A STUDY ON POST-OPERATIVE RADIOGRAPHIC FACTORS AND PATIENT REPORTED OUTCOME FOLLOWING TOTAL HIP ARTHROPLASTY

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CHENNAI, TAMIL NADU

CERTIFICATE

This is to certify that the work entitled"**A STUDY ON POST-OPERATIVE RADIOGRAPHIC FACTORS AND PATIENT REPORTED OUTCOME FOLLOWING TOTAL HIP ARTHROPLASTY "**which is being submitted for M.S. Orthopaedics, is a bonafide work of

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DECLARATION

I, **Dr. L.THAMIZHARASAN**, solemnly declare that the dissertation titled"**A STUDY ON POST-OPERATIVE RADIOGRAPHIC FACTORS AND PATIENT REPORTED OUTCOME FOLLOWING TOTAL HIP ARTHROPLASTY",** has been prepared by me. This is submitted to **"The Tamil Nadu Dr. M.G.R. Medical University, Chennai,** in partial fulfillment of the regulations for the award of M S degree branch II Orthopaedics.

DR.L.THAMIZHARASAN

"A Study on post-operative radiographic factors and patient reported outcome following Total Hip Arthroplasty(THA)."

***Submitted to* "The Tamil Nadu Dr. M.G.R. Medical University, Chennai"**

in partial fulfillment of the regulations for the award of M S degree branch II Orthopaedics by Dr.L.Thamizharasan 221212107.

INTRODUCTION:

Total Hip Replacement is recommended for elderly patients with displaced Fracture neck of femur.Although Total Hip Replacement (THR) is a very successful surgical intervention, some patients experience persistent pain or dissatisfaction with outcome of surgery. Implant positioning is a major factor in the post - operative outcome of Total Hip Arthroplasty. Lewinnek et al proposed safe zone of cup anteversion as 15°±10° (AV) and cup alignment as 40°±10°.Combined anteversion of 25 to 50 degrees is the safe zone.Our aim is to determine whether post-operative radiographic variables are predictive of patient-reported pain, function and satisfaction after primary THR.

Aim: The aim of the study is to analyse the clinical and radiological outcome following uncemented THA in neck of femur fractures.

Methods:

In our study we analysed 40 cases of THA,with 30 cases of fresh displaced fracture neck of femur and 10 cases of Non union neck of femur in the age group of 50 to 76 years.This study is a prospective study conducted between September 2012 to September 2014 with a follow up of minimum 6 months to 2 years.

All patients were taken X-rays and CT scan to measure Cup version,Cup Offset,Limb length discrepancy,femoral stem alignment ,Stem version and Combined Anteversion.The post-operative radiographic variables were statistically analysed with Modified Harris Hip score to find any significant difference in functional outcome.

Results:

In our study it was found that offset restoration,leg length restoration,femoral stem alignment and acetabular inclination are not significant significant predictors of functional outcome following THR.It was found that there exists both statistically and clinically significant difference in functional outcome based on Modified Harris hip score with changes in CT-anteversion and combined anteversion values.

Of 40 cases analysed 10 patients excellent ,18 good,6 fair and 6 poor outcome.CT-scan of 6 patients with poor outcome shows retroversion of cup and 3 patients showed an impinging lesion over iliopsoas.

Conclusion:

Implant position especially Cup version and Combined anteversion of cup and stem is a critical factor in both short-term and long-term outcome of patients with Total hip Arthroplasty.Retroversion of cup is a major cause of impingement and thus pain after THR.CT scan is the best method to find version of cup and stem and thus combined anteversion.

Keywords:"Harris hip score","combined anteversion","retroversion".

CONTENTS

Acknowledgement

PART A

CONTENTS	Page No.
Introduction	1
Aims and Objectives	3
Anatomy of Hip joint	4
Fractures of Femoral neck	14
History of Total Hip Replacement	17
Designs Of THR components	18
Biomechanics of Hip	27
Soft tissue balancing of THR	32
Intraoperative assessment of implant position	42
Post-operative radiographic assessment of THR	49

PART B

CONTENTS	Page No.
Methodology	59
Study procedure	60
Radiographic variables taken in study	63
Statistical method taken in study	64
Observation & Results	65
Radiographic assessment of cases with score	85
Discussion	103
Limitations	108
Conclusion	109

ANNEXURES :

a. BIBLIOGRAPHY

b. MASTER CHART

c. MODIFIED HARRIS HIP SCORE

d. ETHICAL COMMITTEE APPROVAL

e. PLAGIARISM FIRST PAGE & DIGITAL RECEIPT

ABBREVIATIONS

THR - Total hip replacement.

THA - Total hip arthroplasty.

AV - Anteversion.

LLD -Limb length discrepancy.

ANOVA -Analysis of variance.

SD -Standard deviation.

HHS -Harris hip score.

MOD.HHS -Modified Harris hip score.

F-ratio -Fisher's ratio.

df -degrees of freedom

INTRODUCTION

It has been estimated that world wide 1.3 million hip fractures occurred in 1990, it is expected to double by 2025 and increase to 4.5 million by 2050.All femoral neck fracture must be fixed and the type of surgical procedure and fixation depends on the patients physiological age and type of fracture as per Garden's classification.For elderly patients with displaced fracture Total Hip Replacement is recommended.[1]

Although Total Hip Replacement (THR) is considered a very successful surgical intervention, a proportion of patients experience persistent pain or disability, and/or dissatisfaction with the outcome of surgery. Our aim is to determine whether post-operative radiographic variables are predictive of patient-reported pain, function and satisfaction after primary THR.[2]

Implant positioning is a major factor in the post - operative outcome of Total Hip Arthroplasty. Implant malposition such as impingement of neck on the cup liner may be a causative factor for dislocation,decreased range of motion,loosening and polyethylene wear.Therefore,accurate positioning of implant is necessary to prevent impingement and longterm stability of implants.[3]

The optimum position of acetabular cup to be aimed during Total hip arthroplasty have been proposed in a number of studies. Lewinnek et al[4] proposed safe zone of cup anteversion as 15°±10° (AV) and cup alignment as 40°±10° and showed a 4 fold increase in dislocation rate outside this safe zone. Biedermann et al[5] proposed cup anteversion of 15° and cup inclination of 45° were associated with decreased rate of dislocation. Wixson[6] through his studies proposed an optimum target position of cup inclination of 40-45° and anteversion of 17-23° in computer navigated total hip replacement performed through the posterior approach.

Combined anteversion is the major criteria for stability of total hip replacement.Acetabular cup position alone is not a cause for dislocation.Combined anteversion explains us the stability of hip in varying body position ,throughout the wide flexion arc of acetabulum.In future the safe zone for total hip replacement is based on combined anteversion rather than cup position alone.Combined anteversion of 25 to 50 degrees is the safe zone.[7]

In this study , we will analyse the Post - operative radiographic variables following Total hip arthroplasty and its correlation functionally in Neck of femur fractures.

AIM AND OBJECTIVES

Aim:

The aim of the study is to analyse the clinical outcome and post-operative radiographic factors following Total hip Arthroplasty in neck of femur fractures.

Objectives:

a) To study and analyse the radiographic variables following Total Hip Arthroplasty and its correlation functionally and clinically in Neck of femur fractures .

b) To study ,analyse & compare the radiographic and CT-based cup and stem version following Total Hip Arthroplasty in Neck of Femur fractures .

c) To study the version values both in X-ray and CT and its correlation functionally and clinically in Neck of Femur fractures

REVIEW OF LITERATURE

ANATOMY OF HIP JOINT[8]:

The Hip joint is a synovial joint(ball and socket type) formed by the articulation of head of the femur with the acetabulum of pelvis. The joint surfaces are covered with hyaline cartilage.The prime function is to support body weight in both dynamic and static postures.

