A Prospective and Retrospective Study of

MANAGEMENT OF NEGLECTED FRACTURE NECK OF FEMUR BY PAUWELS OSTEOTOMY

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CERTIFICATE

Certified that the dissertation on **"RETROSPECTIVE AND PROSPECTIVE STUDY ON MANAGEMENT OF NEGLECTED FRACTURE NECK OF FEMUR"** is bonafide work done by **Dr. S.KUMAR**, Postgraduate, Department of Orthopaedic Surgery, Kilpauk medical college & Hospital, Chennai – 10 under my guidance and supervision in partial fulfillment of the regulations of The Tamilnadu **Dr. M.G.R. Medical University** for the award of **M.S. Degree Branch II (Orthopaedic Surgery)** during the academic period of June 2003 – September 2006.

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DECLARATION

I declare that this dissertation entitled **“RETROSPECTIVE AND PROSPECTIVE STUDY ON MANAGEMENT OF NEGLECTED FRACTURE NECK OF FEMUR”** has been conducted by me at Department of Orthopaedic Surgery, Kilpauk Medical College & Hospital, Chennai – 10, under the guidance and supervision of my Chief **Prof.K.J.MATHIAZHAGAN B.Sc., M.S.Ortho., D.Ortho** Government Kilpauk Medical College and Hospital Chennai. It is submitted in part of fulfillment of the award of the degree of M.S (Ortho) for the September 2006 examination to be held under The Tamil Nadu Dr.M.G.R Medical University, Chennai. This has not been submitted previously by me for the award of any degree or diploma from any other university.

(DR. S. KUMAR)

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CONTENTS

INTRODUCTION

Fracture neck of femur is aptly called as "the unsolved fracture"[1]. This is because even with so much of advances in orthopedic field, there is no simple method of treatment which can give consistently successful results for this fracture. Management of this fracture especially in younger patients is a really demanding and challenging task for any orthopaedic surgeon.

Fracture neck of femur is common in old people as many of them are osteoporotic. With improvement in quality of life leading to increased life expectancy, the incidence is even more common nowadays. Due to the congested vehicular traffic, it is also commonly seen in young patients after road traffic accidents and many a times they are polytraumatized.

Many of these fractures are unstable. Because of its peculiar blood supply, a fracture neck of femur many cause circulatory disturbance leading to avascular necrosis and non-union. So every fracture neck of femur should be treated as an emergency. It should be reduced accurately anatomically and fixed stably by one of the many implants available now. Usually undisplaced stable fractures have a good prognosis and displaced unstable fractures a poor prognosis.

In our part of the country, because many patients go to native bone setters for treatment of fractures, these patients present with non-union of fracture neck of femur[2].

Another factor leading to non-union is the angle of inclination of fracture. Usually horizontal fractures with less than 30° of angle unite well and those with more than 30° may result in non-union even when treated expertly. This is because in fractures with more than 30° of inclination the resulting forces will act as shearing forces leading to displacement of fragments and non-union[32].

The Pauwels[23] principle which was described in 1927 is used even today successfully. Pseudoarthrosis of femoral neck will unite if inclination of Pseudoarthrosis is changed in such a way that the shearing forces are converted into compression forces. and converting unstable fracture into stable one. This leads to endochondral ossification of the fibrocartilage at Pseudoarthrosis making the fracture unite. Since our patients require squatting for their routine daily activities, it is important to preserve the natural femoral head by making the fracture unite. One should not think of prosthetic replacement for every patient with fracture neck of femur.

The best end result after fracture neck of femur treatment is the patients own healed femoral head and neck and every attempt must be made to achieve that goal.

AIM

The aim of this study is to analyse the role of valgus osteotomy in neglected fracture neck of femur.

HISTORICAL REVIEW

Ambrose pare, famous French surgeon was the first to recognize fracture neck of femur 400 years ago.

Sir Astley Cooper was the first one to delineate between fractures of the femoral neck and other fractures and dislocation about the hip.

1867	-	**Philips** introduced longitudinal and lateral traction for treatment of femoral neck fractures
1876	-	**Maxwell** reported successful use of this technique.
1895	-	**Roentgen** invented x-rays which revolutionized orthopaedics.
1902	-	**Whitman** advocated closed reduction and immobilization in a spica cast. With this he achieved a 30% union rate.
		Watson – Jones used the same method and achieved a 40% union rate.
1911	-	**Cotton** advocated impaction of fractures by blows from a heavy mallet applied to the trochanter before applying a cast.

1921 - **Ruth** advocated closed reduction and maintenance of the reduction in a "Phillips Splint" for 8 weeks followed by non weight bearing for 6-12 months after traction.

1927 - **Wilkie** modified the Whitman method. He used bilateral short leg casts connected by a transverse bar for fracture immobilization.

1850 - **Von Langenbeck** was the first to have nailed a fracture neck of femur.

1875 - **Konig**, 1897 – Nicolaysen both advocated the use of nails in serious cases.

1908 - **Davis** used ordinary wood screws for the fixation of femoral neck fractures.

1907 - **DaCosta** used similar screws for internal fixation.

1919 - **Delbet**, 1920 – Martin and King. They also used similar screws for fixation.

1916 - **Hey - Groves** used a quadriflanged nail to obtain better fixation. But it was made of unsatisfactory material.

1931 - **Marius Nygard Smith – Peterson** introduced and popularized the use of triflanged nail for internal fixation. This technique succeeded because of the development and standardization of biocompatible metals by Venable and Stuck.

1931 - **Johanson** introduced cannulated nail simplifying Smith – Peterson's technique.

1934 - **Westcott** used X-ray control for fixation of fracture neck of femur using cannulated nail.

1936 - **Ganeslen, Telson** and **Ransohoff** and Knowles independently advocated the use of multiple pins for the internal stabilization of femoral neck fractures.

1944 - **Harmon** added a side plate to incorporate these pins.

1945 - **Virgin** and **Mac Ausland** introduced a screw that provided dynamic compression at the fracture site.

1958 - **Deyerle** added a side plate that also acted as a template for pin insertion.

1964 - **Clawson** all introduced telescoping nails or screws which allowed gradual impaction at the fracture site.

1975 - **Calandruccio** introduced Richards compression screw. He achieved 80% union rate and 20% avascular necrosis.

1927 - **Friderich Pauwel** – Pseudoarthrosis of neck of femur will unite if inclination of Pseudoarthrosis is changed in such a way that the shearing forces are converted into compression forces. This leads to endochondral ossification of the fibrocartilege at Pseudoarthrosis.

1936 - **McMurray** performed an oblique medial displacement osteotomy for Pseudoarthrosis of neck of femur. Later he did this for fresh subcapital fractures.

A.E.Muller – Popularised the Pauwels principle. He took a laterally based wedge so as to make the inclination of Pseudoarthrosis to be horizontal. This Pauwels principle stood the test of time and is used even today successfully.

1944 - **Linton** did a primary valgus osteotomy to convert shearing forces to compression forces in vertical femoral neck fractures.

1947 - **Dickson** advocated a geometric osteotomy with bone grafting of fracture site.

1943 - **Blount** did subtrochanteric valgus osteotomy and fixed it with blade plate.

1950 - **DePalma** advocated valgus osteotomy in Pauwels type II and Type III fractures

1956 - **Stewart** and **M.J.Wells** published good results after valgus osteotomy and they bone grafted ununited fractures.

1973 - **Weber and Cech** also reported good results after valgus osteotomy.

1986 - **Huang** all reported good results after valgus osteotomy for fracture neck of femur both fresh and ununited.

1989 - **R.K.Marti, H.M.Schuller** and **E.L.E. Raaymakers** studied the influence of valgus osteotomy on the avascular process in the long term follow up of 50 cases who underwent this osteotomy. Their avascular necrosis rate was 14%. They advised this osteotomy even in cases where there is avascular necrosis provided there is no severe collapse of the head.

1990 - **F.T. Balmer** et al., stressed the importance of careful pre-op planning for valgus osteotomy. By this one can analyse the mechanics of non-union, determine the surgical steps and choose the correct implant.

SKELETAL ANATOMY OF THE UPPER END OF FEMUR

The upper end of femur is made up of head, neck, greater trochanter and lesser trochanter (Fig .1)

HEAD OF FEMUR

It forms two thirds of a sphere and is attached to the neck of femur. It is covered with articular cartilage which is thicker over the superior weight bearing portion. Medial to the axis of femoral head is the fovea centralis where the ligamentum teres is attached.

NECK OF FEMUR

It connects the head of femur to the trochanteric area. It is directed superiorly, anteriorly and medially from the upper end of femur. It is 5 cm in length. It is broader in its base and narrow in its upper end. It is slightly compressed antero-posteriorly. With the shaft of femur it forms an angle of about 125° and an anteversion of about 15° in adults (Fig-3).

GREATER TROCHANTER

Seen in the lateral aspect of shaft of femur and is quadrilateral in shape. The gluteus medius and minimus, the piriformis, the obturator internus and the two gamelli and the quadratus femoris are all inserted to it (Fig3.2).

LESSER TROCHANTER

It projects postero-medially from the junction of neck and shaft of femur and gives attachment to the Ilio-psoas tendon. A ridge of bone called inter-trochanteric crest connects the two trochanters.

The head of femur articulates with acetabulum to form the hip joint. It is a ball and socket type of synovial joint. It is covered by a strong capsule. Anteriorly the capsule is attached to the inter-trochanteric line, but posteriorly the inferior half of the neck is uncovered by the capsule. The capsule is reinforced anteriorly by the ilio-femoral ligament of Bigelow and posteriorly by the ischiofemoral ligament. The articular surface of the head of femur and the capsule of the hip joint are lined by synovial membrane. It is loosely attached to the neck and at the retinacular area, it is lifted off into pads. Beneath the synovial membrane, periosteum covers the proximal femur. Because there is absence of Cambium layer, there is no callus formation in fractures neck of femur[43].

THE TRABECULAR PATTERN IN THE UPPER END OF FEMUR[23]

The upper end of femur consists of five trabecular groups (Fig. 4.1 & 4.2).

They are:

A. Principal Compressive Group

It is the upward projection of the calcar femorale to the weight bearing superior dome of head of femur.

B. Principal Tensile Group

It is also called the Arcuate Bundle of Gallois and Bosquette. It starts in the inferior region of head, arches across the superior region and terminates in the lateral cortex.

C. Greater Trochanter Group

Seen in the region of greater trochanter

D. Secondary Compressive Group

Seen between the two primary groups.

E. Secondary Tensile Group

Also seen between the two primary groups.

The primary compression and primary tensile trabeculae enable the proximal femur to withstand considerable tensile and compressive forces to which it is normally subjected. In the greater trochanter, a Gothic arch is formed by the intersection of arcuate bundle and trochanteric bundle. The head and neck also contain Gothic arch by the intersection of arcuate bundle and supporting bundle. At the point of intersection, the bone is denser and constitutes the nucleus of the head.

There are two areas of paucity of trabeculae, the Babcock triangle situated in the inferior aspect of the head, Ward's triangle situated lateral to primary compression trabeculae and below tension trabeculae in the middle part of the neck. They play a prominate role in the causation of femoral neck fractures in the elderly. They offer less rigid fixation to any implant in this area. It also offers little resistance to shearing forces in fracture neck of femur even after fixation of the fracture.

CALCAR FEMORALE

It is a dense vertical plate of bone extending from the postero-medial portion of the femoral shaft under the lesser trochanter and radiating later to the greater trochanter reinforcing the femoral neck posteroinferiorly. It is thickest medially and gradually thins as it passes laterally (Fig.5).

VASCULAR ANATOMY OF UPPER END OF FEMUR

Crock divided the arterial supply of proximal end of femur into three major groups.

1. An extracapsular arterial ring located at the base of the femoral neck.
2. Ascending cervical branches of the extracapsular arterial ring on the surface of the femoral neck.
3. The arteries of the round ligament.

The extracapsular arterial ring and the ascending retinacular vessels are derived from the medial and lateral circumflex femoral arteries. (Fig-6.1). The medial circumflex artery, usually a branch of femoral artery courses posteriorly between the iliopsoas and pectineus muscles and then between the medial capsule and obturator externus muscle before passing along the posterior intertrochanteric line. It gives of small inferior retinacular (medial ascending) artery. It gives branches to the femoral neck and then passes over the epiphyseal growth plate to enter the capital femoral epiphysis in children.

Posteriorly, the medial circumflex femoral artery communicates with branches of superior gluteal artery and gives off small Posterior retinacular arteries (Fig-6.2). The termination of medial circumflex femoral artery becomes the superior retinacular (lateral ascending) artery, which supplies the greatest portion of blood to the head of femur in adults and the capital femoral epiphysis in children. This artery penetrates the capsule in the trochanteric notch (an extremely narrow space between the greater trochanter and femoral neck) and is therefore vulnerable to injury in fractures of neck of femur.

The lateral circumflex femoral artery usually arises from the Profunda femoris artery (Fig-6.3). It passes lateral and anterior to the iliopsoas muscle, giving off the anterior retinacular (anterior ascending) branch to the proximal femur. The lateral circumflex femoral artery communicates with the medial circumflex femoral artery in the trochanteric fossa, completing the extracapsular arterial ring. The anterior portion of this ring is thus derived primarily from the lateral circumflex femoral artery, whereas the medial, posterior and lateral portions branch from the medial circumflex femoral artery.

The branches of the ascending retinacualr arteries form a subsynovial anastamotic intraarticular arterial ring at the margin of the articualr cartilage of femoral head. The artery of the ligamentum teres contributes only a small portion of the arterial blood supply to the center of the femoral head. It is a branch of the obturator or the medial circumflex femoral artery.

Femoral head circulation arises therefore from 3 sources : Intraosseous cervical vessels that cross the marrow space from below, the artery of ligamentum teres and chiefly the retinacular vessels, branches of the extra articular arterial ring. When a fracture of femoral neck occurs, the intraosseous cervical vessels are disrupted; femoral head nutrition is then dependent on the retinacualr vessels and the artery of ligamentum teres. Revascularisation after fracture occurs through the remaining blood.

