechanical complication, or infection or secondary changes, but the patient still complained of pain in the hip joint.

In the **Malcolm L. Ecker et.al.**[84](1975) series, 79% showed no pain, 18% had mild pain and 1% had moderate pain.

Swelling:

In the present study two patients had a swelling in the trochanteric region at the end of six months.

The swelling in the trochanteric region was due to an adduction deformity and the prominence of the trochanter.

Deformity: In the present study only one patient had an adduction deformity.

The deformity was due to the screw cutout and collapse of the fracture fragment.

Movements:

In the present study all the patients were encouraged to do active hip and knee movements as soon as the pain and inflammation subsided.

At the end of six months four patients had full range of movements by twelve to sixteen weeks, twelve patients had fair range of movements with restriction of terminal degrees , 8 patients had flexion upto $90^0$and abduction of $20^0$and one patient had gross restriction of movements.

The gross restriction of movements in one of the patient was due to the screw cutout, adduction deformity and pain in the hip joint.

The ranges of movements were full range to fair in 96.3% of patients, which is comparable to **Max P. Esser et.al.**[81] series.

Shortening:

In the present study at the end of six months, 24 patients had no shortening, 6 patients had shortening varying from 1.5 to 2cm.

In intertrochanteric fractures 0.5 to 1 cm of shortening is acceptable.

Intertrochanteric fractures occur in the cancellous metaphyseal region and the bone will be osteoporotic in the elderly. The dynamic hip screw allows the proximal fragment along with the Richards screw to slide through the barrel of the side plate.

These factors allow the fracture site to collapse and gain its position of stability, and as the fracture unites causes shortening..

In the series by **Ecker et.al.**[84](1975) and **Sernbo et.al.**[82](1988) shortening was seen in 20% of the cases.

Sitting Cross-Legged and Squatting:

For the Indian patients sitting cross-legged and squatting is very important in their daily activities and also to attend to their toilet needs. It is an important criterion in assessing the results of intertrochanteric fractures treated with dynamic hip screw with barrel side plate assembly in an Indian setup.

In the present study of the thirty patients, twenty two patients (73.3%) were able to sit cross-legged and squat without any difficulty and eight patients (26.6%) had difficulty in sitting cross-legged and squatting.

To sit cross-legged and squat the person must have good range of hip movements. In the present study the eight patients who had restriction of hip movements were not able to sit cross-legged and squat.

Walking:

In the present study, non-weight bearing mobilization with crutches or walker was started post op day 2 in stable fractures and post-op 1-2 weeks in case of unstable patients

Partial weight bearing was started by the sixth week with walking aids.

Based on the radiological union and the patient compliance full weight bearing was started by the twelfth to sixteenth week.

At the end of six months twenty eight patients (93.3%) were walking without any support, two patients (6.6%) were walking with the support of a stick or walker.

In the present study partial weight bearing was started by the second week, which is the same as that reported in the series of **T Sahlstrand**[16] (1974), **Juluru P. Rao et.al.**[22] (1983), **G.S. Kulkarni**[23] (1984), **Sernbo**[82] (1988) and **Sethi et.al.**[75] (1993).

Limp: In the present study six patients (20%) had a limp while walking. In the study limp was due to shortening of 1 cm in five cases and 1.5 cm in one case. In the case which had 1.5 cm of shortening the patient had a screw cutout and an adduction deformity, which also contributed to the limp. Pain was one of the contributing factor for limp in two cases.

Complications: In the present study, three patients (10%) had a superficial wound infection, one patient (3.3%) had a deep infection and one patient (3.3%) had a mechanical complication of screw cutout.

In the patients who had a superficial wound infection, wound healing was delayed by about a week. The wound healed without any complications with regular dressings.

The infection rates observed in other series are as follows:

Complications

Series	**Year**	**Percentage**
Jacobs et.al.[17]	1976	4
Jensen[86]	1980	20
Wolfgang et.al.[21]	1982	1
Heyse Moore et.al.[87]	1982	5.6
Sethi et.al.[75]	1993	8
Sernbo et.al.[82]	1988	2.5
Christopher et.al[42]	2001	4.9
Utrilla[46]	2005	8.5

Radiological Evaluation:

Fracture Union:

In the present study eighteen patients (60%) showed union by twelve weeks and eleven patients (33%) showed union by sixteen weeks. The average time for union was 13.2 weeks.