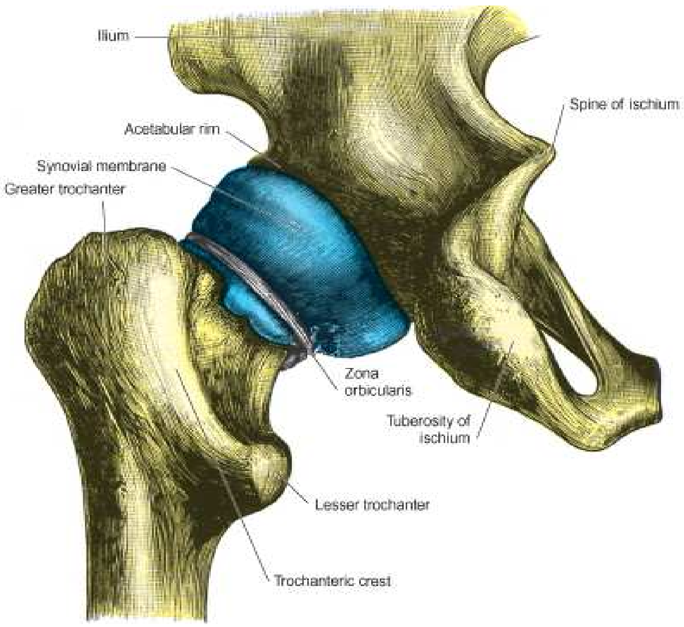


Figure 1: HIP JOINT

The acetabulum is an incomplete spherical socket with nonarticular cotyloid fossa surrounded by an inverted horse-shoe shaped articular surface The acetabulum is formed by union of three pelvic bones ilium,ischium and pubis following fusion of triradiate cartilage at 14-16years of age.The acetabular socket is formed by two columns of bone, as an inverted Y proposed by Letournel and Judet.

The weight bearing articular surface forms the roof of acetabulum.The Quadrilateral surface is formed by lateral border of pelvic cavity and lies adjacent to the acetabular medial wall. The acetabulum by its labrum,a fibrocartilagenous lip covers almost half of femoral head ,extending beyond the equator.

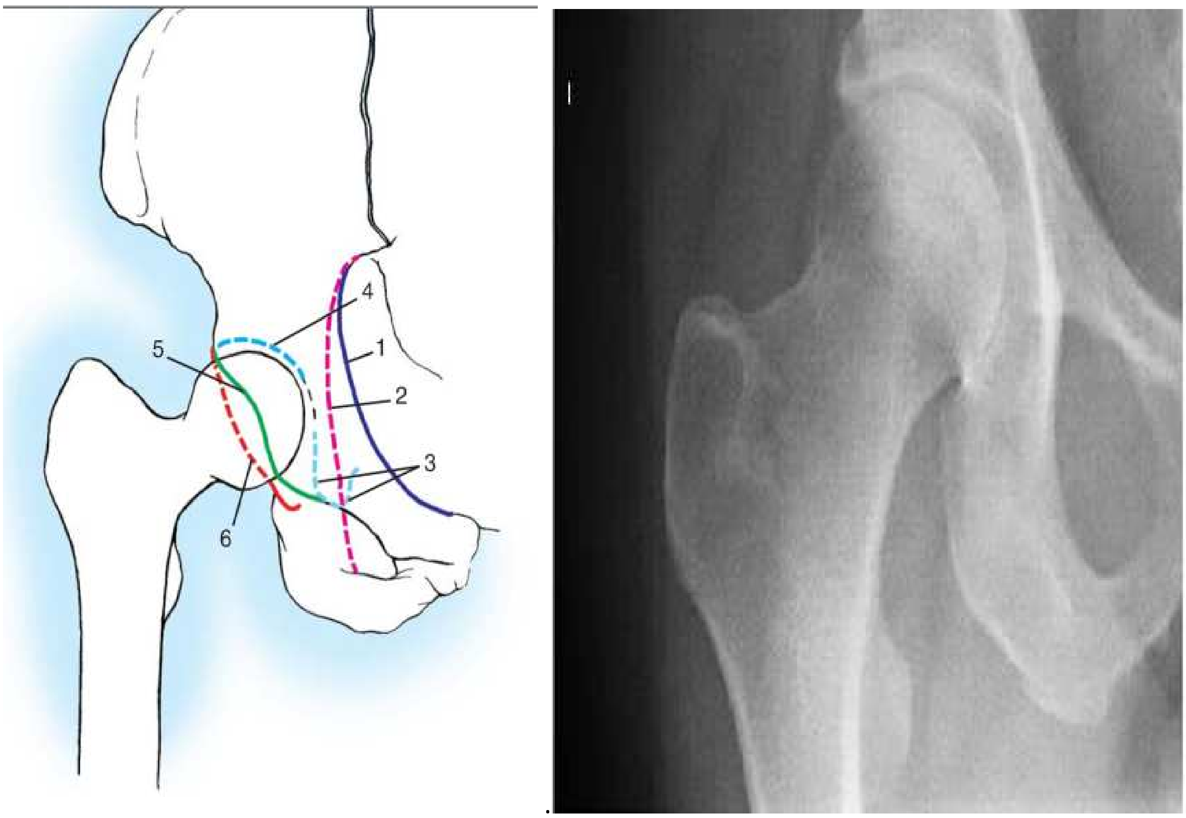


FIGURE 2: Landmarks of standard anteroposterior radiograph of the hip[9]

1.Iliopectineal line 2,Ilioischial line 3,Radiographic tear drop formed medially by flat quadrilateral surface and laterally by antero-inferior portion of acetabulum.4,Dome of acetabulum.5,Anterior and 6,posterior lip of acetabulum.

The Acetabular angle, transverse angle of the acetabular inlet,is measured by angle between the line through the superior and inferior margins of acetabulum to horizontal plane measuring 51 degrees at birth decreases to 40 degrees in adults.

The sagittal angle of the acetabular inlet is measuered between the line through the amterior and posterior margins of actabulum and the sagittal plane measuring 7° at birth and in adults it reaches 17°.

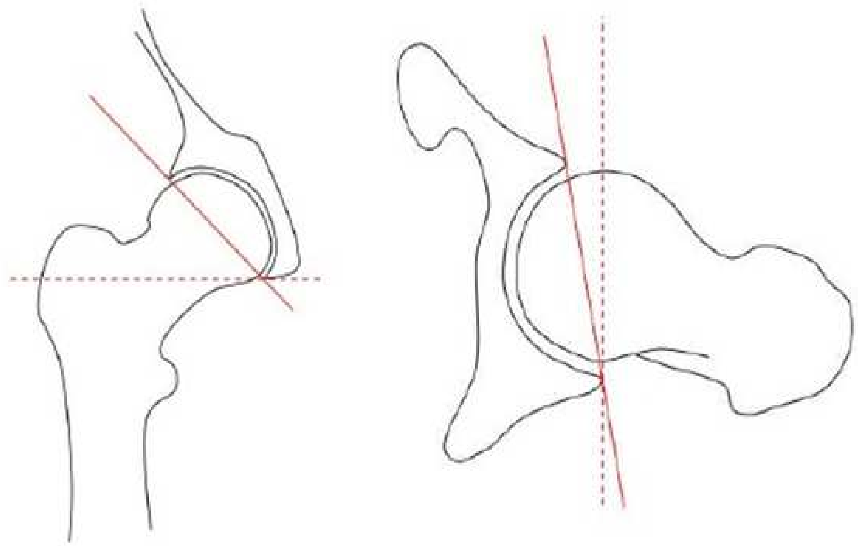
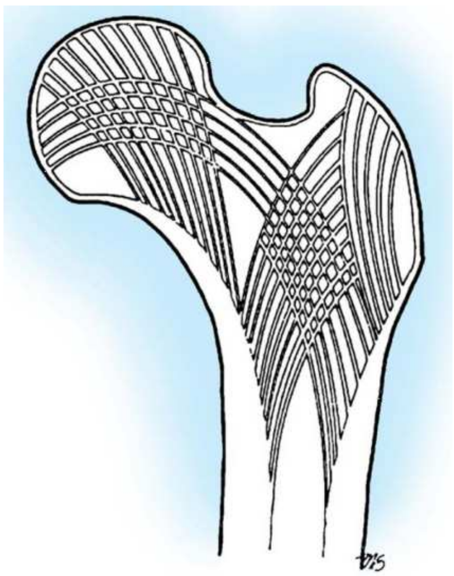


Figure 3:Transverse and sagittal angles of acetabular inlet plane

Ward(1838) ,proposed the trabecular architecture of femoral head.[10]The trabecular archictecture is along the lines of stress, the thicker trabeculae arising from calcar and passing through the superior weight bearing dome of head of femur. Smaller trabeculae arises from foveal area to head,from femoral neck superiorly to trochanter and also along lateral cortex of head. The calcar region is the thick dense plate of bone,arising from the posteromedial region of shaft of femur ,radiating from lesser trochanter to greater trochanter reinforcing the posteroinferior region of neck. The region of calcar is thicker medially and thins out laterally.