CLASSIFICATION OF FRACTURE NECK OF FEMUR

CLASSIFICATION BASED ON PATIENT CHARACTERISTICS[26]

1. Femoral neck fractures in the elderly patient.
    a. Impacted fractures
    b. Displaced fractures
2. Fractures of the femoral neck diagnosed late.
3. Femoral neck fractures in the young adult less than 40 years of age.
4. Stress fracture of the femoral neck.
5. Ipsilateral fracture of the femoral neck and shaft
6. Femoral neck fractures in patients with Paget's disease
7. Femoral neck fractures in patients with Parkinson's disease
8. Femoral neck fractures in patients with spastic hemiplegia.
9. Postradiation fracture of the femoral neck.
10. Pathologic femoral neck fractures secondary to metastatic disease of bone.
11. Femoral neck fractures in patients with hyperparathyroidism.

CLASSIFICATION BASED ON LOCATION AND CHARACTERISTICS OF FRACTURE

Sir Astley Cooper classified fractures of proximal femur into

a. Intracapsular fractures and

b. Extracapsular fractures

BASED ON ANATOMIC LOCATION, THEY ARE CLASSIFIED INTO (Fig.7)

a. Subcapital

b. Transcervial and

c. Baso cervical fractures

PAUWELS CLASSIFICATION[39]

His classification is based on the direction of the fracture angle with reference to a horizontal (Fig-8).

Type I : The angle of the fracture is less than 30°. Since the fracture is almost horizontal, the resultant forces act as compression forces across the fracture.

Type II : The fracture angle is 30°-50°. The resultant forces act as shearing forces and the fracture is unstable.

Type III : The fracture angle is more than 50°. Here since the fracture line is almost vertical enormous shearing forces act across the fracture leading to non –union of the fracture even after adequate reduction and internal fixation.

The disadvantage in Pauwels classification is two dimensional, and the direction of the fracture line on the X-ray could be altered by changing the direction of the beam or position of the limb. The Pauwels classification is more useful for understanding the mechanism of osteotomy and helps in pre operative planning

PERLINGTON'S CLASSIFICATION (Angle the fracture line forms with respect to the vertical line)

I - 70°

II - 50°

III - 30

GARDEN'S CLASSIFICATION [44]

This system is based on the degree of displacement of fractures noted on pre reduction X-rays (Fig-9).

Type I : Impacted or incomplete fractures. In these fractures, the trabeculae of the inferior neck are still intact. This is also called as abducted impaction fracture

Type II : A complete fracture without displacement. The weight bearing trabeculae are interrupted by a fracture line across the entire neck of femur.

Type III : A complete fracture with partial displacement. The trabecular pattern of the femoral head does not line up with that of the acetabulum. There is shortening and external rotation of the distal fragment.

Type IV : A complete fracture with total displacement of the fracture fragments. The femoral head assumes a normal relationship in the acetabulum. Therefore the trabecular pattern of the femoral head lines up with the trabecular pattern of the acetabulum.

Garden's stage I and II have good prognosis and stage III and IV have poor prognosis.

MEYER’S CLASSIFICATION

Type I : Displaced fracture

Type II : Undisplaced fracture

COMPREHINSIVE CLASSIFICATION OF FRACTURES (CCF) OF FEMORAL NECK

This is recommended by AO. The advantages of AO classification are (Fig-10):

1. It is universally accepted.
2. It is therapeutically and prognostically significant.
3. Since it is an alphanumeric classification, computer storage and retrieval is easy, thereby comparison of results between various investigators can be easily made.

In this classification, the neck of femur is assigned the code 31 B, where 3 denotes femur, 1 denotes the proximal end of femur and B denotes the neck of femur.

Then they are classified according to the geometry of fracture as follows :

B1 : Subcapital undisplaced

.1 impacted with 15° or more ,

.2 impacted with less than 15° of Valgus ,

.3 non-impacted fractures

B2 : Transcervical

.1 basal

.2 adduction pattern

. 3 shear pattern

B3 : Subcapital displaced.

.1 moderate varus displacement with external rotation,

.2 moderate displacement with shortening and external Rotation,

.3 marked displacement .

Here the prognosis is good for B1 fractures and poor for B3 fractures.

ETIOLOGY AND MECHANISM OF INJURY[26]

Femoral neck fractures are uncommon in young patients with normal bone. These fractures occur most commonly during the seventh and eighth decades. These should be considered fractures through pathologic bone secondary to either osteomalacia or osteoporosis. Many authors suggested an association between osteomalacia and fracture neck of femur but it is not as significant as that with osteoporosis.

Femoral neck fractures are more commonly preceded by the development of osteoporosis. The history of minor trauma associated with most femoral neck fractures also points to this. This osteoporosis is commonly due to advanced age, attainment of menopause in women and decreased physical activities. Osteoporosis also plays an important role in the treatment of femoral neck fractures. This leads to marked comminution of the posterior cortex of neck of femur and to decreased quality of internal fixation secondary to the inability of the bone to hold the internal fixation devices.

Most patients suffering from femoral neck fractures have had trivial or minor injuries. Kocher suggested two mechanisms of injury in femoral neck fractures. The first is a fall producing a direct blow over the greater trochanter[45]. The second is the lateral rotation of the extremity. Here the head is firmly fixed by the anterior capsule and iliofemoral ligament while the neck rotates posteriorly. The posterior cortex impinges on the acetabulum and the neck buckles[46]. A third recently suggested mechanism is cyclical loading which produces micro and macro fractures. A stress fracture of this type becomes complete following a minor torsional injury[47].

In young patients with fractures of neck of femur, the causative trauma is a major one like road traffic accidents or fall from a height. This result in a direct force along the shaft of the femur with or without a rotational component. Since often these patients are poytraumatized, the incidence of failure in the treatment of the fractures is high.

FACTORS CAUSING NON UNION FRACTURE NECK OF FEMUR[3]

ANATOMICAL FACTORS

Fracture neck of femur is a unique fracture in which the entire fracture surface is within joint capsule. Because of this, the organization of fracture haemotoma at the fracture site is prevented through the angioinhibitive factors in the synovial fluid. Furthermore the absence of Cambium layer in the periosteum of neck of femur makes the fracture to unite only by intramedullary endosteal callus. Since the proximal fragment is small there is difficulty in controlling it and hence treating it by closed methods, it will definitely go in for non-union.

CAPSULAR TAMPONADE

After fracture of neck of femur because of bleeding from the fracture surface, a haemarthrosis of hip joint occurs causing distention of the joint capsule and increased intra articular pressure. Many a times this pressure exceeds diastolic blood pressure leading to occlusion of the retinacular vessels causing further damage to vascularity of the proximal fragment. This will lead to non-union and avascular necrosis.

Deyerle recommends aspiration of the hip if surgery is delayed more than a few hours and a decompressive capsulotomy in all cases at the time of internal fixation.

Revascularisation of the head appears after anatomical reduction and stable fixation of the fracture by following means.

1. Ingrowth of vessels from the viable distal fragment across the fracture site.
2. The Artery of Ligamentum teres establishes its circulation to the nearby avascular head.
3. The viable part of the head extends its vascularity to the nearby avascular head.

If the fracture is malreduced and inadequately fixed, this revascularization is affected leading to non-union and avascular necrosis.

Inadvertent use of large implants and many implants may compromise vascularity of proximal fragment leading to non-union.

Forceful attempts at closed reduction or open reduction may decrease the vascular supply of proximal fragment leading to non-union and avascular necrosis.

FRACTURE ANGLE[23]

In Pauwels Type I fracture, the fracture line is almost horizontal and so the resultant forces acting on the fracture will compress and unite it.

In Pauwels Type II and Type III fractures, because the fracture line is oblique or vertical, the resultant forces act as shearing forces leading to non-union.

Marked comminution of the posterior cortex of neck of femur will lead to non-union of fracture neck of femur.

Displaced fractures of neck of femur are prone for non-union because of the disturbed vascular supply to the proximal fragment.

Inadequate post-operative immobilization and early weight bearing may lead to non-union.

The most common and most important cause of non-union in our part of the country is treatment of these fractures by native bone setters. Since those fractures definitely won't unite by native treatment, all the patients will come after three months to one year after injury with non-union. In most of the patients in our series, the pseudoarthrosis of neck of femur is due this factor only.

OSTEOPOROSIS

Fractures of neck of femur occur even with trivial violence if there is osteoporosis. It causes more posterior cortical comminution resulting in fracture gap. Implant failure may occur due to poor purchase of implant in the porotic head. Singh's Index has been accepted to assess the degree of porosis and thereby prognosis. Osteoprosis below grade 3 shows poor prognosis (Fig-11).

DIAGNOSIS AND MANAGEMENT OF NEGLECTED FRACTURE NECK OF FEMUR

Patients with neglected fracture neck of femur usually present a few months after injury with complaints of pain in the affected hip and a limp. On examination, the affected limb will be in external rotation and there will be wasting of thigh muscles. Tenderness will be present over the Scarpa's triangle. Movements of the hip will be restricted with pain, crepitus and muscle spasm. Telescopy will be positive or there may be only minimal yielding. There will be shortening of the involved limb and gait will be Trendelenberg's gait.

Diagnosis is usually confirmed by plain X-ray anteroposterior view of the hip. An internal rotation and traction view will show the angle of inclination of the fracture and avascular changes in the head of femur. A frog-leg view of the hip will show the amount of comminution and the degree of absorption of neck of femur.

There were many procedures described in literature for the management of neglected fracture neck of femur of femoral neck. The choice of procedure depends on the following factors.

1. Age and physical status of the patient.
2. Status of femoral head whether viable or avascular.
3. Status of femoral neck and
4. Duration of non-union.
5. Presence or absence of the osteoporosis
6. State of the joint space .

The procedures are :

1. OSTEOTOMY PROCEDURES

a. Displacement Osteotomy (Mc Murray) [20] **(Fig-12)**

Here the line of weight bearing is shifted medially and the shearing forces across the non-union is decreased because the fracture surface becomes more horizontal. It has to be oblique osteotomy making angle of about 30-45 degrees with longitudinal axis of the femur. Osteotomy starts from the base of greater trochanter or little below that and goes upwards and medially passing through the upper part of the lesser trochanter. The disadvantage with this procedure is that since no internal fixation is used, the osteotomy is unstable making applications of hip spica mandatory. Hip spica is cumbersome to all the patients and in this procedure, the non-union may not unite. This procedure is rarely used nowadays.

b. Angulation osteotomy

Pauwels Valgus osteotomy [32] : This procedure makes use of the Pauwels principle which states that, if the fracture inclination is reduced to less than 30°, the forces acting on the fracture are converted into compression forces making the fracture unite. Here, a laterally based wedge is removed at the level of lesser trochanter and when the osteotomy is closed, the fracture line will become more horizontal. The fracture and osteotomy are fixed stably using AO 120° double angled osteotomy plate (Fig-14). In **webers** technique osteotomy is fixed with K wires and tension band principle. **Blount** also described a similar osteotomy (Fig-13).

c. Dome osteotomy

This is made 1-2 cm distal to the lesser trochanter. Multiple drill holes are made in a dome shaped fashion and they are connected to complete the osteotomy. The distal fragment is rotated and the osteotomy is fixed with a dynamic hip screw system.

2. BONE GRAFTING PROCEDRUES

a. Fibular Grafting[21]

Here the fracture is fixed with cancellous screws supplemented with either a free or vascularised fibular graft (Fig-15). The vascularised fibular graft procedure requires good experience and the help of a microvascular surgeon.

b. Meyer's muscle pedicle graft procedure[19]

This procedure is indicated when the patient was able to walk prior to fracture, within one year after fracture, with no serious intercurrent disease and having the ability to co-operate in the post-operative programme. This technique improves the result by providing stable fixation and more rapid and complete revascularization of the femoral head. In this procedure, the quadratus femoris muscle with its attachment is taken and fixed to the posterior aspect of femoral neck (Fig-16). Provides blood supply to femoral head Graft act as neutralization force & additional stability to fracturer .Iliac graft may be added to fill gap in posterior neck. Dr. D.P. Baksi of Calcutta reported good results using this procedure.

3. ARTHROPLASTY PROCEDURES[7]

This should be done only in patients above 60 years of age who are not candidates for the previously mentioned procedures and in patients with avascular necrosis of femoral head.

A. Hemi-arthroplasty

This is usually done for fresh fracture of neck of femur in elderly patients, pre existing lesion in hip ,neurological disorders-seizure disorder, parkinson disease and patient with mental illness Either a Thompson or Austin-Moore prosthesis is used to replace the femoral head. For Pseudoarthrosis of femoral neck, if the acetabulum is intact without any degenerative changes, this procedure can be used.

B. Bipolar hemiarthroplasty

Prosthesis consist of a femoral component which articulates by snap fit into high density, polyethylene liner of a metallic cup . Cup moves freely within acetabulum. As it allows motion at two levels there is low acetabular erosion and can be easily converted to THA later.

C. Total Hip Arthroplasty (Fig-17)

This is now the procedure of choice in elderly patients with Pseudoarthrosis of femoral neck and in young patients who also have avascular necrosis of femoral head with secondary arthritic changes in the acetabulum. This can be either cemented or uncemented. The acetabular component is made up of Cobalt – Chrome alloy or titanium. This procedure removes pain in the hip and provides good mobility to the patient.

D. Excision Arthroplasty[17]

This procedure is reserved for elderly patients who are medically not fit for such major procedure like total hip Arthroplasty. Here the head of femur is excised. This provides pain relief, but the hip will become unstable (Fig-18).

4. ARTHRODESIS[17](Fig-19)

Arthrodesis of the hip joint relieves pain and provides stability. This procedure is reserved for young active manual labourers who developed a vascular necrosis of head of femur and secondary arthritic changes in the acetabulum following fracture neck of femur.

In this series we studied the role of Pauwels Valgus osteotomy in treating pseudoarthrosis of neck of femur.