The average time for radiological union in other series are as follows:

Fracture union

Series	Year	Union Time
Ecker et.al.[84]	1975	15 weeks
Wolfgang et.al.[21]	1982	11.7 weeks
Juluru P. Rao et.al.[22]	1983	18 weeks
Mohanty and Chacko[73]	1984	14.5 weeks
Christopher et.al[42]	2001	15 weeks

Sliding of the Screw:

In the present study in twenty nine cases the Richard's screw backed out due to the fracture site collapse resulting in union of the fracture. In the remaining one case there was no backing of the screw.

The sliding of the hip screw is due to the collapse of the fracture site as the intertrochanteric fracture occurs in the cancellous metaphyseal bone. The barrelallows the dynamic hip screw to slide within it and permits the proximal fragment to collapse or settle on the fixation device, seeking its own position of stability.

The average amount of sliding in the present study was 5.85 mm, ranging from 2 mm to 10 mm.

The amount of sliding of the Richards screw in other series is as follows:

Sliding of the screw

Series	Year	Average amount of Sliding
Jacobs[17]	1976	Stable – 5.33 mm Unstable – 15.7 mm
E. Marc Mariani[25]	1989	13.4 mm
Luis A. Flores[88]	1990	Tronzo type 1 – 6 mm Tronzo type 2 – 7 mm Tronzo type 3 – 12 mm Tronzo type 4 – 14 mm Tronzo type 5 – 23 mm

Neck Shaft Angle: In the present study a 135^0 angled barrel side plate was used and the screw was placed centrally, hence the neck shaft angle was maintained in twenty nine (96.7%) cases. In one case (3.3%) where the screw was placed in the superior part of the head that led to screw cutout, causing a varus deformity and a decrease in the neck shaft angle.

The dynamic hip screw with barrel side plate assembly is a collapsible fixation device, which permits the proximal fragment to collapse or settle on the fixation device, seeking its own position of stability. As a result of this the neck shaft angle is maintained.

The neck shaft angles noted in other series are as follows:

Neck shaft angle

Series	**Year**	**Varus**	**Valgus**
Ecker et.al.[84]	1975	0.15%	---
Laskin et.al.[89]	1979	12%	----
Wolfgang et.al.[21]	1982	1.7%	0.7%
Utrilla[46]	2005	1.7%	---
Present study	2010	1.5%	---

Mechanical Complications:

In the present study there was only one case (3.3%) of mechanical complication; screw cutout from the femoral head. The screw cutout was due to misplacement of the screw in the superior part of the head and the use of a 135^0 barrel side plate as a result of which, as the fracture site collapsed the screw cutout from the femoral head. Diffuse osteoporosis also may be a contributing factor for the screw cutout. The same patient had an adduction deformity and a shortening of 1.5 cm. The patient also had pain in the hip joint and gross restriction of hip movements.

The percentage of screw cutout noted in other series is as follows:

Mechanical complications

Series	Year	Percentage
Wolfgang et.al.[21]	1982	4.2
Juluru P. Rao et.al.[22]	1983	3.1
Christopher[42]	2001	4
Marc Sudan[43]	2002	1.2
Utrilla[46]	2005	2
Brian[52]	2008	5.5
Present series	2010	3.4

Therefore the ideal position for the placement of the screw is in the center of the femoral head in both anteroposterior and lateral views 10 mm from the articular surface and a side plate with 135^0angle barrel should be used to maintain the neck shaft angle and allow for the fracture site to collapse and the dynamic hip screw to slide through the barrel without cutting out of the head.

If the screw cannot be placed centrally, then it should be placed in the posteroinferior quadrant of the head in the lateral view and low on the calcar in the anteroposterior view, so that the nail would have to plow through a maximum amount of bone before cutting out of the femoral head.

There were no other mechanical complications in the study such as penetration of the screw into the hip joint or acetabulum etc.

Implant Failure:

In the present study there were no cases of implant failure, such as breakage of the plate, breakage of the screw or separation of the screw from the plate etc.