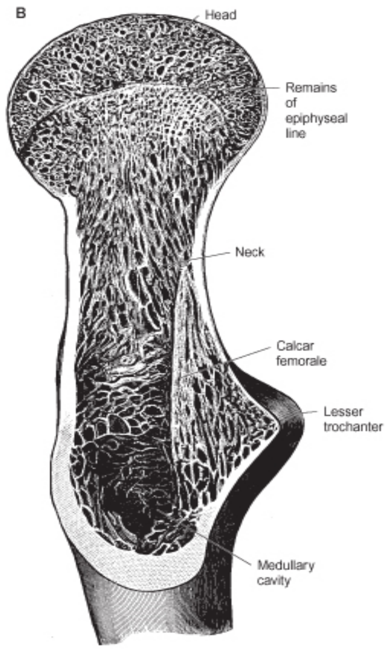


Figure 4:A.Trabecular architecture of femoral head B.Oblique section of femoral head showing trabecular system ,calcar femorale and variations in cortical thickness.

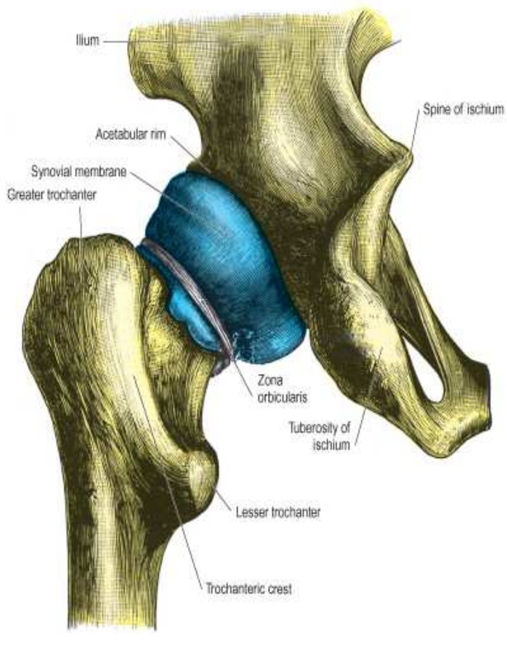
CAPSULE[8]:

The capsule is dense and strong and has attachments to the margins of acetabulam,beyond its labrum and outer aspect of labrum,to acetabular notch,to the transverse acetabular ligament and the rim of the obturator foramen. Anterosuperiorly the capsule is thicker,thinner posteroinferiorly and is loosely attached.

The region of capsule has two types of fibers: longitudinal and circular

- The **circular fibers(zona orbicularis)** form a collar around the femoral neck and are not directly attached to bone.
- The **longitudinal retinacular fibers** are most numerous in the anterosuperior region region of neck containing blood vessels for neck and head.

Figure 5: Synovial cavity of Hip joint,posterior aspect.



LIGAMENTS[8]:

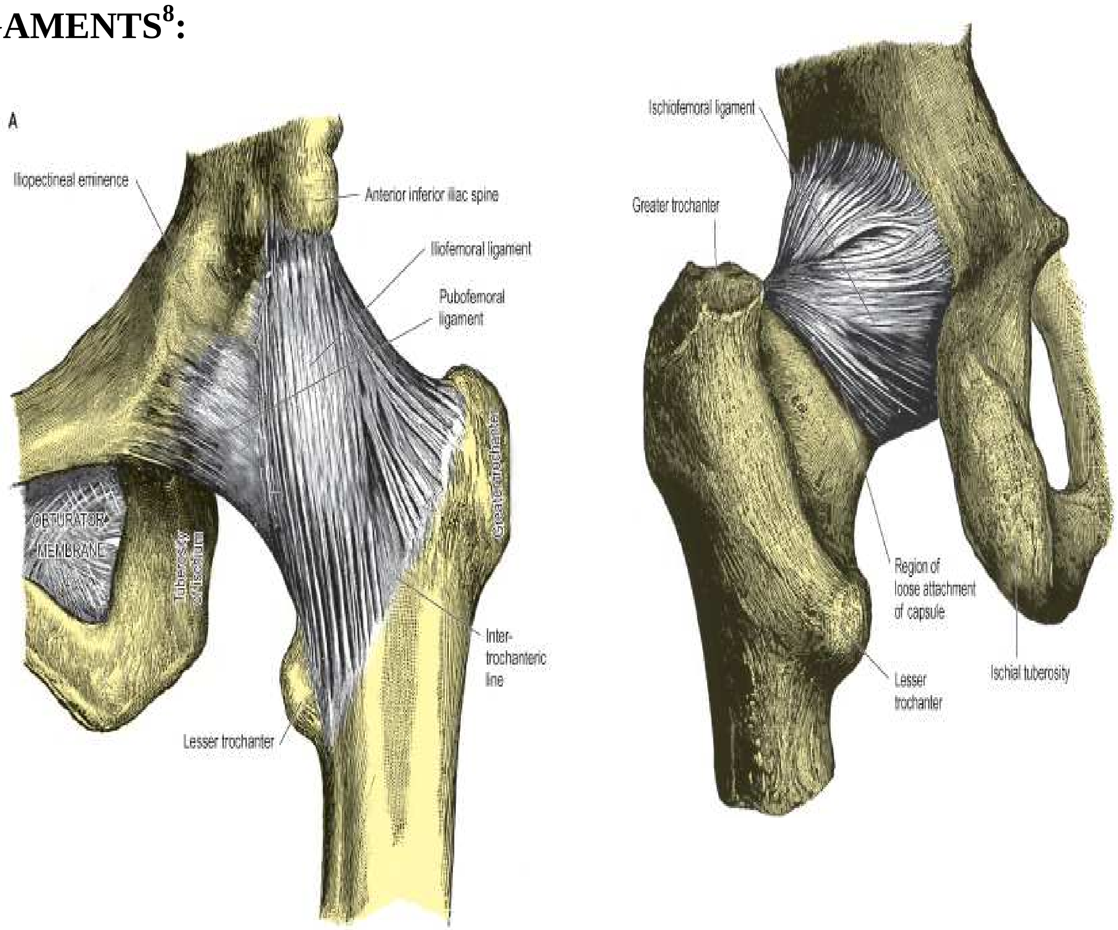


Figure 6:Hip joint anterior and posterior aspect

There are five ligaments in the hip joint namely,the iliofemoral,pubofemoral, ischiofemoral, transverse acetabular and the ligamentum teres reinforcing it.As hip moves, the capsular ligaments, wind and unwind around the hip, affecting stability, excursion and capacity of joint.

The iliofemoral,ischiofemoral and pubofemoral ligaments are the extracapsular ligaments and has its attachments to the ilium,ischium,and pubis respectively**.**These ligaments blend with the capsule and thus prevents excessive range of motion in joint.

The **iliofemoral ligament** is the strongest ligament,is inverted Y shaped. This ligament prevents the trumk from falling backward in upright position and tilts the pevis backward during sitting in its relaxed state. It also prevents excessive adduction and internal rotation of the hip.