PAUWELS PRINCIPLE AND CLASSIFICATION

Based on theoretical aspects, Pauwels could demonstrate in 1935 that the healing process of femoral neck fracture was in fluenced far more by biomechanical than biologic factors. He divided the force R (the sum of al forces acting upon the hip joint) into partial force, P consisting solely of the pressure encountered between the head and neck fragments, and a force S, which represents the force pushing down from above on the femoral head. If P is greater than S, a compression force D occurs, which produces union. If P is less than S, shear and tension forces supervene, making bony union improbably. The shearing force S is diminished by friction between the fragments. The remaining force is defined as the uninhibited shear force Ks. Thus, three types of fractures may be defined (Fig-20).

PRE- OPERATIVE PLANNING

To get an excellent result by doing a valgus osteotomy for fracture neck of femur, a carefully done pre- operative planning is mandatory[32](Fig-21). By doing a pre- operative planning, one can know the angle of inclination of the fracture, the amount of wedge to be taken and the entry point for blade plate.

For pre- operative planning, an antero posterior view X ray of the hip with the limb in traction and internal rotation of 10- 20° is taken.

A tracing of the acetabulum, head, neck and proximal third of femur is drawn on a tracing paper placed on the X ray. The angle of inclination of fracture is also drawn. Our aim of surgery is to attain an angle of inclination of 30° at the end of procedure, so that the shearing forces will get converted into compressive forces across the fracture site making the fracture unite.

For example if fracture angle is 60°, then the amount of wedge to be taken is 30° (i.e 60 – 30 = 30°). Draw a horizontal line as site for osteotomy at the level of upper border of the lesser trochanter, perpendicular to anatomical axis of femur. Mark 30° laterally based wedge below that line. Wedges upto 30 ° always to be taken below osteotomy. If wedge is more than 30 °initial 30° taken below the lesser trochanter and remaining amount taken above the lesser trochanter.

Maintain cortical bridge of about 15 mm between the site of osteotomy and entry point of seating chisel. The entry point for blade on the lateral femoral cortex above the osteotomy is at a point equal to the distance between the blade and cut- back of the plate.

Angle of entry point of the blade relative to the shaft is determined by the degree of wedge desired in the coronal plane. During surgery series of metal triangles of known angular dimensions are placed along the femoral shaft to allow proper guide wire angulation. When planning to use 120° double angle blade plate, the angle of blade entry relative to the femoral shaft is calculated as 180° plus desired angle of wedge minus 120° (or 60°plus desired angle of correction) . For example if 30°of wedge desired, angle of entry for blade is 90°

OPERATIVE TECHNIQUE (Fig 22)

- Fracture table
- Supine position
- Spinal anesthesia or general anesthesia
- Closed reduction of fracture, confirm reduction by intra operative X- rays
- Watson Jones lateral approach
- If reduction not acceptable by closed method , reduce fracture by open method
- Fix the fracture with cancellous screw well above the desired entry point for blade plate insertion.
- Mark for blade plate insertion1.5cm from the osteotomy level.
- Entry point drilled with drill bit for easy insertion of seating chisel.
- Seating chisel inserted carefully upto the desired length
- Insert 120° angled blade plate.
- Insert additional screw just above level of osteotomy into proximal fragment hold the additional stability.
- Mark the transverse line at the level of lesser trochanter.
- Template placed so that 30° is below the line.
- Make osteotomy and
- Remove the calculated wedge of bone.

- Reduce the osteotomy site & fix with screw from distal to proximal hole.

Post op protocol

- Non-weight bearing hip and knee mobilisation exercises - 6 weeks
- X-rays taken every 4 weeks to know the progression of union of osteotomy site and fracture site
- Partial weight bearing after 6 weeks.
- Full weight bearing after radiological evidence of union
- After radiological union patient advised to come for follow up every 6 months

MATERIAL AND METHODS

Study conducted at the department orthopedics , Kilpauk medical college hospital, Chennai.

Period of study –1998 – 2006

Both retrospective & prospective study.

We operated 19 cases neglected fracture neck of femur and one case after implant failure. Totally 20 patients included for study.

1. SEX

Male	14
Female	6

2. AGE GROUP

Average age is 35.5years (range 15 – 55)

Age group in years	No. of cases
$\leq$ 20	3
21-30	6
31-40	4
41-50	4
51-55	3

3. MODE OF INJURY

Most of our cases were due to fall or RTA

Fall	12
RTA	8

4. SIDE

Equal in side distribution

5. DURATION OF FRACTURE

2 months to one year

Average duration after fracture : 5 ½ months

2 – 6 months	10
6-9 months	9
9-12 months	1

6. **PAUWELS TYPE**

Type II	14
Type III	6

7 . Mode of fixation

120° double angled blade plate	**14**
Maini's plate	**3**
Weber's technique	**3**

INCLUSION CRITERIA

1. Age group less than 60 years
2. Duration of fracture more than 3 weeks old
3. Pauwels type II & III
4. Garden TYPE III & IV
5. Active individuals

EXCLUSION CRITERIA

1. Age group more than 60 years
2. Duration of fracture less than 3 weeks old
3. Pauwels type I
4. Garden TYPE I & II
5. Osteoporosis
6. AVN with severe collapse

RESULTS

All the 20 cases were followed up our follow up period ranges from 4 months to 8 years.

All patients were assessed by clinical, functional & radiological evaluation using Harris hip scoring system.

1. PAIN

3 out of 20 patients had persistent pain in the hip because of avascular necrosis of femoral head.

2. UNION

All but one patient had good consolidation of both osteotomy site and fracture at the end of 6 months. One patient had implant cut out partly due to inadequate fracture reduction and partly due to premature weight bearing. Planning for redo of surgery. One patient had union with retroversion.

3. GAIT

14 of 20 patients had normal gait. 3 had minimal limp and one had moderate limp.

4. SUPPORT

All of 20 patients walked without any support.

5. HIP FUNCTION

16 patient more than 75 % of range movements & 4 had 50 -75 % of ROM

17 of our 20 patients were able do normal day to day activities like walking, cycling, squatting & sitting cross legged. 3 patients has difficulty in squatting & sitting cross legged.

6. LIMB LENGTH DISCREPANCY

15 patients had no limb length discrepancy.

One patient had lengthening 1cm.

4 patients had shortening 1-2 cm.

7. INFECTION

One of our patient superficial wound infection which was controlled with antibiotics and dressings.

8. AVASCULAR NECROSIS OF FEMORAL HEAD.

4 patients developed AVN

Ficat & Arlet stage 2 : 3 patients

Ficat & Arlet stage 4 : 1 patients

3 patients stage 2 does not show progression of the AVN changes. One patient went for collapse of femoral head and secondary osteoarthritis of hip joint for which he underwent cemented total hip replacement

HARRIS HIP SCORE :

Average hip score : 85.1

Excellent	:	9
Good	:	6
Fair	:	2
Poor	:	3

CASE REPORTS

Case 1 (Thangaraj)

16 year old boy presented with 4 month old fracture neck of femur. He sustained the injury by road traffic accident. Initially had native treatment His pre op X-ray showed Ficat & Arlet stage 2 Avascular necrosis. Pre-operative Pauwels angle was 60 °and shortening of 2 cm. A 30 degree laterally based wedge taken and osteotomy was fixed with 120 °angled blade plate. Post operative period was uneventful.

At 12 weeks osteotomy site united.

At 16 weeks fracture united.

Serial X- rays don't show any progression of AVN.

After 1 year patient able to do his normal activities including walking, running & cycling.

He had full movements at the hip and knee. No limb length discrepancy. After surgery he able to squat in toilet and sit in the floor in cross legged position.

His Harris hip score is 96 points

CASE -2 (Panjali)

45 year female sustained fracture neck of femur 4 months before . She had native treatment

She came with complaints of pain in left hip & limping .

On examination 2 cm shortening present and, telescopy positive. X- ray showed non union fracture neck of femur and pauwels classification type II

She underwent pauwels osteotomy fixed with 120° double angle blade plate.

Fracture united in 6 months.

Her functional outcome was excellent

Her Harris hip score was 86.

CASE-3 (Mansoor)

24 year Male sustained fracture neck of femur 1 month before. He had treatment in private hospital.

He came with complaints of pain in left hip & limping .

On examination 1 cm present. X- ray showed fracture neck of femur and pauwels classification type II

He underwent pauwels osteotomy fixed with 120° double angle blade plate.

Fracture united in 6 months.

His functional outcome was excellent

His Harris hip score was 92.

CASE -4 (Thangaraj))

15 year boy sustained fracture neck of femur 6 months before and underwent AM pins elsewhere. Even after 6 months fracture not united. Patient had c/o pain in hip,& limp. And had 2 cm shortening. X-ray showed non union of fracture neck of femur, varus alignment of neck and implant break out through superior neck .

Treated by implant removal and Valgus osteotomy with fixation by maini's plate.

Fracture and osteotomy united in 3 months his functional out come is excellent.

His Harris hip score 92.

CASE- 5 (Parvathi)

20 years female sustained fracture neck of femur 8 months before. She underwent valgus osteotomy and fixation with webers technique.

Fracture united in 6 months.

Functional outcome excellent.

Harris hip score 96.

CASE -6 (Jayaparvathi)

45 years female sustained fracture neck of femur. Had native treatment, presented after 2 months with pain in hip.

Her X-ray shown fracture neck of femur, pauwels type II.

She underwent valgus osteotomy and fixation in 120° duouble angle blade plate.

Fracture and osteotomy united in 3 months.

But she had persistent pain in hip and her movements in the hip was restricted flexion - 30°, abduction - 20°, adduction - 20°, internal rotation - 10°, external rotation-20°. X-ray showed excessive callus formation at fracture site.

Her functional outcome – poor.

Harris hip score 66.

CASE -7 (Ramakrishnan)

50 year old man sustained # neck of femur 7 years before and underwent fixation with Cancellous screws and Valgus Osteotomy fixation with Webers technique .

Had pain right hip 6 months aggravated by walking and difficult in squatting & cross leg sitting. X-ray showed AVN of femoral head and secondary osteoarthritis

Treated with Cemented Total Hip Arthroplasty

Functional outcome of the patient is excellent.

Preoperative Harris hip score was 65. After THR Harris hi score is 82.

DISCUSSION

The best end result after a femoral neck fractures is the patient's own healed femoral neck and head[36]. Pauwels osteotomy follows this principle, representing a logical concept in the treatment of delayed unions and non-unions. In our small series, we achieved consolidation of fracture in all cases. Our series consist of 20 patients of neglected fracture neck of femur most of them presented after undergoing native treatment and most of them were young active patients in the age group range of 16 -55 years.

We achieved union in 19 out of 20 cases Union rate is 95%. Our series is small one . In a number of smaller series of pure Pauwels osteotomy , the union rate in 58 cases was 96%. The largest series was published by Marti[33], who reported on 50 cases of intertrochanteric osteotomy (Pauwels osteotomy) and had a consolidation rate of 86% . In small series, 100% union rate is reported following valgus osteotomy plus moderate medialization[34]. In two French publications reporting 98 nonunions treated essentially with combined intertrochanteric valgus and medialization osteotomies , a consolidation rate of 74% was mentioned[32] . Nonunions in 63 patients treated with subtrochanteric osteotomies consolidated in 52%[35]. Compared to the literature, our rate of consolidation is in agreement with the success

of other authors achieved with pure Pauwels osteotomy , and higher than in combined osteotomies (valgus and medialization) or subtrochanteric osteotomies.

F.T.Ballmer, MD et.al. achieved union by one osteotomy alone in 12 of 17 cases (70%) and three cases needed revision before union, increasing the overall consolidation rate to 88 % [32] .

The end result in our material was compromised by the AVN rate (four cases) .It may become more if other diagnostic modalities for AVN are used or if all patients are followed up for a longer period of time. But our AVN rate of 22% is not higher than the figures in the literature after femoral neck fracture, which mention radiologically and scintigraphically proven AVN rate of 12 % to 55%[36,37]. Some authors believe that the risk of AVN in femoral neck fracture s or non unions may increase with longer healing periods. Marti could not find the length of time as an influence between the original fracture and osteotomy on the functional results assed by Harris hip score . Radiographic signs of AVN are not a mandatory contraindication for Pauwels osteotomy[38]. Marti's series 22 patients had radiographic evidence of AVN. After osteotomy three patient showed progressive and painful collapse of the femoral head necessitating hip replacement at 7,30 and 63 months[33] . At a follow up examination after 7.1 years in Marti 's series, 88% of primary AVN at the time of osteotomy (no severe collapse of head) were satisfied or very satisfied[30]. In lesser degrees of AVN (Ficat grade I to II) osteotomies are absolutely justified, especially in young patients[32]. F.T.Ballmer, et.al. in his study had mild AVN in 5 cases out of 17 cases[39]. In our series one of the 4 patient AVN features regressed and patient had excellent outcome. One patient showed progression of AVN changes resulting in development of osteoarthritis features. Regression may be due to revascularization process. Revascularization on the other hand may also progress, although no contribution from a uniting fracture can be present. It is possible that any intact retinacular and ligamentum teres vessels have increased in size and number; if this is so, then valgus osteotomy is unlikely to further jeopardize the nutrition of the femoral head, and the uniting fracture will help support revascularization. Although AVN is influenced by various factors like mode of injury, delay from injury to surgery , initial injury to retinacular vessels and trauma during surgery , the most of the vascular insult occur at the time of initial injury. Valgaisation upto 30 degrees has no adverse effects on the retinacular vessels. Soto Hall et al observed that AVN was rare when treatment was neglected because patients inevitably assumed the position of greatest joint capacity (flexion, abduction & external rotation). This posture relieves the intra articular tamponade and lessens the possibility of AVN.

Total hip replacement is indicated in cases of failure of valgus osteotomy, implant break through and after avascular necrosis. In THR following osteotomy of proximal femur needs proper pre op planning, selection of implant and meticulous execution. So Valgus osteotomy can not be excluded as a treatment for # neck of femur on the basis that it seriously prejudices the quality of subsequent THR[29, 30].In our series of 20 patients, one patient went for collapse of femoral head and secondary osteoarthritis of hip joint for which he underwent cemented total hip replacement and his functional outcome was excellent .In Iwase,Toshiki series 12 cemented and 18 uncemented conversions, the survivorship of cemented stems were higher[40] F.T.Ballmer, et.al. in his study of 17 cases 2 cases of AVN and one case of persistent non union needed Total Hip Replacement[32]. In Marti's series of 50 patients 7 patients needed Total Hip Replacement , one case of implant brokenout,3 cases of persistent nonunion and 3 cases of collapsed femoral head with osteoarthritis.