The rates of implant failure reported in other series are as follows:

Implant failure

Series	**Year**	**Percentage**
Ecker et.al.[84]	1975	6.4
Doplett et.al.[90]	1980	2.9
Jensen et.al.[86]	1980	5.3
Christopher[42]	2001	2.3
Utrilla[46]	2005	2
Present	2010	--

Non-Union/Avascular Necrosis/Secondary Osteoarthritis:

In the present study none of the cases developed Non-Union or Avascular Necrosis of the femoral head or Secondary Osteoarthritis of the hip joint following the surgery during the period of follow-up. Non-union of an internally fixed intertrochanteric fracture is an uncommon occurrence.

The cases of non-union reported in other series are as follows:

Non-Union/Avascular Necrosis/Secondary Osteoarthritis:

Series	**Year**	**Number of Cases**
Ecker et.al.[84]	1975	2
Jacobs et.al.[17]	1976	1
Wolfgang et.al.[21]	1982	3
Present study	2010	0

Avascular Necrosis of the femoral head following an intertrochanteric fracture of the femur is a rare occurrence. **Cleveland et.al.**[12] (1959) and **Kyle et.al.**[83] (1979) report an incidence of 0.8% of avascular necrosis. Only seven cases of avascular necrosis have been reported in the literature.

RESULTS

In the present study, thirty cases of intertrochanteric fracture of the femur were managed with a dynamic hip screw and barrel side plate. The data collected in this study is assessed, analyzed, and the results were evaluated as per the criteria stated above.

Of the thirty cases, there were six cases with excellent results, thirteen cases with good results, ten cases with fair results and one case with poor results.

In six patients the results were excellent. The patients did not have pain in the hip joint or swelling in the trochanteric region, or deformity. Two patients had no shortening, but nine patients who had about 0.5 cm of shortening were also graded as excellent due to other criteria. The patients had full range of hip movements by twelve - sixteen weeks. They were able to sit cross-legged and squat without any difficulty by about sixteen weeks. These patients were able to walk without any support or limp by about sixteen weeks. There was radiological evidence of bone union by twelve weeks. There were no complications. The patients were fully satisfied with the treatment.

Thirteen patients had a good result. In this group too the patients did not have pain in the hip or swelling in the trochanteric region or deformity. These patients had a shortening of 0.5 to 1 cm. These patients had full range of hip movements by sixteen to twenty four weeks. These patients were able to sit cross-legged and squat without any difficulty by twenty-four weeks. These patients were able to walk without support by twenty-four weeks. Of the thirteen patients twelve did not have limp only one patient who had a limp was graded good due to other criteria like good range of hip movements and radiological union by sixteen weeks. There was radiological evidence of union by sixteen weeks. There were no complications.

These patients were satisfied.

Ten of the patients had fair results. They did not have pain in the hip or swelling in the trochanteric region or deformity. They had a shortening of about 1 cm. They had restriction of terminal degrees of hip movements. Three of the patients were not able to sit cross-legged or squat but one of the patients was able to sit cross-legged and squat for a short duration. These patients were walking with support and two patients had an associated limp. Radiologically the fractures united without any signs ofmalunion. One of the patients had a superficial wound infection, which delayed the wound healing by a week. The other patients had no complications. One of the patients had poor results. This patients continued to have pain in the hip; in this patient the pain was due to screw cutout from the femoral head. The same patient with a screw cutout had an adduction deformity and prominence of the trochanter. He had gross restriction of hip movements and was not able to sit cross-legged or squat. The radiographs showed fracture union but in the case with screw cutout there was a coxavara deformity.

The results in the present study are similar compared to other series which are as follows:

OVERALL RESULTS

Series	Year	Excellent	Good
T. Sahlstrand[16]	1974	72%	18%
Sernbo et. al.[82]	1988	82%	18%
Sethi et. al.[75]	1993	72%	18%

CONCLUSION

In the present study of 30 patients with intertrochanteric fracture of femur were surgically managed with dynamic screw with barrel side plate assembly. The data was assessed, analyzed, evaluated and the following conclusions were made:

- Intertrochanteric fracture of the femur is common in the elderly, due to osteoporosis.
- The mode of injury for intertrochanteric fracture in the elderly is a trivial trauma, however in the young individuals it occurs following a forceful trauma.
- Since the mode of injury is a low velocity trauma, the incidence of associated injuries is less.
- Since the fracture is common in the elderly the incidence of associated diseases requiring medical attention is high.
- The degree of comminution depends on the quality of bone, in the elderly individuals, as the bone is osteoporotic the incidence of comminution is more.
- As the fracture is more common in the elderly, early reduction and internal fixation increases patient comfort, facilitates nursing care, helps in early mobilization of the patient and decreases the duration of hospitalization.
- Anatomical reduction can be achieved by closed manipulative or open methods.
- As the incidence of comminution is high, these fractures may require a stable reduction and internal fixation. Bone grafting is required if there is a deficiency.