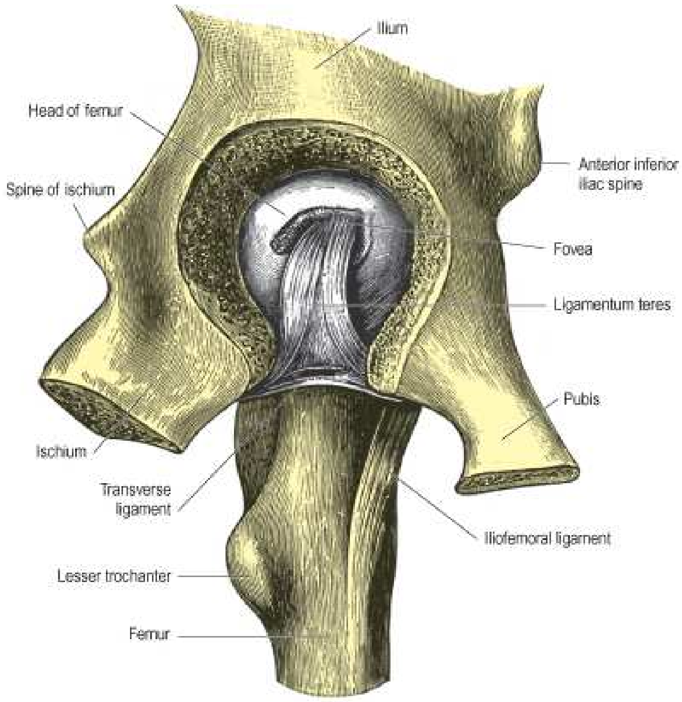


Figure 7:Hip joint from within pelvis,acetabular floor removed

The **ischiofemoral ligament** has three parts superior,lateral and medial parts attached around the neck and restricts medial (internal) rotation of hip.

The **pubofemoral ligament** is triangular and blends with capsule, restricting abduction and internal rotation of the hip joint.

The **zona orbicularis**,blends with the extracapsular ligament in the most narrowest part of neck and helps head in maintaining contact with the joint like button hole.

The **ligamentum teres**, is flat triangular ligament with its apex at fovea of head and base to the acetabular notch. This ligament is stretched during dislocation of hip and prevents further displacement.It acts as conduit to artery of head of femur and is vitally important as this may be only blood supply to the head during neck of femur fracture in children.

BLOOD AND NERVE SUPPLY[8]:

The major blood supply to hip joint is from the medial and lateral circumflex femoral artery, branches of profunda femoris and rarely as variation from femoral artery.These vessels form an extracapsular ring at the base of neck between lateral circumflex artery and medial circumflex femoral artery . The retinacular vessels arise from them on the surface of neck as medial, lateral anterior and posterior groups,lateral vessels being important. The ascending cervical arteries form subsynovial intraarticular arterial ring at the articular margin of head,forming epiphyseal arteries as they penetrate the head. The lateral epiphyseal vessels are the most important as they supply the weight bearing area of head of femur. The inferior metaphyseal vessels and artery of ligamentum teres join wth these epiphyseal vessels.

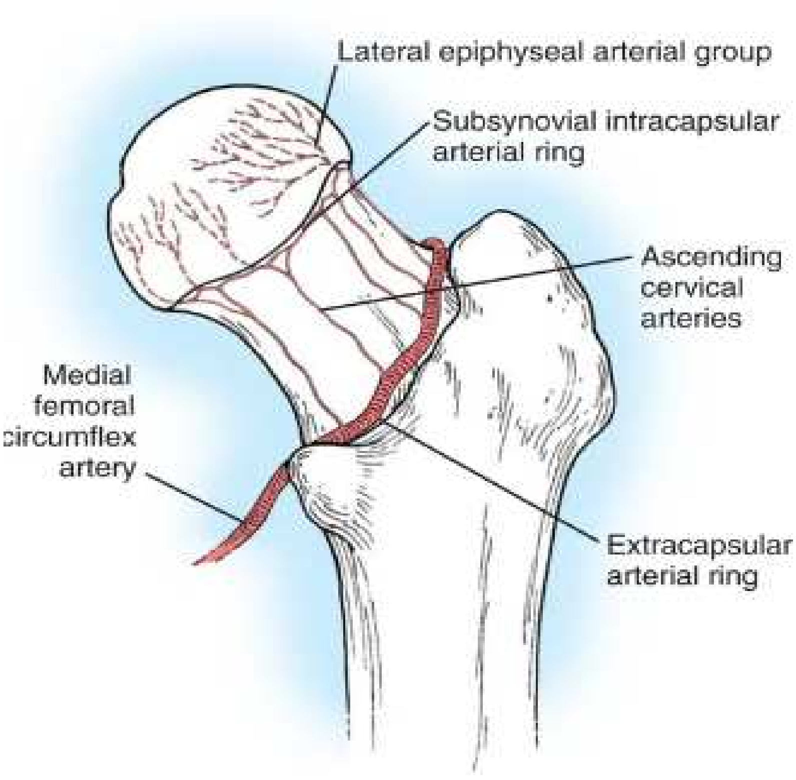


Figure 8:Blood supply to femoral head

There are two important anastomoses around hip joint namely,the cruciate and trochanteric anastomoses formed by branches between profunda femoris and gluteal vessels.The trochanteric anastomoses is major blood supply to head of femur.

The hip joint is supplied by femoral nerve and its branches,the obturator nerve,superior gluteal nerve,and the nerve to quadratus femoris.

Muscles and movements[8]:

Flexion is produced mainly by iliopsoas . Pectineus, rectus femoris and sartorius assists in flexion. The adductor longus muscle helps in initiation of flexion from full extension.

Extension is produced mainly by gluteus maximus and the hamstrings. Gluteus maximus becomes active during climbing or arising from bending position as during extension of thigh against against resistance.

Abduction is produced mainly by gluteus medius and minimus.Tensor fascia latae and sartorius assists in abduction. These muscles periodically contract during the phases of the walking or running.

Adduction is produced mainly by adductor longus, brevis and magnus.Pectineus and gracilis assists in adduction.

Medial rotation is produced by tensor fasciae latae and the anterior fibres of gluteus medius and minimus. Limitation is by lateral rotators, ischiofemoral ligament and the posterior part of the capsule. It is weak action.

Lateral rotation is produced mainly by obturators, the gemelli and quadratus femoris. Gluteus maximus,piriformis and sartorius assists in its action. Limitation is by medial rotators and the lateral band of the iliofemoral ligament.It is a powerful action.

FRACTURES OF THE FEMORAL NECK[10]:

Fractures of the neck of femur remains an unsolved fracture to orthopaedicians with regards to treatment and its results.With increase in geriatic age group as life expectancy is increased with each passing decade,there is an increased number of hospitalized patients with neck of femur fractures.

The majority of fractures occur in elderly female patients. The usual cause is a trivial fall with transmission of an applied force to the femoral neck through the greater trochanter, producing the fracture. Another mechanism is external rotation of the leg with increasing tension in the anterior capsule and iliofemoral ligaments. As the neck rotates, the head remains fixed and a fracture occurs resulting in posterior neck comminution observed in many fractures. The usual site of the fracture is the weakest part of the femoral neck, just below the articular surface.

Majority of neck of femur fractures in young patients is due to high energy violence and has associated injuries.Incidence of osteonecrosis an nonunion is higher in them.Outcomes are based on the the injury pattern, extent of displacement, comminution, adequacy of reduction and fixation.

Majority of femoral neck fractures are intracapsular.Intracapsular fractures are associated with delayed healing and non union due to angiogenic inhibiting factors in synovial fluid , lack of periosteal layer in neck and delicate vascular supply to femoral head.

The Garden classification is the most common classification for displaced neck of femur fractures and is based on degrees of displacement. In his classification, the direction of the medial compression trabeculae arising from the calcar to the weight bearing dome of the femoral head superiorly indicate the degree of rotation of the fracture in the anteroposterior radiograph. These trabeculae normally lie in alignment with their projections in the pelvis and form an angle of 160 to 170 degrees with the medial cortex of the femoral shaft and also align with similarly oriented trabeculae in the acetabulum. On the lateral view, the trabecular alignment from the head to the neck fragment normally should be 180 degrees. Angulation of the head fragment into more anteversion or retroversion affect the alignment of these trabeculae.

The Garden I fracture is a valgus impacted fracture. The fracture is incomplete with a lateral fracture line that does not breach the medial cortex.

The Garden II fracture ,the fracture is complete but undisplaced, and trabecular lines in the head are colinear with the acetabulum and the femoral neck distal to the fracture.

The Garden III fractures are incompletely displaced fractures. The femoral head has not lost contact with femoral neck, but the head is varus and extended position, resulting in angulation of the trabecular lines.