In our series one patient had implant cut through due inadequate reduction fracture and premature weight bearing . implants that are used for internal fixation of proximal femur are prone to failure due to the large bending loads that are present in the proximal femur and poor bone quality that is usually associated with fracture. Many displaced fractures are unstable , with posterior and medial comminution leading to loss of a stable medial buttress. The implant may cut out of the superior femoral neck as the fracture settles into varus position , break at the site of fracture, or, in the case of a side plate device, pull out from the femoral shaft. Technical problems that may lead to failure include poor blade position and imperfect fracture reduction. In Bahador Alami-Harandi's study had 2 implant failures out of 28 valgus osteotomy[39]. F.T.Ballmer,. in his study had 3 cases revision osteosynthesis and implant exchanges due to primarily perforated blades of implant failure at the shaft[32].

CONCLUSION

Our Indian patients require squatting and sitting cross legged for normal day to day activities. Therefore in a patient with neglected fracture neck of femur, we can not achieve this by prosthetic replacement as it has its own limitations. One must aim to preserve the natural head of femur.

Though many methods for treating neglected fracture neck of femur, valgus osteotomy is a very effective procedure. The other procedures like Meyer's muscle pedicle grafting and free or vascularised fibular grafting are more extensive, expensive and high morbidity to the patient.

Meticulous pre operative planning regarding placement of blade and level of osteotomy along with early stable fixation is essential for fracture union.

We conclude that for the patients under 55 years of age with neglected fracture of the femoral neck, the Pauwels osteotomy produces many good results, even in the presence of avascular necrosis of femoral head providing the head has not collapsed.

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ANNEXURE

PROFORMA

Name : Hospital no.

Age : Sex

Address :

Occupation :

Date of presentation :

History

Time since injury :

Mode of injury :

Treatment history :

Pain :

Deformity :

Limp :

Daily activities :

Clinical examination

Tenderness in hip :

Limp length :

Range of movements in hip

Flexion, Extension, Abduction, Adduction, :

Internal rotation & External rotation :

Telescopy :

Trendelenberg sign :

Pre op plan

Pauwels angle :

Pauwels type :

Avascular changes :

Osteoporosis

Degenerative changes in hip

Per op

Degree of wedge taken :

Reduction closed/open :

Mode of fixation :

Post op

X- ray - Quality of reduction and fixation :

Post op pauwels angle :

Complications :

Follow up

History : pain, deformity & daily activities

Examination : deformity ,limp length and range of movements

Radiological : fracture union, osteotomy union and implant position. A vascular changes in femoral head

Complications :

Harris hip score :

HARRIS HIP SCORE : (1969)

In this hip score a maximum of 100 points is used with the following maximum possible scores. Pain and functional capacity are the two basic considerations.

Pain	-	44
Function	-	47
Range of motion	-	5
Absence of deformity	-	4
Total	-	100

I PAIN

Because of is subjective nature, the following gradations are made.

PAIN (44)

None	-	44
Slight	-	40
Mild	-	30
Moderate	-	20

Marked - 10

Disabled - 0

II FUNCTION (47)

Gait - 33

Daily activities - 14

Gait can be characterized in terms of support, limp and distance that can be walked. Eleven points are assigned to each of these three things.

The following functional activities are assessed and graded to assign points to daily activities.

Stairs - 4

Shoes and socks - 4

Sitting - 5

Public transportation - 1

III RANGE OF MOTION - 5

Index values are determined by multiplying the degrees of motion possible in each arc by the appropriate index.

Flexion - 0-45x1; 45-90x.6; 90-110x.3

Abduction - 0-15x8; 15-20 x.3

Adduction - 0-15 x.4

External Rotation - 0-15 x.4

Internal rotation - any x 0.

To determine the overall rating for range for range of motion, multiply the sum of the index values x 0.05. Record trendelenberg test as positive, level or neutral. It is recorded but not rated in this system.

IV ABSENCE OF DEFORMITY POINTS -4

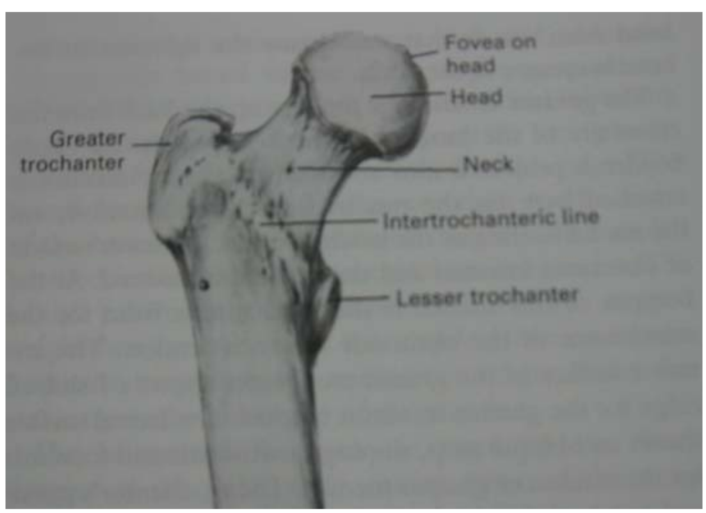
Presence of any of the following constitutes a significant deformity and eliminates four points.

a. A permanent flexion contracture greater than 30 degrees.
b. Fixed adduction of more than 10 degrees.
c. Fixed internal rotation of more than 10 degrees.
d. A limb length discrepancy of more than 3.2 cm.

A score of ninety to one hundred was considered an excellent result. Eighty to ninety was good, seventy to eighty fair and below seventy poor.

ANATOMY OF PROXIMAL FEMUR

Fig. 1



CUT SECTION OF HIP JOINT

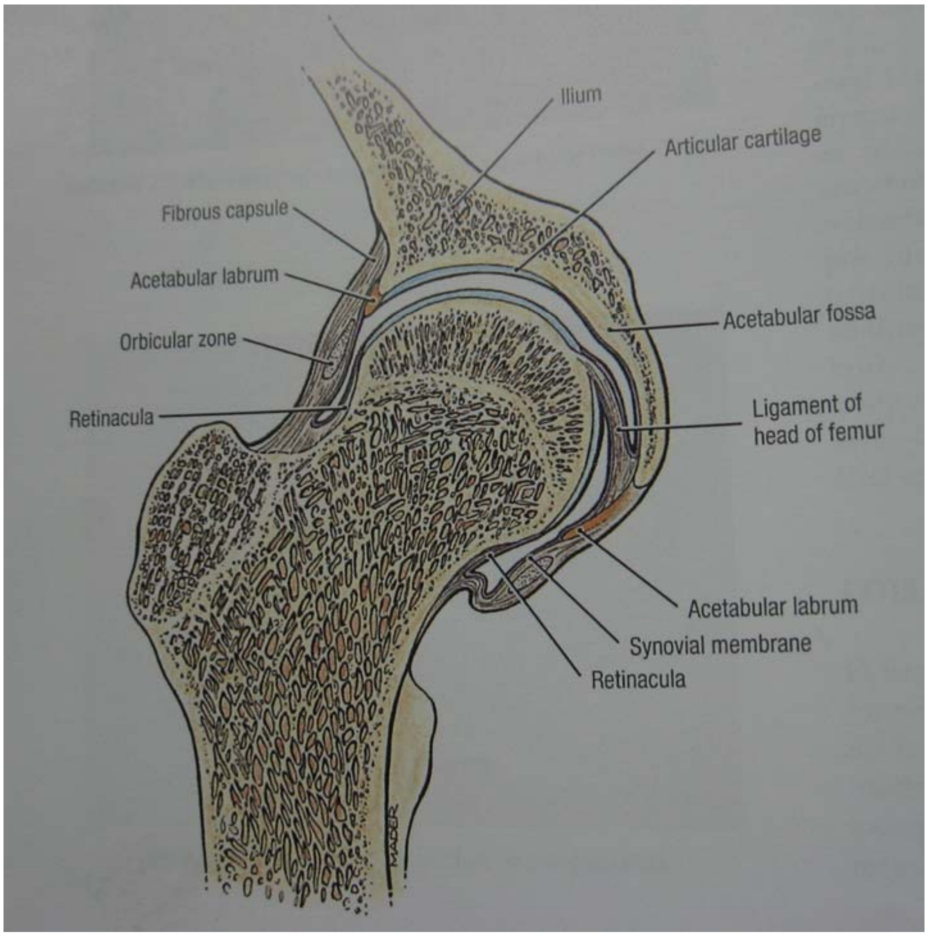


Fig 2

ANTEVERSION OF FEMORAL HEAD

Fig .3.1

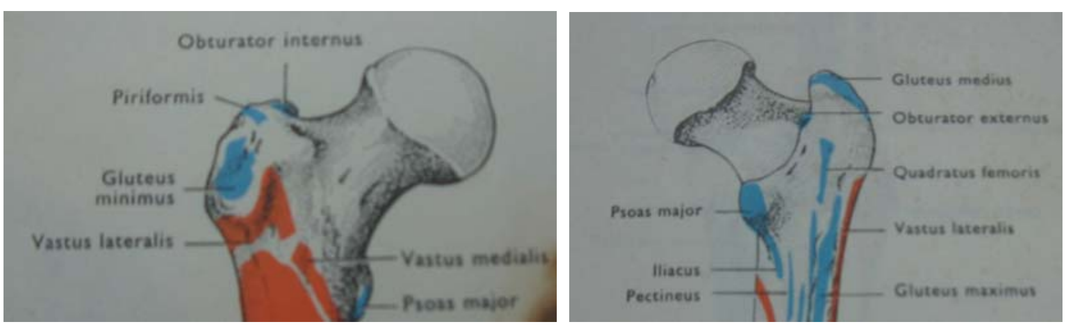


Fig3.2 to show the muscle attachments in anterior and posterior aspect of proximal femur

THE TRABECULAR PATTERN IN THE UPPER END OF FEMUR

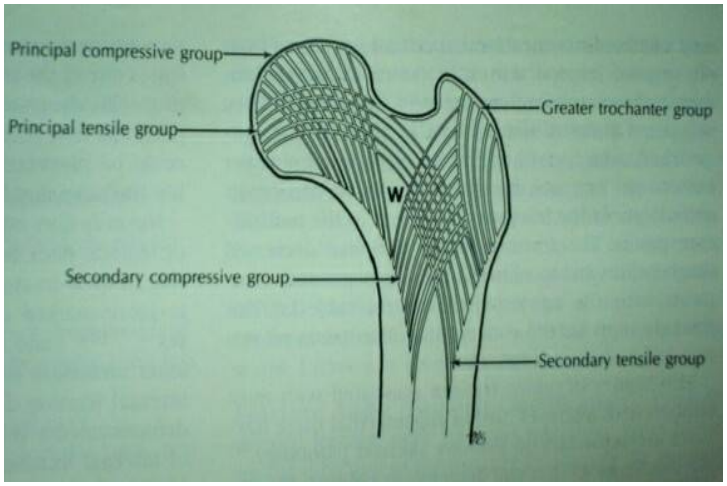


Fig .4 .1

Fig.4.2

CALCAR FEMORALE

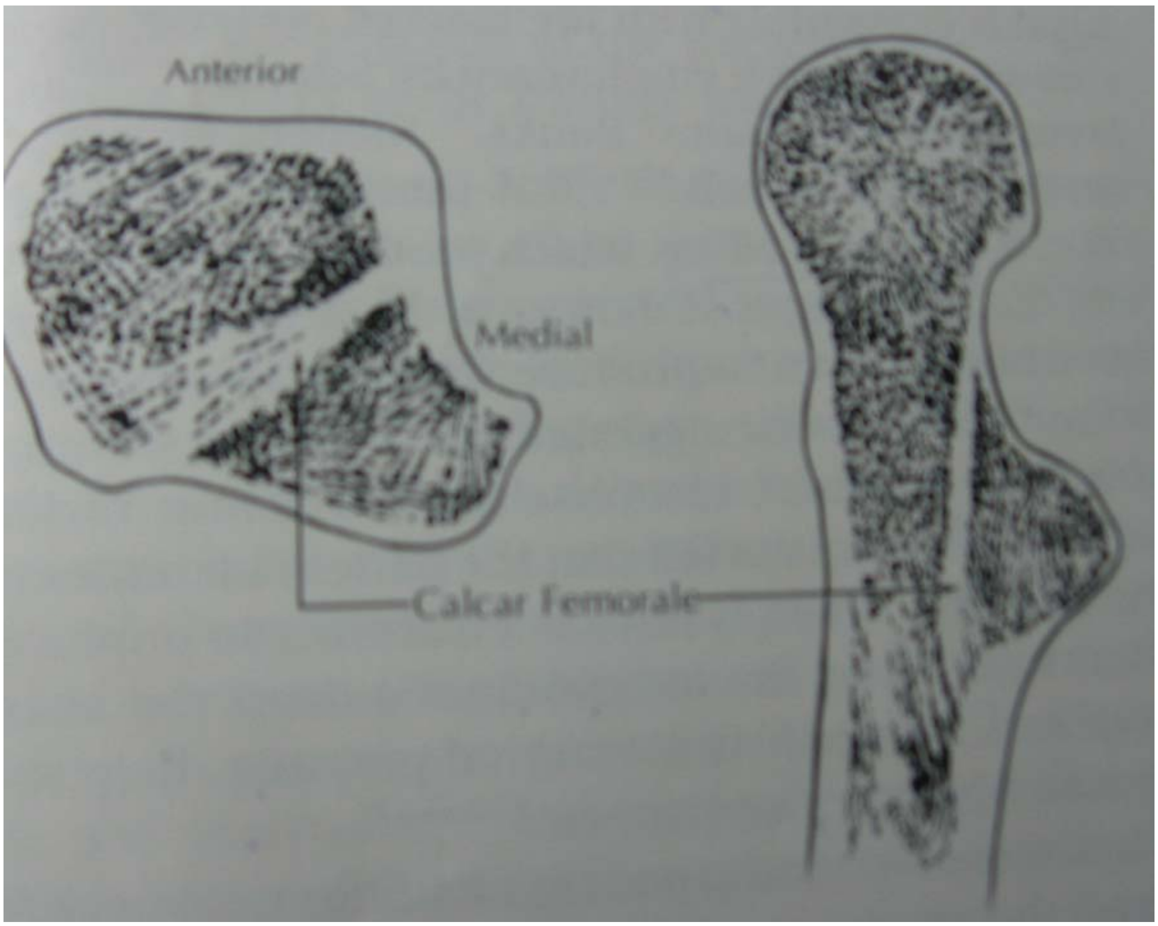
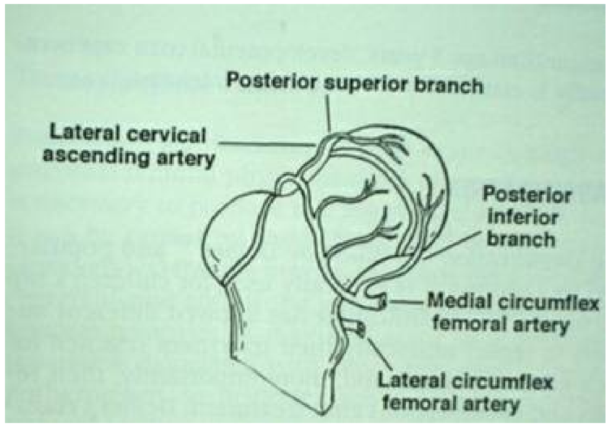
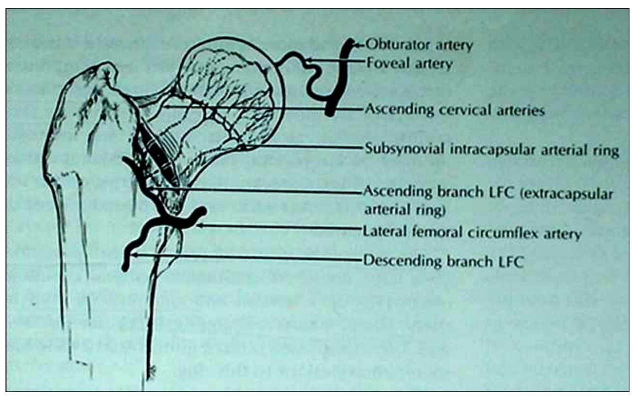