- The dynamic hip screw with a barrel side plate has the advantage in that it allows controlled collapse of the fracture site.
- Central placement of the screw within the femoral head is desirable.
- A side plate with a barrel at 135^0 angle, is ideal to maintain the neck shaft angle and prevent the screw from cutting out of the femoral head.
- The fixation with dynamic hip screw is rigid even in osteoporotic bone.
- Though the dynamic hip screw is technically demanding, the implant design and its biomechanical properties have reduced the incidence of joint penetration and implant failure.
- Post-operatively early mobilization can be begun as the fixation is rigid and because of the implant design.
- The fixation of intertrochanteric fractures with a dynamic hip screw markedly reduces the morbidity and mortality, in the elderly individuals in whom the fracture is more common.
- If the above technical details are achieved, the function of the hip joint is regained to near normal and the rehabilitation of the patient is smooth. The review of literature also suggests that the theoretical advantage of the dynamic hip screw is real.
- Hence the Dynamic Hip Screw with Barrel Side Plate assembly remains the implant of choice in the management of intertrochanteric fractures.

SUMMARY

- In this study thirty cases of intertrochanteric fractures surgically managed with a dynamic hip screw with barrel side plate, between September 2008 and September 2010 at R.L.Jalappa hospital attached to Sri DevrajUrs Medical College, Kolar were included.
- The age of the patients in the study, ranged from 23 years to 88 years, average being 54.7 years.
- In the study, 9 patients were female and 21 were male.
- Only 06 cases was due to forceful trauma due to a rta and the rest 24 cases were due to a trivial trauma as a result of fall.
- 19 patients had an injury of the right femur and the other 11 had an injury to the left femur.
- 13 patients had associated diseases such as Hypertension in 06 patients, Diabetes Mellitus in 2 patients, 4 patients had both HTN/DM, Bronchial Asthma in one patient .
- In the study the intertrochanteric fractures were classified as per Boyd and Griffin's classification. Of the 30 patients 4 had type I fracture, 19 had type II fracture, 5 had type III fracture and 2 had type IV fracture.
- All the cases were internally fixed with a dynamic hip screw with a 135^{0}barrel side plate assembly.
- In the study, the total duration of hospital stay of the patients ranged from 2 weeks to 4 weeks averaging 3.07 weeks.
- Post-operatively, only three patients had pain in the hip joint at the end of six months.

- Two patients had a swelling in the trochanteric region at the end of six months.
- The swelling was due to the prominence of the trochanter.
- One patient had malunion of greater trochanter.
- Only one patient had an adduction deformity.
- Nine patients had full range of movements by the fifteen to sixteen weeks, 12 patients had good range of movements, 8 patients had fair range of movements with restriction of terminal degrees and one patient had gross restriction of movements.
- Twenty four patients had no shortening; six patients had shortening, of around 1.5 to 2cm.
- Twenty two patients were able to sit cross-legged and squat without any difficulty and 8 patients had difficulty in sitting cross-legged and squatting at the end of 6 months.
- Full weight bearing was started by the twelfth to sixteenth week depending on the radiological union and the patient compliance. At the end of six months 28 patients were walking without any support, 2 patients were walking with the support of a stick or walker.
- Six patients had a limp while walking. The limp was due to shortening.
- Eighteen patients showed union by twelve weeks and eleven patients showed union by sixteen weeks. The average time for union was 13.2 weeks.
- In twenty nine cases the Richard's screw backed out due to the fracture site collapse resulting in union of the fracture. The average amount of sliding in the present study was 5.85 mm, ranging from 2 mm to 10 mm.