The Garden IV fracture is completely displaced, and trabecular lines line up as the femoral head returns to a neutral position with the acetabulum. The femoral neck has lost contact with the head and rotates externally, so the trabecular lines in the neck are not colinear those within the head**.**

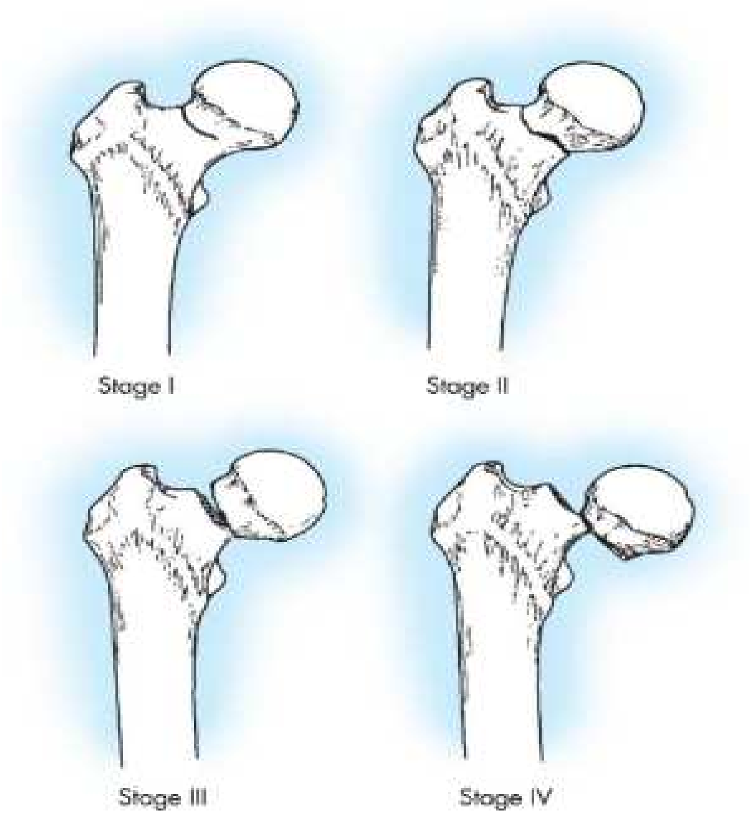


Figure 9:Garden classification of femoral neck fracture

HISTORY OF TOTAL HIP REPLACEMENT AND PROSTHESIS:

Gluck reported first THR with acetabular and femoral components made of ivory cemented to bone.[11]

Kenneth Mckee modified metal on metal arthroplasty,he mated the acetabular metal component to the Thompson prosthesis.He introduced cobalt-chrome alloy articulations.[11]

Watson -Farrar modified the neck to reduce impingement but has high incidence of complications due to poor implant design and implant placement with poor aseptic techniques.[12]

Ring developed first uncemented metal prosthesis with a metallic acetabular shell with screws articulated to cementless Moore prosthesis.[12]

Tronzo modified it by replacing screws with one large and three small prongs driven into acetabulum to prevent rotation.[12]

Fig10 :Mc Kee-Farrar(A) and Ring prosthesis(B)

Sir John Charnley[13,14,15] introduced the concept of ' low friction torque arthroplaty' and 'self curing acrylic cement'.He gave concepts of lubrication,materials,design trochanteric osteotomy,asepsis and operating room hygiene.He determined that coefficient of friction of steel ball to Teflon was close to normal joint and use of 22.225mm diameter head reduce the frictional torque. The central concept of 'low friction torque arthroplasty' is procedure of cementing,use of 22.225mm head,metal on polyethylene articulation and trochanteric osteotomy.

Fig11 :Sir John Charnley & his concept of low friction torque arthroplasty.

The size of head is important as increasing the size leads to increased range of motion.A 22mm head provides 90 degreesof motion,while 32mm head provides 106 degrees of motion.Range of motion is also increased by chamfering the acetabular cup or by decreasing the depth of acetabular cup.

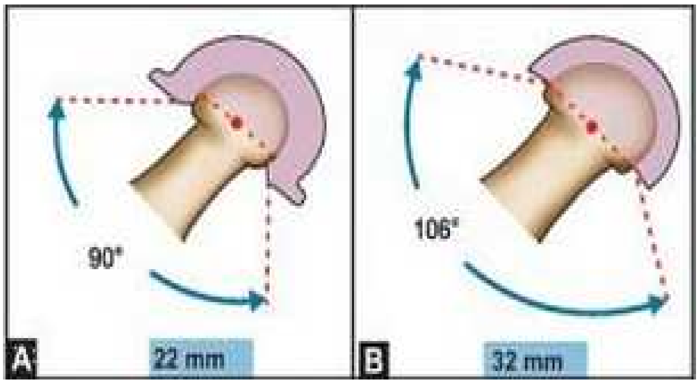


Fig 12 :Increasing head size increases range of motion.

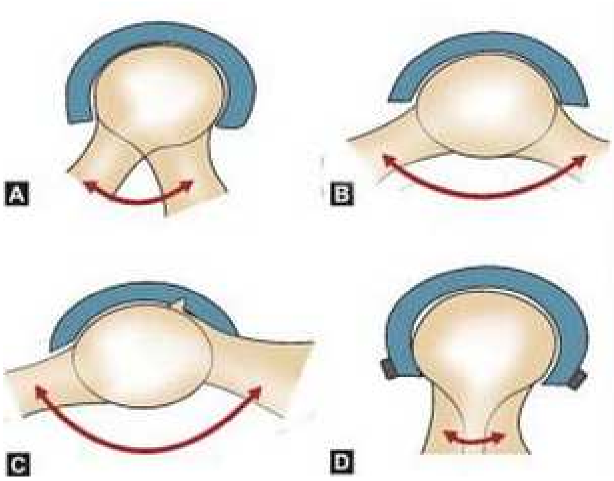


Figure13 :(A) Shallowing the acetabulum(BandC)chamfering of acetabulum increases the range of motion.

Total hip arthroplasty has been revoltionzed in the field of both acetabular and femoral components:

CEMENTED ACETABULAR COMPONENTS[11,16]:

The cemented cups are made of thick walled polyethylene. Vertical and horizontal grooves on external surface increase the stability.Newer cups have PMMA spacers of 3mm,provide uniform cement mantle and avoid bottoming out,which results in a discontinous cement mantle at summit of cup.

Figure14 :Cemented acetabular cups.

CEMENTLESS ACETABULAR COMPONENTS[16,17]:

Cementless stem were introduced to increase the longevity and reduce the incidence of aseptic loosening.

Press fit cups such as Mathys hemispherical cup and Spitorno hip system was developed initially with ealy good results but longterm results are unsatisfactory.

Most current acetabular sockets are now porous coated ingrowth cups ,especially hydroxyapatite coated to facilitate bony ingrowth.The cups are held in place by 6.5mm cancellous screws but drawback is fretting. The liner may be metal ,polyethylene or ceramic.the outer diameter of it matches the shell and inner diameter vary with head size.

Figure 15 :Hydroxyapatite coated acetabular cup.

CEMENTED FEMORAL STEMS[11,13-15,17]:

Mckee-Farrar and Charnley stems were the first cemented femoral stems.Although newer designs came,Charnley's still remains the standard.

Design features of a successful cemented stem must be wedge shaped,and have a broad medial border proximally and broad lateral border distally.All stems are now straight distally but degree of proximal curve varies.Excessive proximal curve should be avoided to prevent cement overhanging proximally an laterally,as it leads to difficult revision.No difference between collared and collarless stem with regards to load transfer and subsidence,but collar may be useful in determining version.

Stems may be textured or polished.Polished stems have longer life and produce compressive forces towards the bone cement interface than shear forces in matted finish.No benefit of porous coating as loosening occurs at the bone cement interface.Any metal can be used in cemented stems , but modern designs use cobalt chrome alloy as modulus of elasticity is higher which reduces the stresses in proximal cement mantle and reduces the incidence of fracture in bone cement.

Figure16 :From left to right: Charnley flatback,Second generation round back,third generation,flanged cobra stem,triple taper C-stem.