Fig. 5

VASCULAR ANATOMY OF UPPER END OF FEMUR





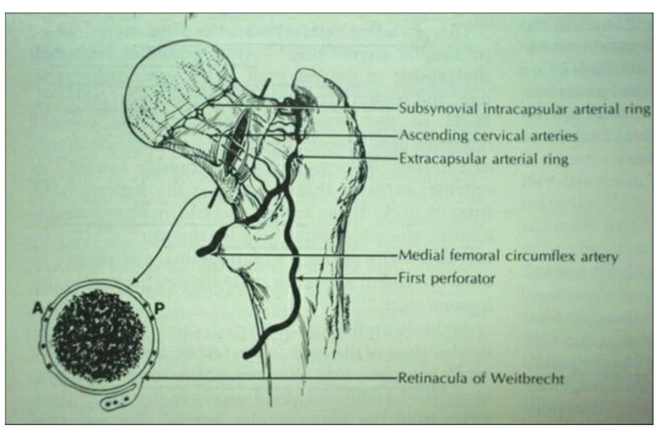


Fig.6.1,6.2 & 6.3

CLASSIFICATION BASED ON ANATOMIC LOCATION

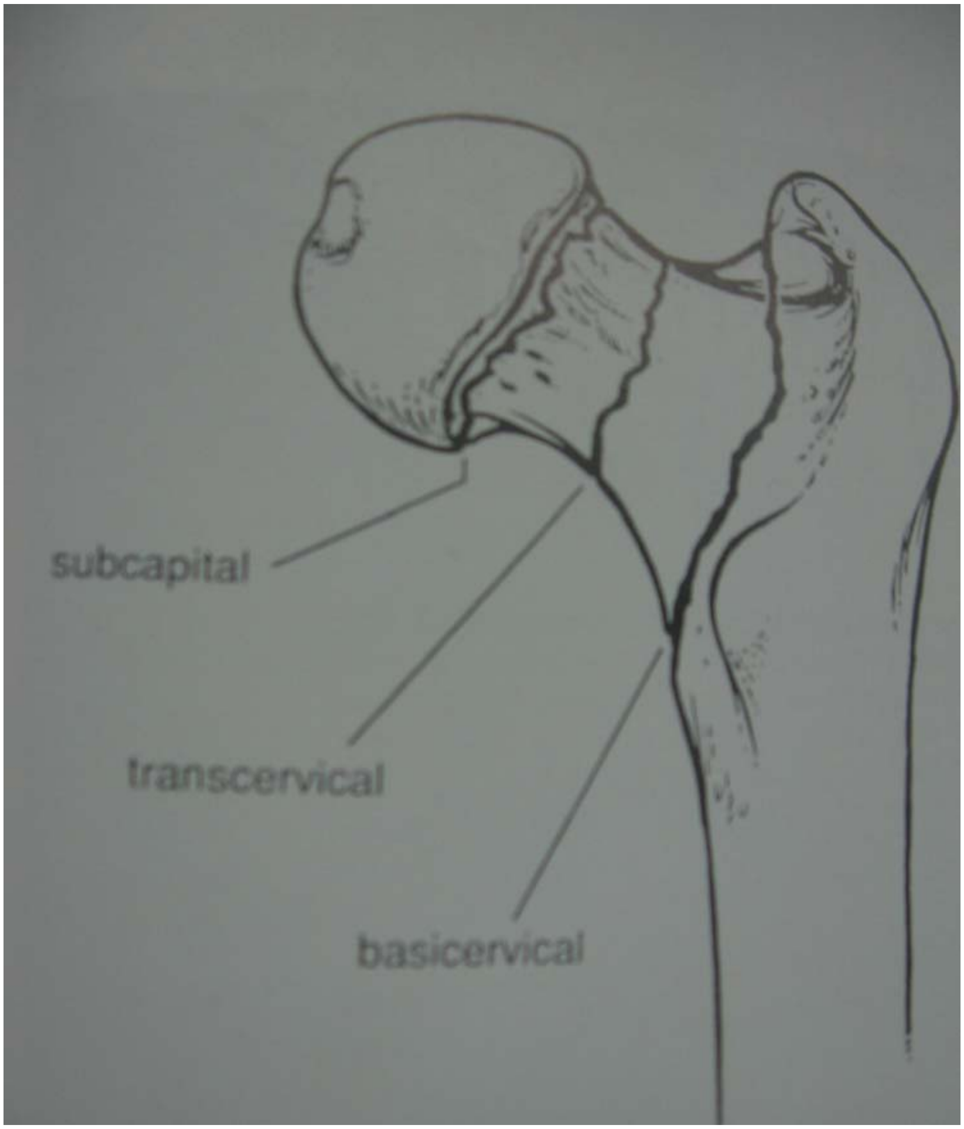


Fig. 7

PAUWELS CLASSIFICATION

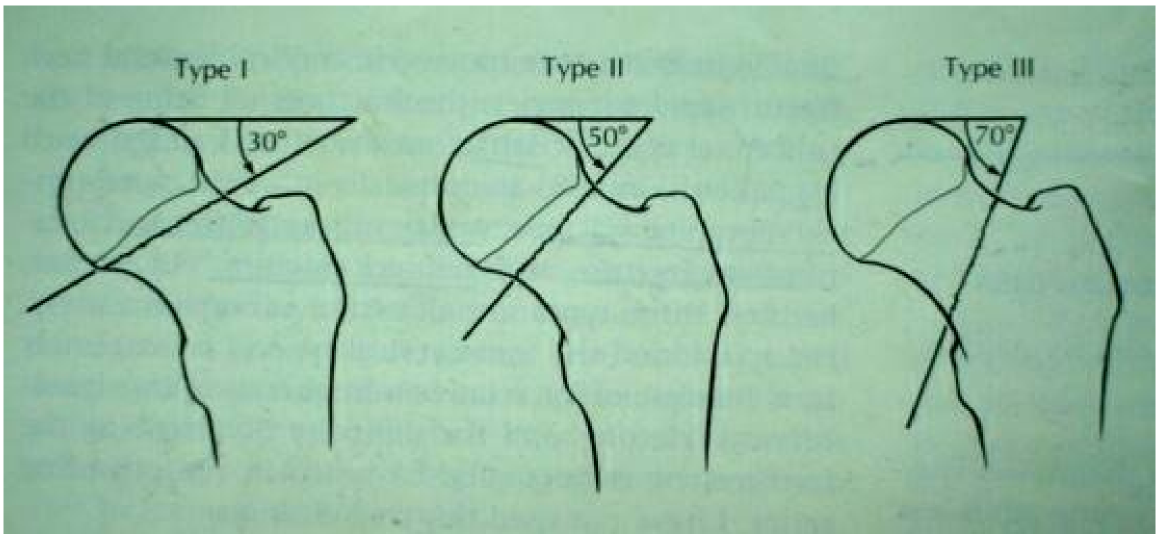


Fig. 8

GARDEN'S CLASSIFICATION

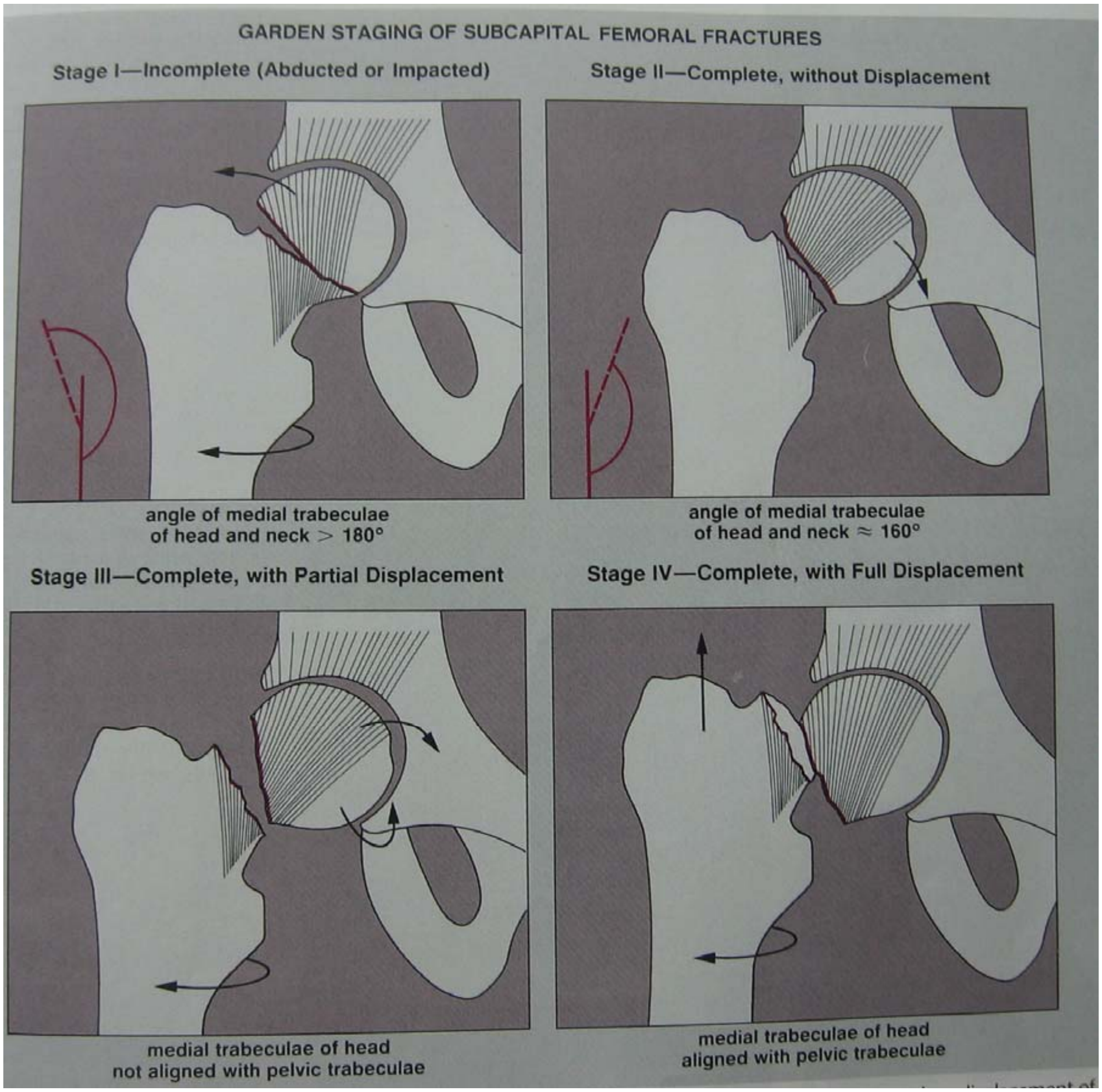


Fig.9

COMPREHINSIVE CLASSIFICATION OF FRACTURES (CCF) OF FEMORAL NECK

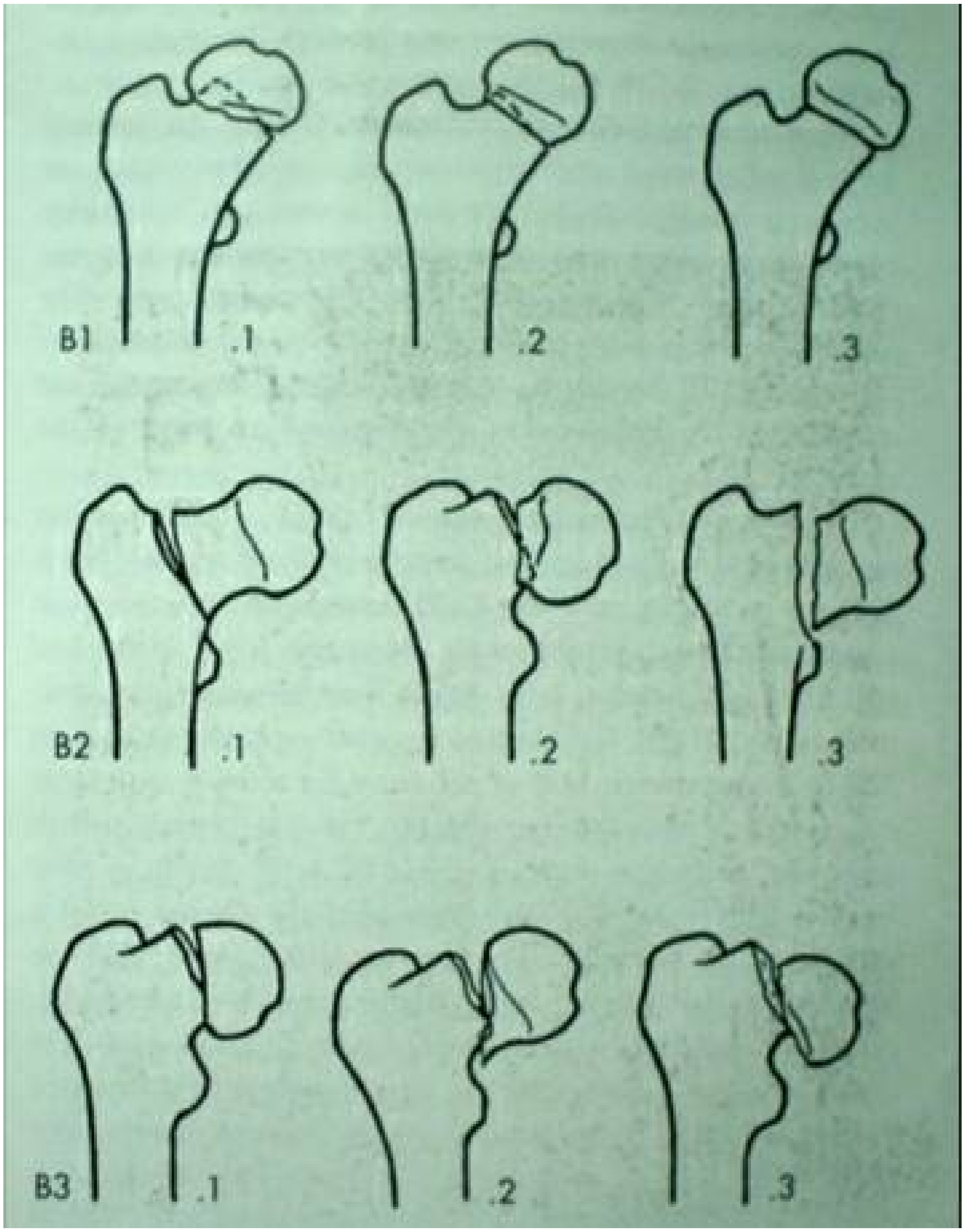