- As a 135^0angled barrel side plate was used and the screw was placed centrally, the neck shaft angle was maintained in twenty nine cases. In one case where the screw was placed in the superior part of the head that led to screw cutout, causing a varus deformity.
- Complications in the study were four cases of superficial wound infection, and one case of a mechanical complication of screw cutout.
- There were no cases of implant failure, such as breakage of the plate, breakage of the screw or separation of the screw from the plate etc.
- None of the cases developed Non-Union or Avascular Necrosis of the femoral head or Secondary Osteoarthritis of the hip joint following the surgery during the period of follow-up.
- In this study, 6 cases had excellent results, 13 cases had good results, 9 cases had fair results and 1 case had poor result.
- By the analysis of the data collected in the present study, Dynamic Hip Screw with Barrel Side Plate remains the implant of choice in the management of intertrochanteric fractures.

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PROFORMA

NAME :

5. IP NO.:

1. AGE :

6. D.O.A :

2. SEX :

7. D.O.D :

3. ADDRESS :

8.D.O.S :

COMPLAINTS

1. Mode of trauma :
2. Pain in the hip or proximal thigh region :
3. Inability to move the limb :
4. Associated complaints :

HISTORY OF PRESENT ILLNESS

1. History of trauma :

a. Trivial trauma direct/indirect

Sudden slip & fall

Any other mode

b. Forceful trauma direct/indirect

Fall from height/ fall while running

Automobile accident

c. Miscellaneous :

2. Treatment received before reaching the hospital / method of first aid given-

PAST HISTORY

1. History of chronic illness – DM / HTN / BR. ASTHMA / TB
2. Past medical history -------

Personal and family history

a. Married / unmarried

b. Nature of work :

c. Menstrual history(in case of females) :

d. Habits : smoker / non smoker

Alcoholic / non alcoholic

e. Bladder function : normal / altered

GENERAL PHYSICAL EXAMINATION

1. Built : obese / moderate /poor
2. Nourishment : good / moderate / poor
3. Pallor : icterus : cyanosis:

   Clubbing : lymphadenopathy :
4. Vital signs :

a. Pulse rate : c. Respiratory rate :

b. Blood pressure : d. Temperature :

OTHER SYSTEMS

1. CVS :
2. RESPIRATORY SYSTEM :
3. PER ABDOMEN :
4. CENTRAL NERVOUS SYSTEM:

LOCAL EXAMINATION

INSPECTION

- Attitude of limb :
- Level of ASIS :
- Apparent shortening :
- Swelling around the proximal thigh / hip :
- Skin changes :
- Position of patella :

PALPATION

- Tenderness :
- Abnormal mobility:
- Crepitus :
- Transmitted movements :
- Local rise of temperature :
- Any abnormal mass felt :
- Palpatory Bryants :

MEASURMENTS	**RIGHT**	**LEFT**

1. APPARENT LENGTH :

2. TRUE LENGTH :

a. Thigh

--supratrochanteric -----

-- infratrochanteric -----

b. Leg ------------------

3. Bryant's triangle :

4. Nelaton's line :

5. Schoemaker's line :

MOVEMENTS OF HIP : Left active / Passive / Right active / Passive

Flexion:

Extension:

Abduction:

Adduction:

Internal rotation:

External rotation:

Stability test:

Telescopy:

ASSOCIATED INJURIES

INVESTIGATIONS

1. X-RAY of proximal third of femur including hip joint – AP & LATERAL VIEW
2. Screening chest x-ray.
3. ECG
4. Blood :

a. Hb% :

b. Total count :

c. Differential count :

d. Blood grouping & typing :

e. Blood Urea :

f. S. Creatinine :

g. RBS :

i. Any other specific investigations :

FINAL DIAGNOSIS :

MANAGEMENT

PRE OPERATIVE TREATMENT

1. Skeletal traction :
2. Analgesics :
3. Antibiotics :
4. Blood transfusion :
5. Others :

OPERATIVE TREATMENT

1. Date of operation :
2. Anaesthesia :
3. Approach :
4. DHS :
5. Blood Transfusion :
6. Intra operative complications :

POST OPERATIVE TREATMENT

1. Antibiotics :
2. Analgesics :
3. Blood transfusion :
4. Suture removal on :
5. Follow up X-ray :
6. Post- op rehabilitation:

POST OPERATIVE COMPLICATIONS

Immediate

1. Swelling of the limb.
2. Other complications

Late

1.wound infection

2. deep vein thrombosis

3. shortening/ lengthening

4. pulmonary embolism

5. deformity

Follow up:

	After 1 mth	After 3 mts	After 6mts	After 1yr
Range of movements (hip/knee)				
Tenderness at fracture site				
X-ray findings				
Any other complications				

Final Result: Excellent/Good/Fair/Poor.