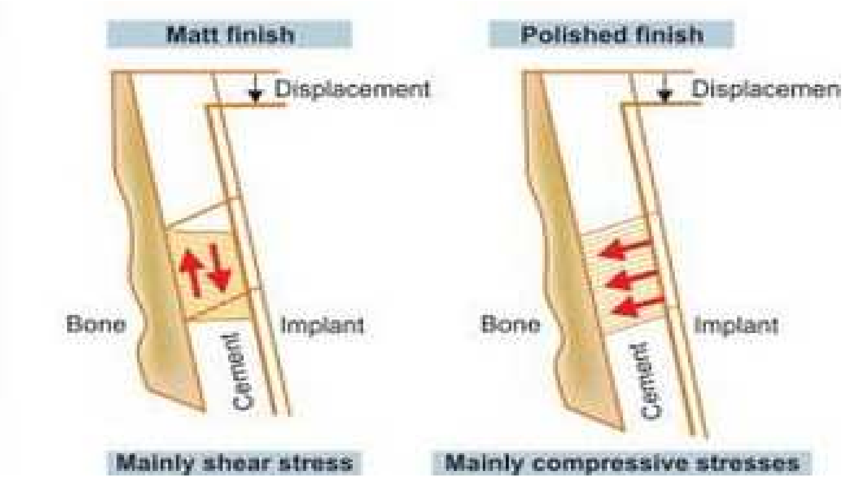


Figure 17 :Shear forces at matt finished and compressive forces in polished stems.

CEMENTLESS FEMORAL STEMS[11,17-19]:

Osteointegration is the basis for cementless fixation.It is the process of attachment of lamellar bone to the implant surface without intervening soft tissues[20].This process takes 4-12 weeks after implantation as long as 3 years[21,22].A good and adequate bony contact along with firm fixation of implant to avoid micromotion is essential for osteointegration[21].Micromotion <20µm leads to bone formation,40-150µm to fibrous and bony formation,>150µm to fibrous tissue formation.[23-25]

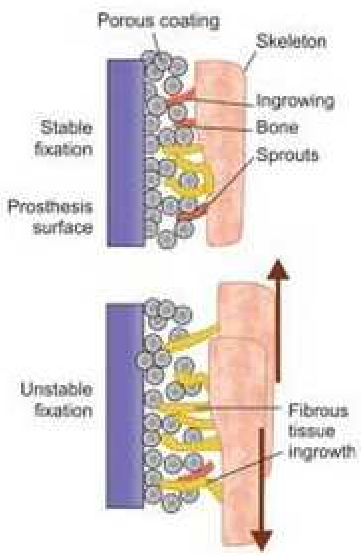


Figure18:Stable fixation is needed for bony ingrowth.

Three types of cementless stems:

1)Press fit stems 2)Macrointerlock fixation 3)Metal coatings(bioinert and bioactive)

Press fit stems:

These stems calcar support or wedge fit.Moore is calcar support and others are wedge fit stems.If collared stem is used,implant would be unstable either if stem becomes wedge fit before collar touches calcar or collar touches the calcar before stem becomes wedge fit.The disadvantage of coventional press fit stems is sizing as medullary canal sizes vary with individuals and thus large number of sizes of implant needed.

These implants can be metaphyseal or diaphyseal fit.Metaphyseal fit is better as proximal end of femur supports the vertical load and torsional resistance and distal end resist toggling.

Macrointerlock fixation:

Press fit is supplemented by mechanical interlocking either with steps,ribs,threads,dimples,flutes or wings.

Metal coatings(bioinert and bioactive):

Ingrowth is formation of bone inside porous surface and Ongrowth refers to bone growth on roughened surface.It depends on the coatings and surface characteristics of implant.Pore size of 50-100μm and porous metals,sintered beads and fibre mesh are essential for bone ingrowth[20,26].Ongrowth surface are made by grit blasting and plasma spraying.These porous coated stems are bioinert and its stability depends on initial press fit.

Regarding the extent of coating,most support circumferential porous coating of porous implant,as extensive porous coating is associated with increase in stress shielding and thigh pain. Proximal coated stems can be cylindrical or tapered.Tapered stems permit proximal loading and produce constant stress along their length.Cylindrical stems have gradient with high stress in distal than proximal causing stress shielding.

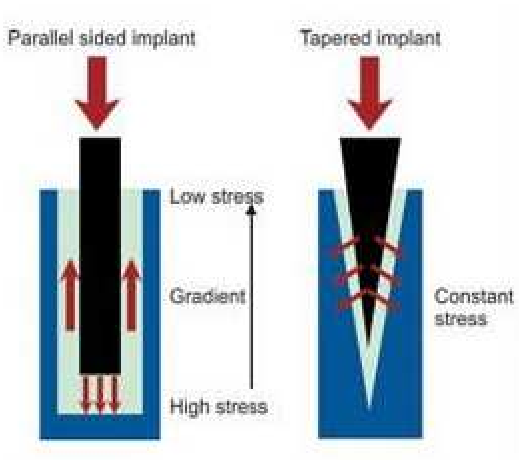


Figure 19 : Stress effect in cylindrical and tapered stems.

Bioactive coatings such as hydroxyapatite stimlate bone growth due to its osteoconductive property[27,31].Optical thickness of hydroxyapatite is 50µm and laid on rough surface.[27-30]

Figure 20 :HA coated Corail system

Cementless stems are either straight or anatomical.Anatomical stems with inbuilt version are side specific and straight stems are not side specific.

Khanuja et al[32] classified cementless stem into six types based on shape,osseous contact and progression of stem fixation from proximal to distal.

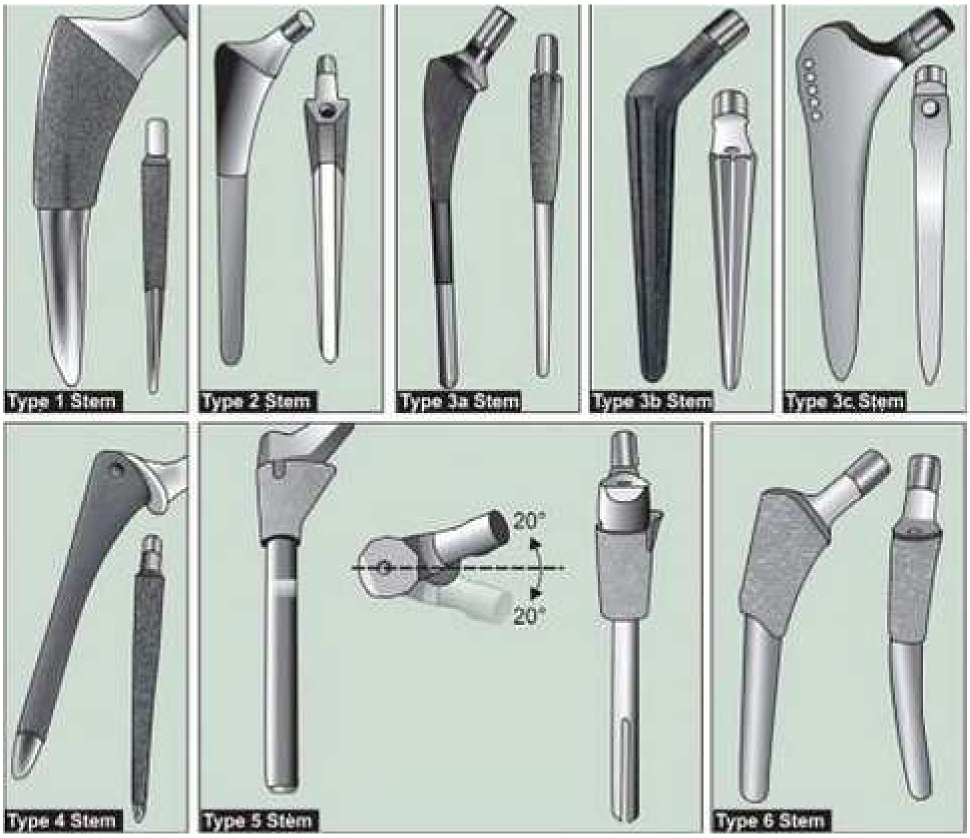


Figure 21 :Classification of cementless stems

Type 1-3 are tapered stems and designed for proximal fixation.

Type 4 fully coated stem to obtain distal fixation

Type 5 Modular stems with separate metaphyseal and diaphyseal components.

Type 6 Curved anatomic stems.

BIOMECHANICS OF HIP[33]:

The human hip undergoes cyclic loading during ambulation and place forces three to five times of body weight on the prosthetic components. During strenuous activity, running or climbing, the joint is exposed to much greater forces- 12 times of body weight.