Fig 10

SINGH'S INDEX STAGING

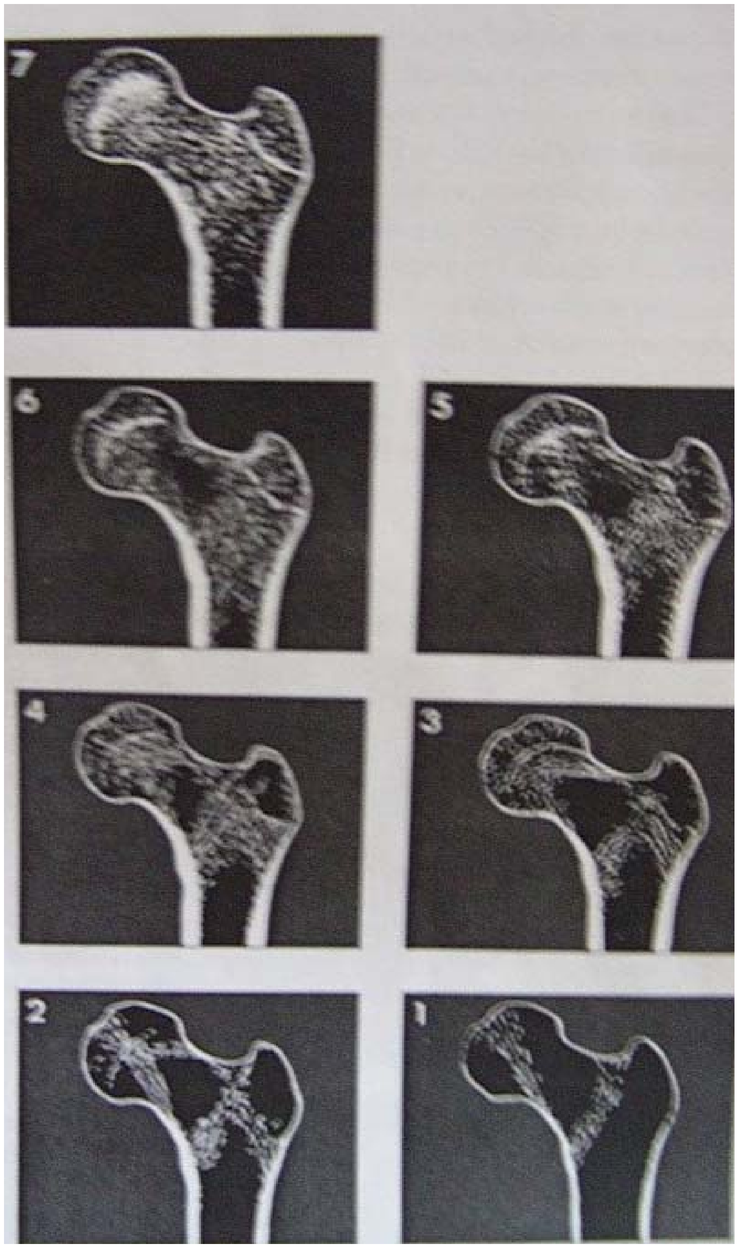


Fig .11

MC MURRAY OSTEOTOMY

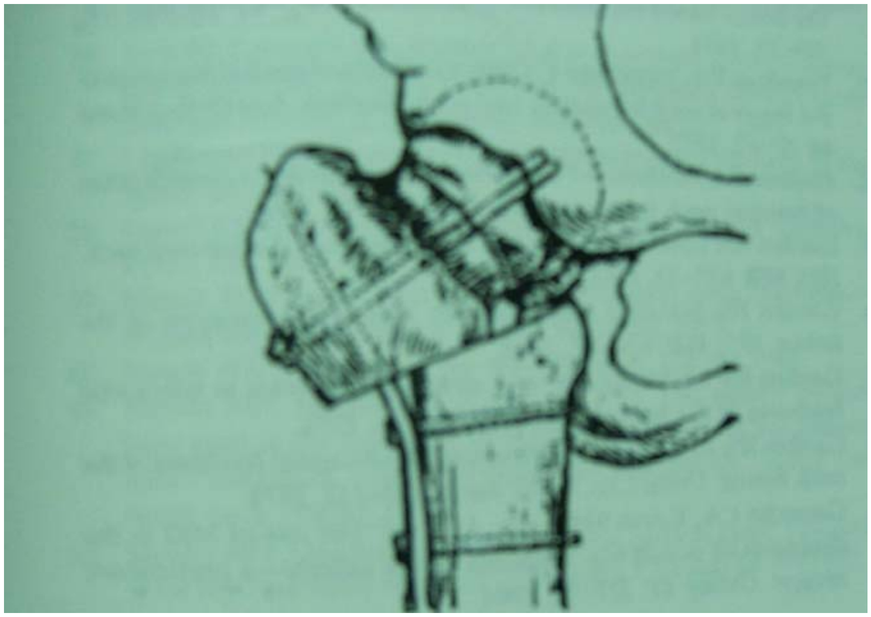


Fig .12

BLOUNT OSTEOTOMY

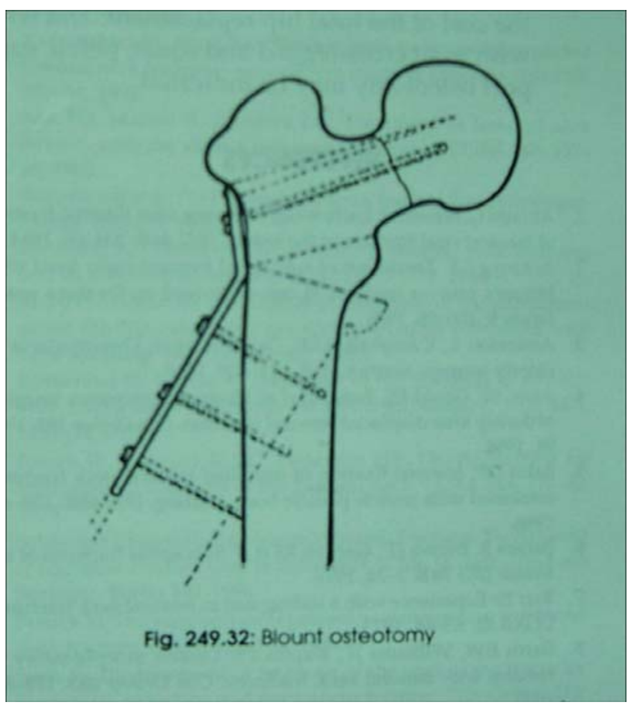


Fig. 249.32: Blount osteotomy

Fig .13

PAUWELS VALGUS OSTEOTOMY

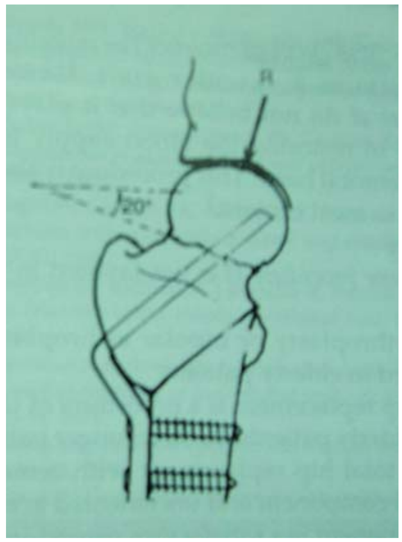
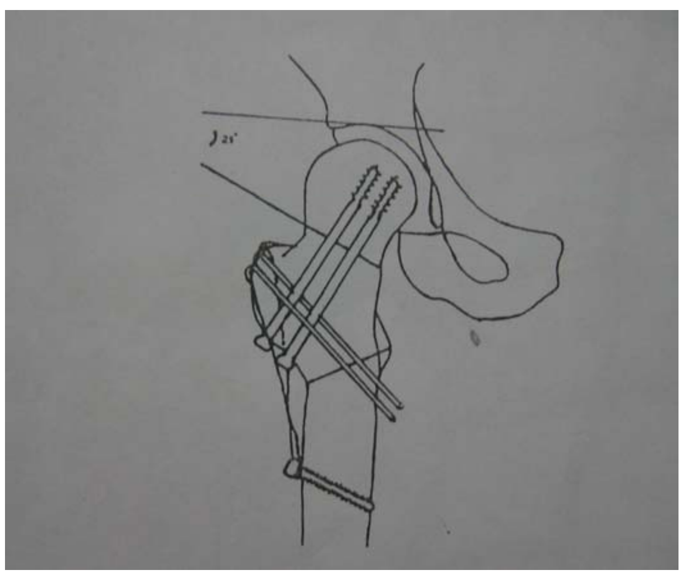


Fig .14

WEBERS TECHNIQUE



VASCULARISED FIBULAR GRAFT.