KEY TO MASTER CHART

OP	Out Patient
DOS	Date of Surgery
M	Male
F	Female
Rt	Right
Lt	Left
RTA	Road Traffic Accident
#	Fracture
BB	Bowel and bladder
HTN	Hypertension
DM	Diabetes Mellitus
Pt	Patient
M/3	Middle Third

Master Chart

Sl.No	Name	IP no.	Age	Sex	Side	DOS	Type of injury	Associated injuries	Classifi cation	Risk factors	Early complications	Late complications	results
1	Babajan	448883	26	M	Lt	10/9/2008	Rta	---	1	---	---	Pain	Fair
2	Manjunath	451780	45	M	Rt	23/09/2008	Fall	---	1	---	---	--	Good
3	Bythappa	452388	58	M	Rt	29/09/08	Fall	---	2	---	---	---	Excellent
4	Md.Rafiq	465929	32	M	Rt	25/11/08	Rta	---	2	---	---	---	Excellent
5	Rebekka	466174	46	F	Rt	26/11/08	Fall	---	2	DM/HTN	Sup skin infection	----	Good
6	N.V.Venkatesh	469636	32	M	Rt	23/12/08	Rta	---	3	--	---	---	Excellent
7	Chalapathi	477719	35	M	Rt	13/01/09	Rta	# 2-4th ribs lt	1	---	---	---	Good
8	Sarasamma	480170	60	F	Rt	27/01/09	Fall	---	2	---	Sup skin infection	---	Fair
9	Gangamma	480890	70	F	Lt	2/2/2009	Fall	---	2	HTN	---	Shortening	Fair
10	Anjappa	466174	50	M	Lt	15/02/09	Fall	---	2	DM	---	---	Good
11	Chinamma	486983	65	F	Lt	24/02/09	Fall	---	2	HTN/DM	---	---	Good
12	Rangappa	486976	62	M	Lt	24/02/09	Fall	---	2	BA	---	Shortening	Fair
13	Srinivas	487453	40	M	Rt	2/3/2009	Fall	---	2	DM	---	---	Excellent
14	Parvathamma	492290	70	F	Rt	24/03/09	Fall	---	2	---	---	---	Good
15	Rafiqulla khan	493597	27	M	Lt	26/03/09	Rta	---	3	---	---	---	Fair

16	Bachamma	498884	60	F	Rt	20/04/09	Fall	---	4	---	---	Shortening	Fair
17	Venkatamma	503660	65	F	Rt	13/05/09	Fall	---	2	DM/HTN	---	---	Good
18	Janardhan reddy	505377	48	M	Rt	18/05/09	Fall	---	2	HTN	---	---	Good
19	Hanumanth gowda	511126	88	M	Rt	10/6/2009	Fall	Colles# rt	2	---	Sup skin infection	Shortening	Fair
20	krishnappa	492579	58	M	Rt	2/7/2009	Fall	---	2	HTN	---	---	Excellent
21	Nagesh	512503	23	M	Rt	16/08/09	Rta	---	2	---	---	---	Good
22	Venkatappa	537114	78	M	Rt	23/09/09	Fall	---	3	---	---	Shortening	Fair
23	Narayanappa	545885	65	M	Rt	27/10/09	Fall	---	2	HTN	---	---	Good
24	Narayan swamy	553359	50	M	Lt	17/11/09	Fall	# shaft m/3 femur	3	---	Infection	Implant failure	Poor
25	Vasantha	552659	54	F	Rt	1/12/2009	Fall	---	1	DM/HTN	---	Shortening	Fair
26	Lakshmamma	565654	70	F	Lt	6/1/2010	Fall	---	2	---	---	---	Fair
27	Venkatareddy	568832	75	M	Lt	20/01/10	Fall	---	4	---	---	---	Good
28	Sri ramappa	571665	82	M	Rt	8/2/2010	Fall	2^{nd} MC # rt	2	HTN	---		Good
29	Krishnappa	597862	65	M	Lt	21/05/10	Fall	--	3	HTN	---	---	Good
30	Ramesh gowda	599889	45	M	Lt	26/05/10	Fall	---	2	---	---	---	excellent