Forces acting on the hip joint was described by , the body weight depicted as a load applied to a lever-arm extending from body's centre of gravity to the centre of the femoral head. During a single -legged stance, the abductor musculature depicted as lever arm extending from lateral aspect of greater trochanter to center of femoral head should produce an equal moment to hold the pelvis level and a larger moment to tilt the pelvis to the same side while walking or running.

The ratio of the length of the lever arm of the body weight to the abductor musculature is 2.5:1, so during single leg stance the abductor muscles must exert 2.5 times the body weight to maintain the pelvis level. During stance phase of gait, the estimated load on femoral head is equal to the sum of the forces produced by the abductors and the body weight and is three times the body weight. The load on the femoral head during straight leg raising is also same .

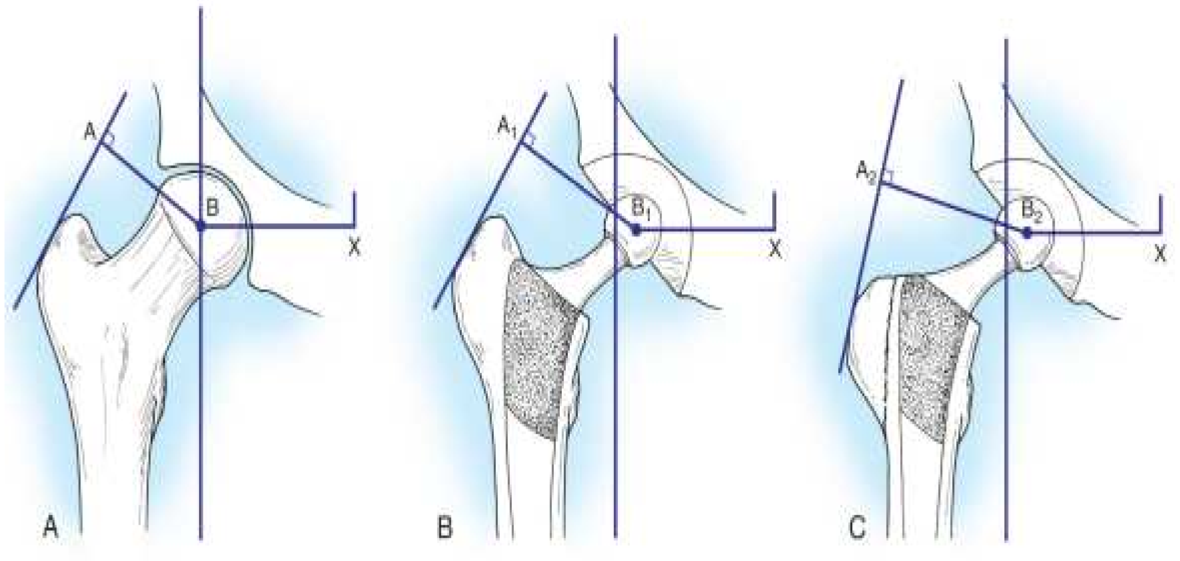


Figure 22: Lever arms acting on hip joint. **A**, Moment acting on body's center of gravity by body weight , X, acting on lever arm, B-X, should be counterbalanced by moment produced by abductors, A, acting on lever arm,A-B. **B**, Use of high offset neck lengthens lever arm A-B Medialization of acetabulum shortens lever arm B-X, and. **C**, Osteotomized greater trochanter reattached laterally and distally lengthens lever arm A-B further and tightens abductor musculature

In arthrits and other disorders of hip where there is partial or total loss of head or the neck is shortened ,the abductor lever arm is shortened and the ratio of the lever arm of the body weight to the abductors became 4 : 1. This lead to a decrease in moment produced by body weight and the counterbalancing force of abductors is also decreased. We can surgically reduce the total hip load by 30% by altering the length of two lever arms by achieving a ratio of 1:1.

The forces on the hip joint act both in the coronal plane, and also sagittal plane as the body center of gravity is posterior to the joint making the stem to bend posteriorly. The forces acting in the sagittal plane is increased, when we flex the loaded hip ,during using stairs ,arising from chair and during an incline. These forces acting in both planes produce torsional effect to stem.

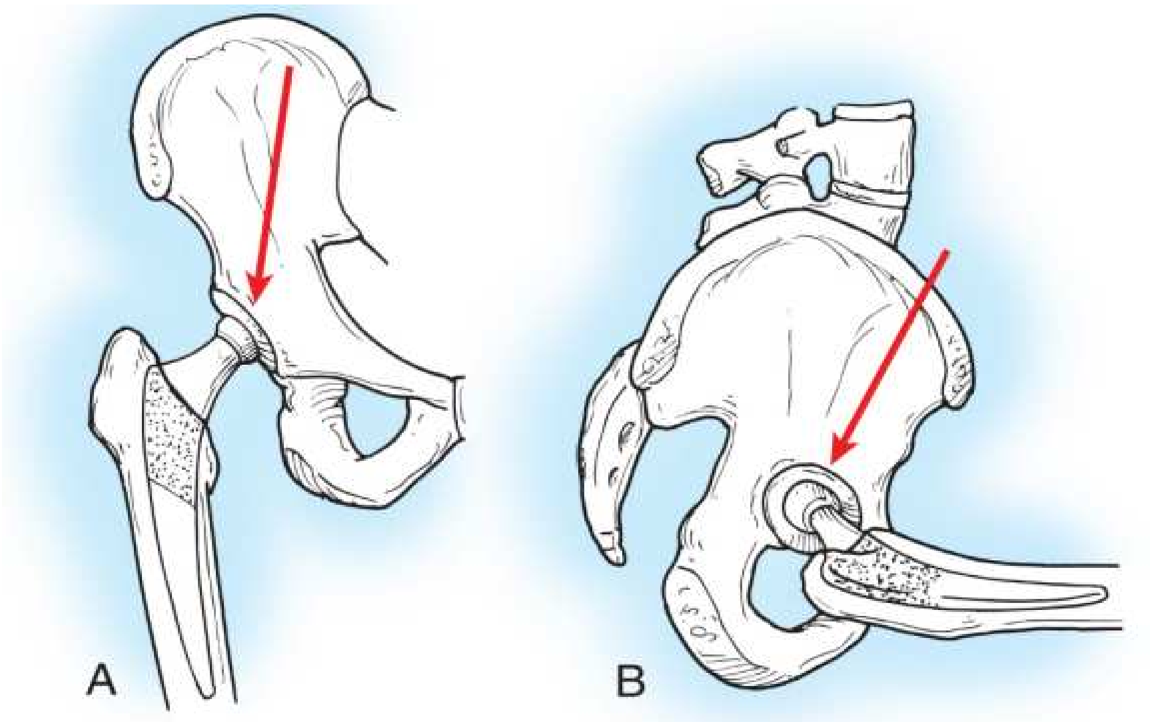


Figure 23: Forces causing torsion of stem.**A**. Forces acting on hip in coronal plane deflect stem medially, and **B**,forces acting in sagittal plane deflect stem posteriorly, during lifting with hip flexed.Both forces lead to torsion of stem

During normal gait , forces acting on the femoral head are 15 to 25 degrees anterior to sagittal plane of prosthesis causing retroversion or posterior deflection of stem. Increasing the proximal width of stem produce better fixation in metaphysis and also increase the torsional stability.

Davy et al [34] found that , during static single stance phase the hip contact force was 2.1BW and 2.6 to 2.8 BW during the stance phase of gait.During straight leg raising and stair climbing there is an increase in out of plane forces. At peak loads, the angle of the resultant force was 30° to 35° to the neck of the prosthesis and 20° posterior to the plane of the implant (Figure 18 Resultant force R). Out-of-plane loads (such as getting up from chair) produce torque and tends to rotate the femoral stem about its axis .