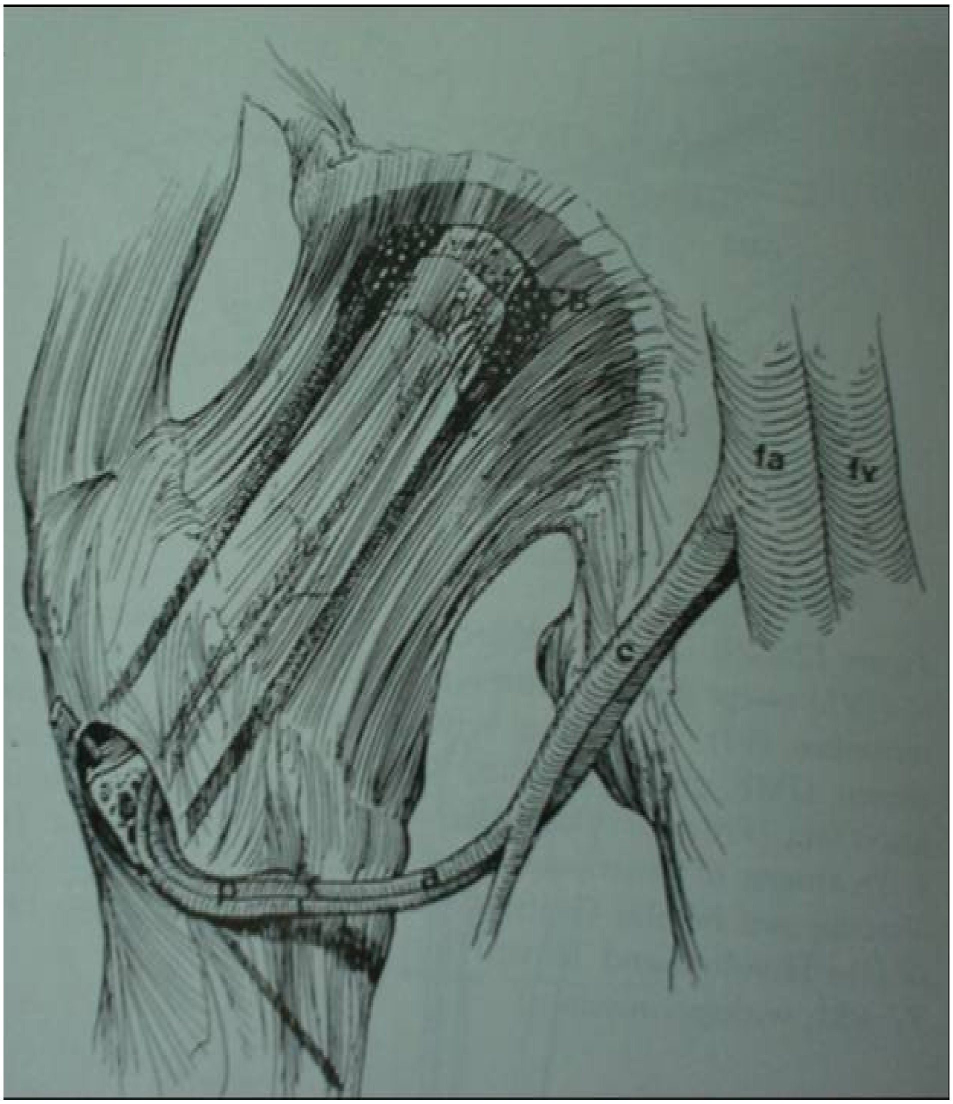


Fig .15

MEYER'S MUSCLE PEDICLE GRAFT

PROCEDURE

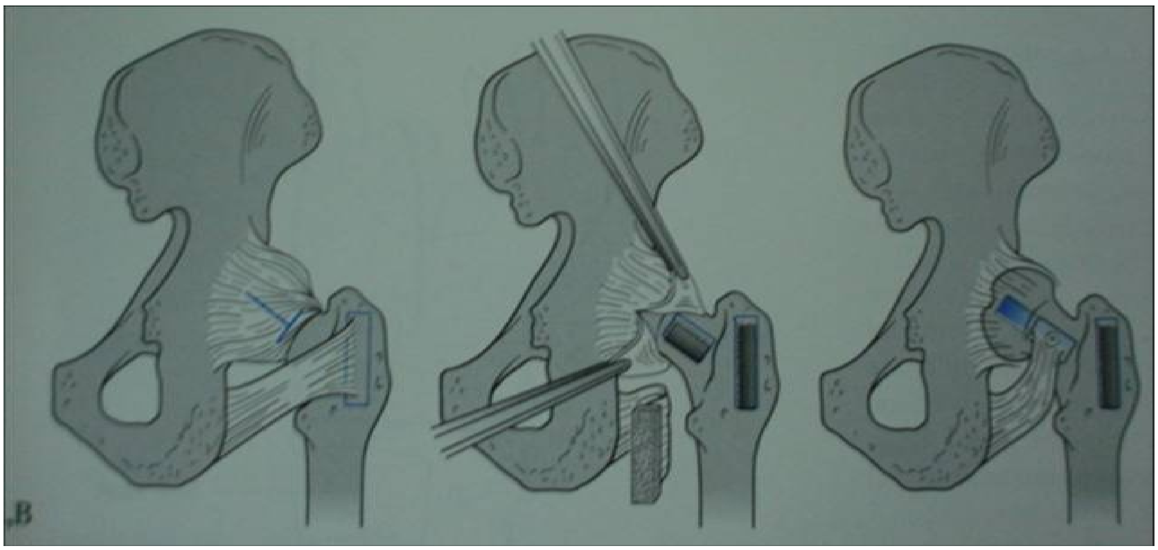


Fig .16

TOTAL HIP ARTHROPLASTY

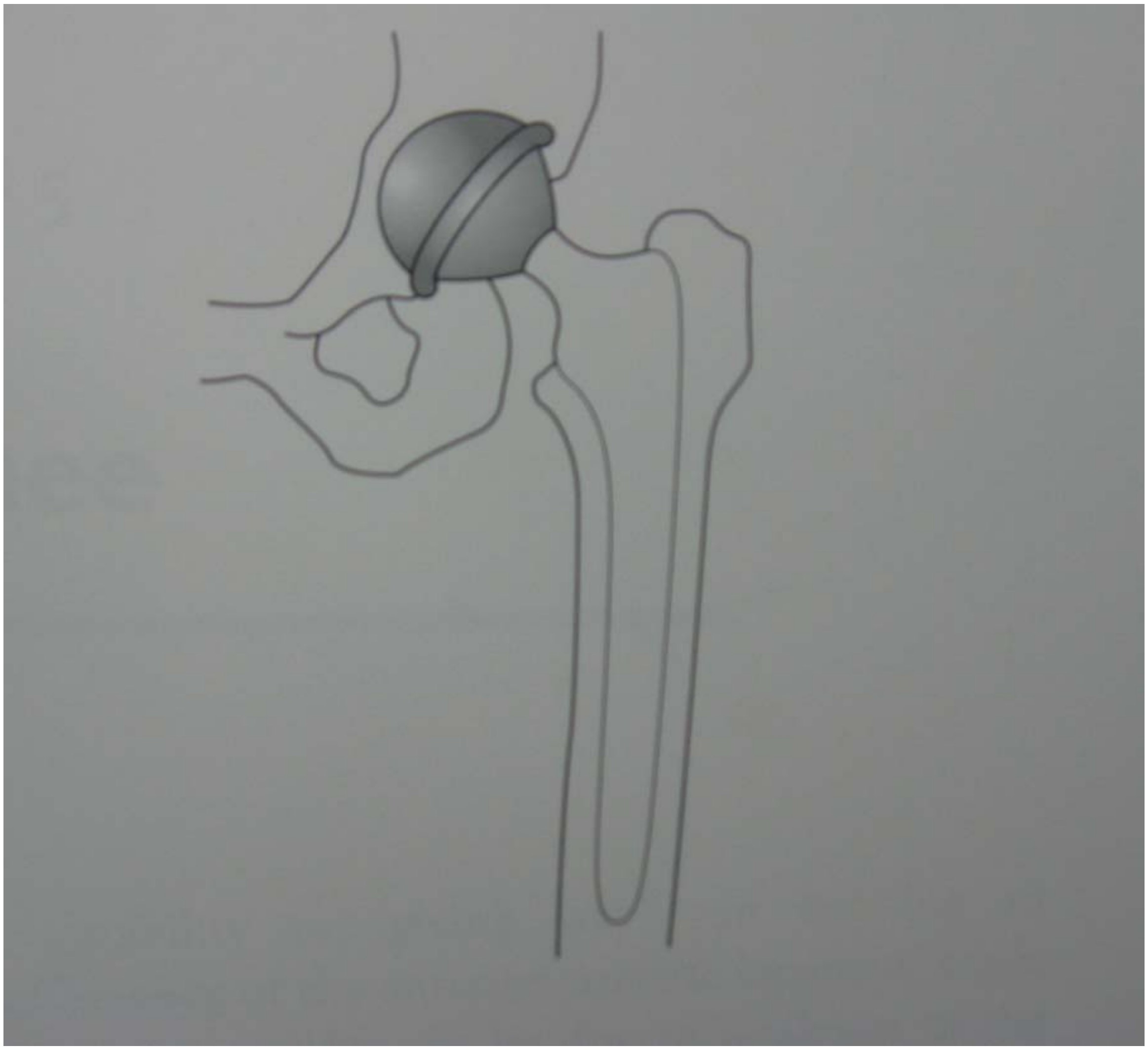


Fig .17

EXCISION ARTHROPLASTY-GIRDLESTONE

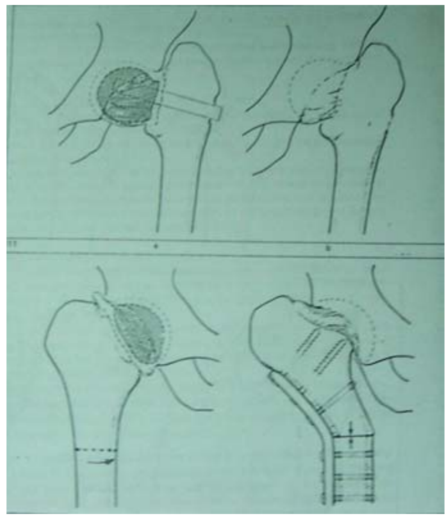


Fig 18

ARTHRODESIS

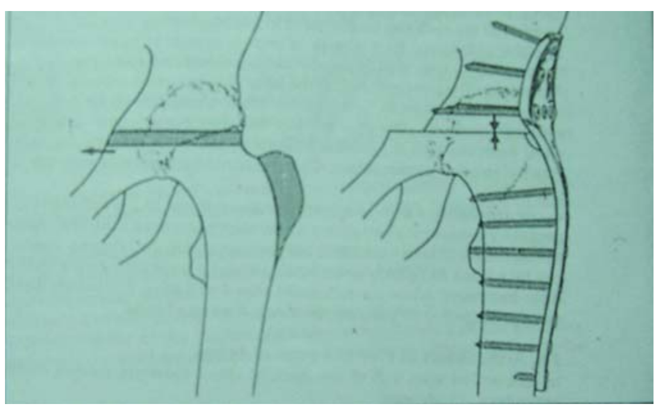


Fig.19

PAUWELS PRINCIPLE AND CLASSIFICATION

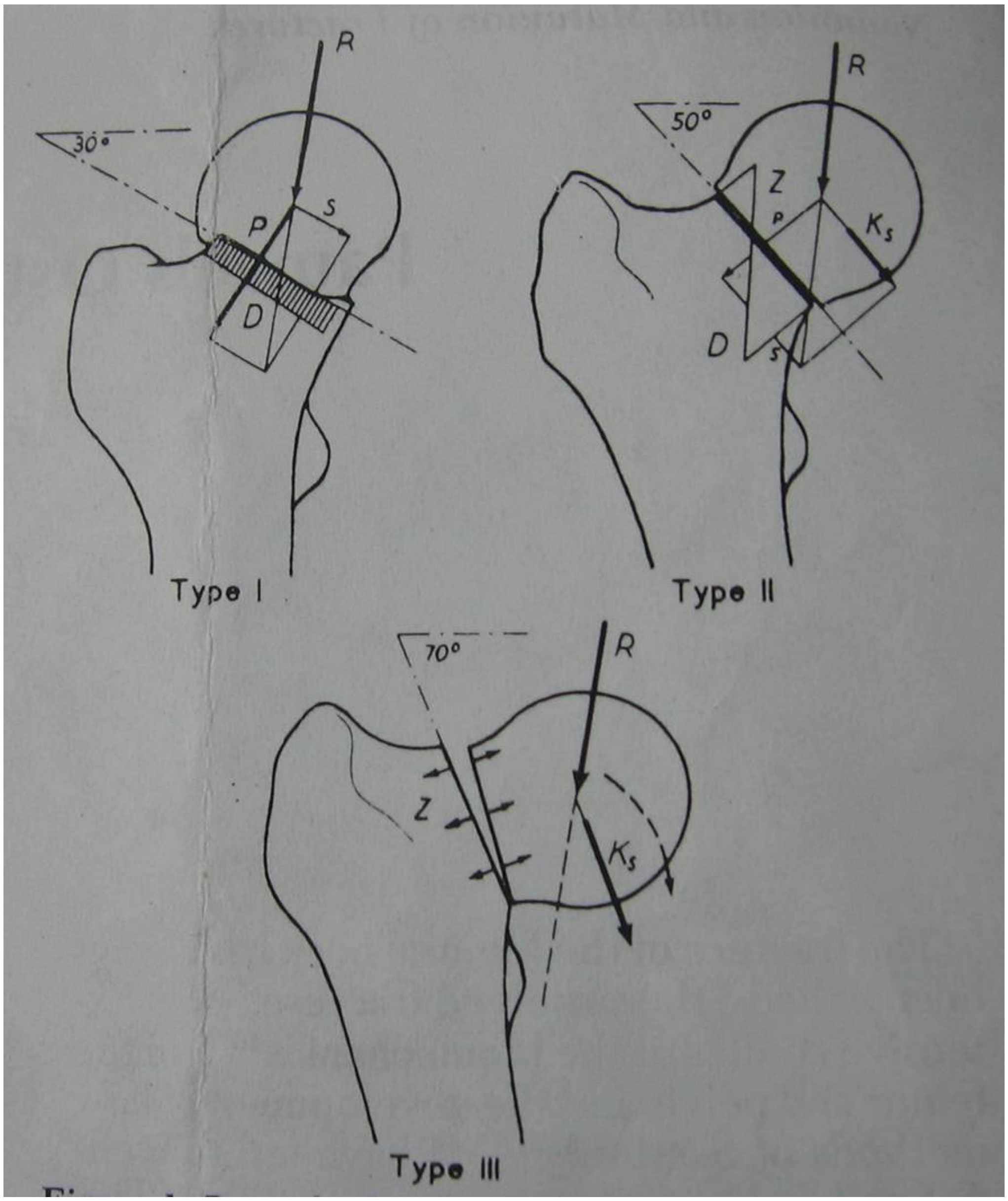


Fig.20

PRE- OPERATIVEPLANNING

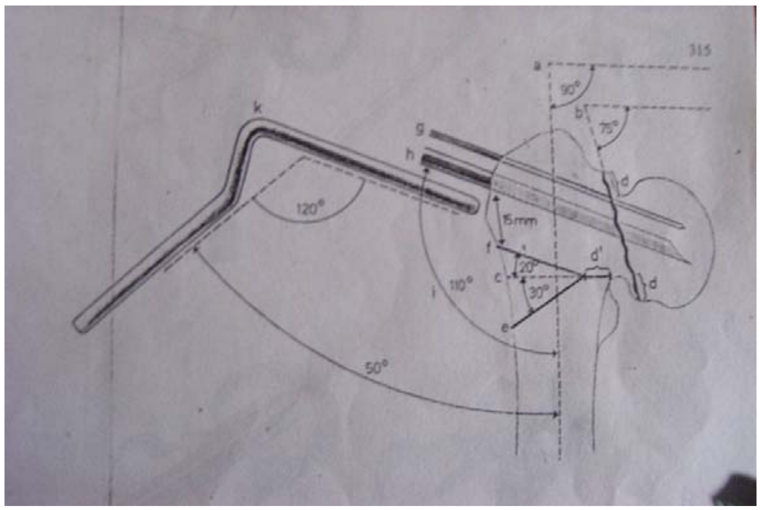


Fig . 21

OPERATIVE TECHNIQUE

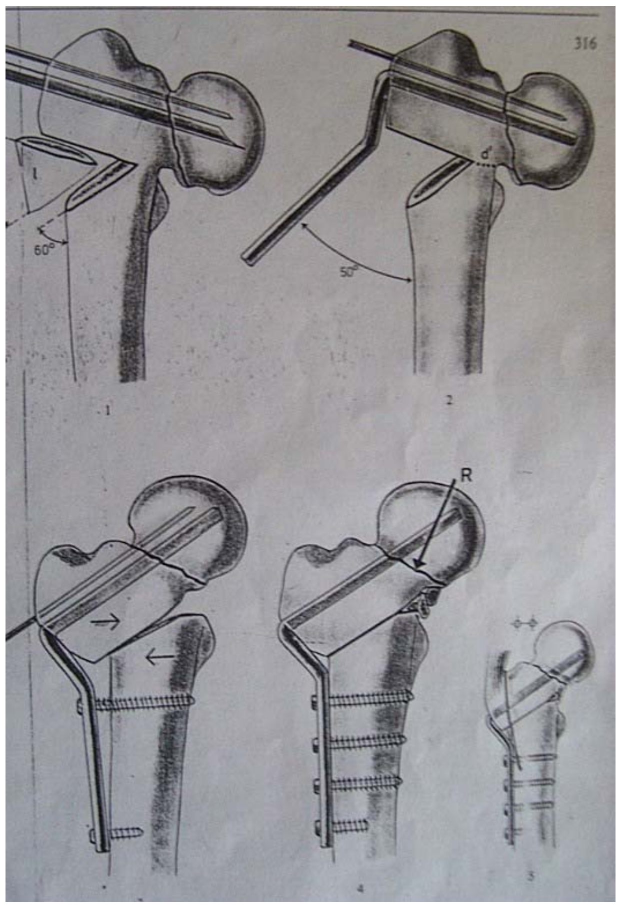


Fig.22

INTRA OPERATIVE PICTURES

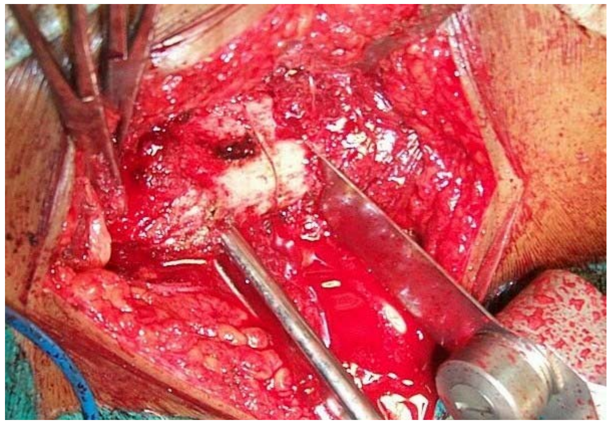


Fig.23.1 Showing seating chisel in position, osteotomy and wedge

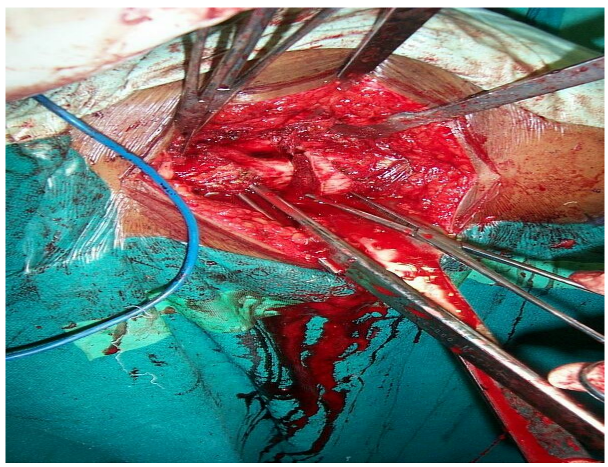


Fig.23.2 After wedge removal

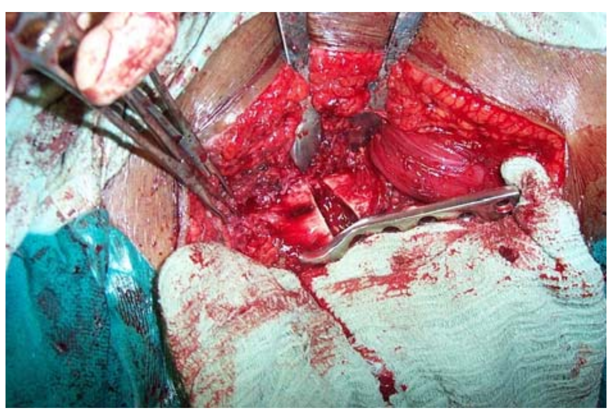
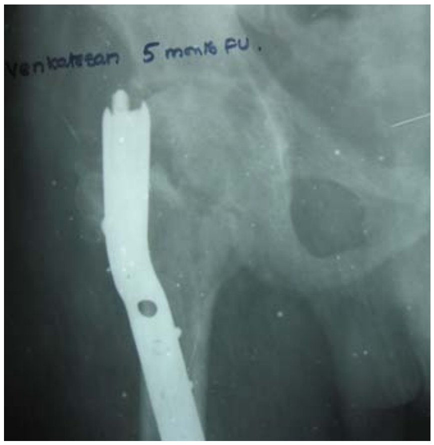
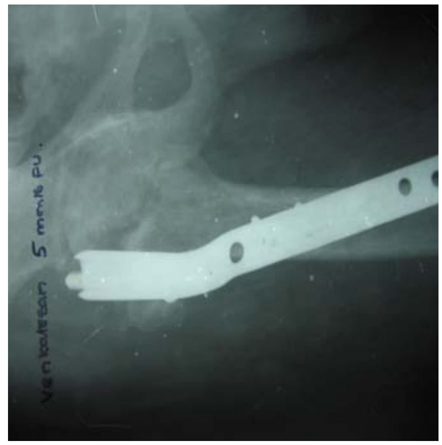


Fig 23.3. Reduction of osteotomy and fixation with
120 degree double angle blade plate

COMPLICATIONS





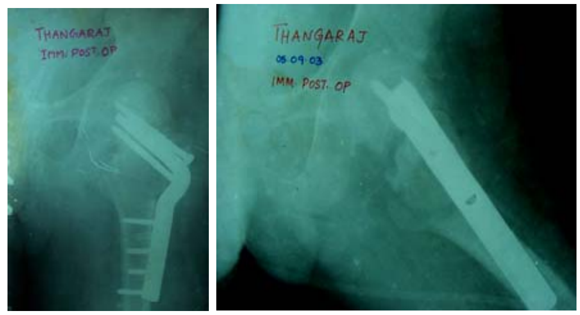
IMPLANT BREAK THROUGH

AVASCULAR NECROSIS

AVASCULAR NECROSIS WITH SECONDRY OA

UNION WITH EXCESSIVE CALLUS

THANGGRAJ 18 / M



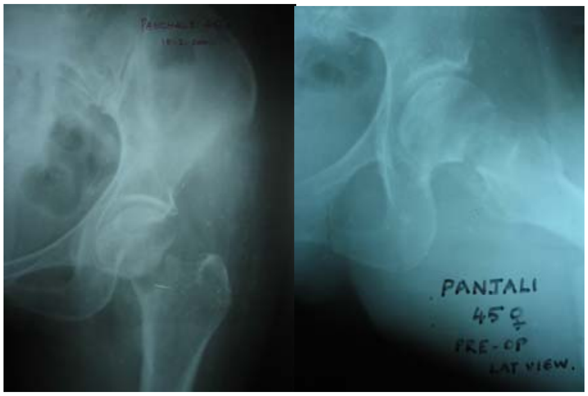
PRE – OP

IMMEDIATE POST OP

2 ½ YEARS FOLLOW UP

2 ½ YEARS FOLLOW UP

PANJALI 45 /F



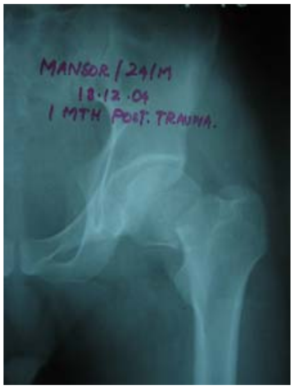
PRE – OP

IM MEDIATE POST OP

14 MONTHS FOLLOW UP

14 MONTHS FOLLOW UP

MANSOOR 26/M



PRE OP IMMEDIATE POST OP

17 MONTH S FOLLOW UP

17 MONTH S FOLLOW UP

THANGARAJ 15 / M

PRE – OP

IMMEDIATE POST OP

14 MONTHS FOLLOW UP

14 MONTHS FOLLOW UP

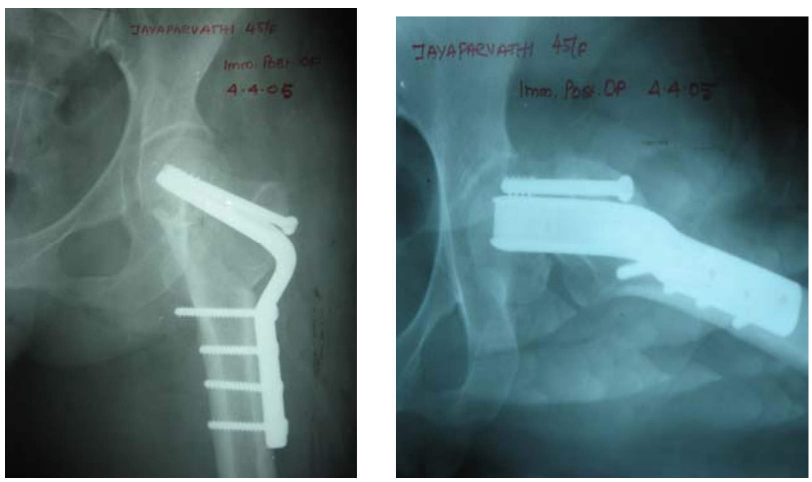
PARVATHI 20 /F

8 YEARS POST OP

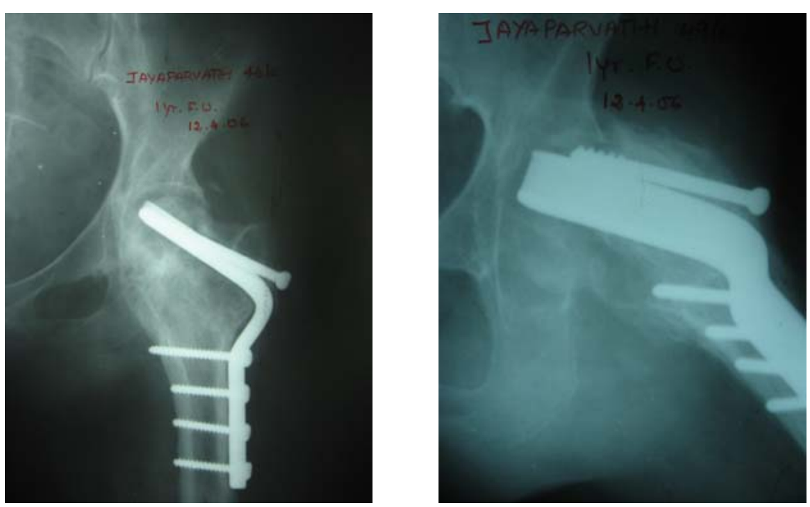
AFTER IMPLANT REMOVAL

JAYAPARVATHI 45/F

PRE – OP



IMMEDIATE POST OP



1 YEAR FOLLOW UP

RAMAKRISHNAN 50 / M

7 YEARS POST OP

AFTER THR

S. No	Name	Age	Sex	Mode of injury	Duration of fracture	Pauwels type	Mode of fixation	Time taken for fracture union	AVN	Follow up	Harris hip score	Result
1	Sampath kumar	55	M	RTA	6 months	II	120° double angle plate	5 months	NO	54 months	95	Exellent
2	Munusamy	52	M	Fall	5 months	III	120° double angle plate	4 months	NO	54 months	92	Exellant
3	Panjali	45	F	Fall	4months	II	120° double angle plate	6 months	NO	48 months	86	Good
4	Nagaraj	55	M	RTA	6 months	III	120° double angle plate	5 months	NO	42 months	88	Good
5	Thangaraj	16	M	RTA	4months	III	120° double angle plate	6 months	Yes	30 months	96	Exellant
6	Chengama	54	F	Fall	6months	III	120° double angle plate	5months	NO	24months	90	Exellant
7	Anchalatchi	45	F	Fall	4months	II	120° double angle plate	6months	NO	27months	89	Good
8	Raja	26	M	RTA	6months	II	120° double angle plate	5months	NO	24months	74	Fair
9	Manjoor	24	M	Fall	1month	II	120° double angle plate	6months	NO	15months	92	Good
10	Vittabai	42	F	Fall	2months	III	120° double angle plate	6months	NO	24months	90	Exellant
11	Palanisamy	30	M	RTA	7months	II	120° double angle plate	5months	NO	24months	87	Good
12	Dayalan	29	M	Fall	12months	III	120° double angle plate	6months	NO	18months	86	Good
13	Nagappan	40	M	RTA	9months	II	Maini's plate	6months	Yes	12months	88	Good
14	Saravanan	36	M	Fall	6months	III	Maini's plate	4months	NO	18months	78	Fair
15	Venkatesn	32	M	Fall	2months	II	120° double angle plate	-	NO	4months	60	Poor
16	Thangaraj	15	M	Fall	6months	II	Maini's plate	3months	NO	4months	92	Exellant
17	Jayaparvathi	45	F	Fall	2months	II	120° double angle plate	3months	Yes	12months	66	Poor
18	Om veer	26	M	RTA	6months	II	webers techneque	3months	NO	8 Years	92	Exellant
19	Parvathi	20	F	Fall	8months	II	webers techneque	6months	NO	8 Years	96	Exellant
20	Ramakrisnan	50	M	Fall	4months	III	webers techneque	4months	Yes	7 Years	65	Poor