Walking and Jogging [34]:

The forces acting on the hip joint vary with speed of walking from 3.0BW at slow pace to 4.5 BW at 5km/h; below 1.0BW during swing phase and 5.0BW during jogging . The largest component of the hip force is along femoral axis (-Fz) ,a downward component . The component -Fx is less than half of -Fz and acts on femoral head medially. The backward-acting force component (-Fy) is considerably low and reach 1.0 BW during fast walking

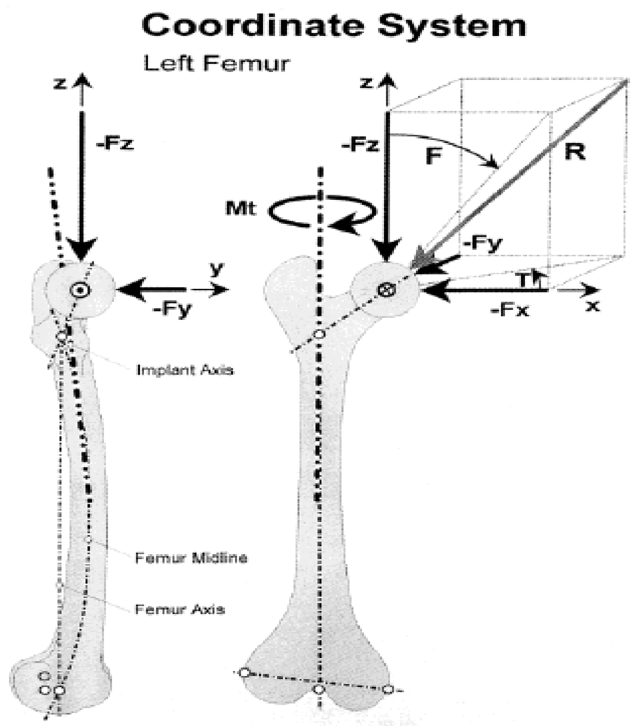


Figure24: The coordinate system. x,y and z axis represent the axis of knee, walking direction and axis of femur.Fx, Fy, and Fz represent the direction of force components acting towards head of femur. Resultant force as R. The load direction in frontal and transverse plane as Fand T. Mt- the torsional moment.

During analysis, two patients stumbled,their hip joint forces were recorded to be 8.7BW (Fig. 20). Stumbling and all unplanned activities produced heavier loads on a prosthesis than normal activity. So,patients with uncemented hip arthroplasties with uncemented stems, should be careful during walking.

SOFT TISSUE BALANCING IN TOTAL HIP REPLACEMENT:

The soft tissue envelope that surrounds the hip acts as constraint that prevents head from subluxating or dislocating out of the acetabulum. Therefore preservation and adequate balancing of these structures are important when a THR is performed.Postoperative pain in total hip replacement is caused by failure to achieve soft tissue imbalance and abductor malfuction even in radiologically well fixed components.A proper soft tissue balance consists of restoration of hip biomechanics by restoring the center of rotation (by reproducing the offset and limb length),implanting the component in optimum position,minimizing impingement and stability and addressing soft tissue contractures around the hip.

Importance of Femoral offset[35-40]:

Femoral offset is the distance between the centre of femoral head and a line drawn perpendicular to the center of femoral canal[35]. The hip joint acts as a fulcrum between the body weight and opposing hip abductors[36,37]. A dynamic equilibrium exists between them in keeping the pelvis level and thereby prevents Trendenlenberg lurch.The lever of hip abductor muscles is less than the lever arm of body weight body keeping the hip abductors at mechanical disadvantage.Thus abductors must generate a force greater than body weight for equilibrium.Studies have shown that this can translate into higher joint - reaction forces in THR if the femoral offset is not restored[39].

Figure 25:The hip joint acts as a fulcrum between the body weight (W)and the opposing hip abductors(M).The lever of hip abductors (B) is less the lever arm of body weight(A). Resultant joint reaction force as R. x,y as vectors of forces in horizontal and vertical directions.

When femoral offset is increased, the lever arm of abductor muscles is increased and thus reduces the abductor muscle force required for normal gait. This minimises the resultant reactive forces across the hip joint and results in lower rates of polyethylene wear .The increase in offset also improves the contractile efficiency of the abductors by increasing the resting length ,also decrease the femoro-pelvic impingement,improving soft tissue tensioning and stability[36].

A prosthetic design that decreases the neck-shaft angle will increase the offset with improved abductor tension but will decrease the limb length.This design has intrinsic limitations due to increased torsional forces at the bend that tends to rotate the femoral component especially during load transmission.

Davey et al[39] concluded that the strain at the bend increased in linear fashion with increasing offset.

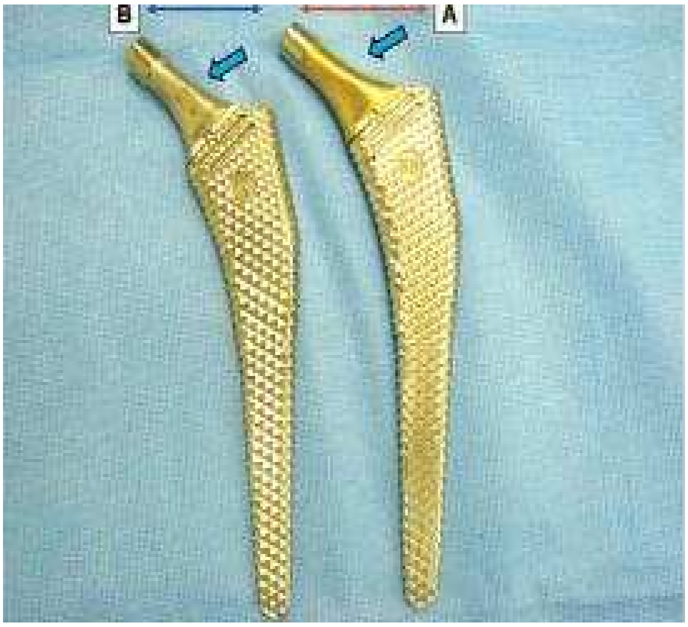


Figure26:The implant on right has lower neck- shaft angle and thus increased offset(A>B).However the overall length is slightly decreased by decreasing the neck-shaft angle.

The dual offset medialize the neck to increase the offset ,without affecting the length[40].The use of modular 'offset' or lateralized acetabular liners increase the offset while preserving the length.But the center of rotation is displace laterally and inferiorly ,increasing the body weight lever arm ,undesirable outcome.Thus used in cases of instability when surgeon used others methods to increase the offset The neck resection at lower level along with longer neck segment with a more distal femoral stem placement lateralizes femoral shaft without altering limb length.

Limb length discrepancy[41-47]:

Limb-length discrepancy is one of the most common cause of patient dissatisfaction after THR[41-47].LLD is common after THA with reported average discrepancy between 3-16mm[43,45].Generally LLD is well tolerated with only1/3rd of patients noticing the difference and only half of these finding it bothersome.

The boundary between acceptable and unacceptable levels of LLD remains undefined. A true LLD of more than 1.5cm may be a concern as it can cause functional impairment(abductor weakness),back pain,hip pain,early fatigue,awkward gait,imbalance,sciatica,numbness,instability,aseptic loosening,and occasionally revision surgery[41-47].When limb is lengthened 4cm,significant nerve injury may be seen in upto 28 percent of patients[47].Edwards et al[47] noted an average lengthening of 2.7cm for peroneal nerve palsy and 4.4cm for sciatic nerve palsy.

Preoperative templating and intraoperative measurements are essential.the patient should be counseled that the goal of surgery initial fixation and stability and accept that some lengthening may be needed to achieve this.If an unacceptable real LLD occurs postoperatively,it is important to recognize it and treat it properly.The options include shoe lift on contralateral side or shortening the operated side by using stems with an increased offset,using modular implants,component repositioning,medializing or superiorizing the hip center,using offset acetabular liners,performing trochanteric osteotomy or using constrained liners to achieve stability.

POSITIONING OF COMPONENTS:

Implant malposition is an important cause for instability,dislocation, impingement,accelerated wear and failure of the THR.Significant changes in pelvic orientation and position occurs during the lateral position intraoperatively.Fixed bony landmarks are independent of patient positioning ,in contrast to external aiming devices ,and should be used during surgery to assist with the positioning of the components.Useful landmarks include transverse ligaments,distal tear drop(most distal and medial part of the acetabulum,behind the transverse ligament and at the superior border of obturator foramen),infracotyloid groove,lateral pubis,superior ischium,superolateral acetabulum,lesser trochanter,greater trochanter,center of femoral head and saddle of the neck.Computer navigation aids in identifying them.

The centre of rotation of hip affects the forces generated about the prosthesis. In a mathematical model, Johnston, Ber and and Crowninshield found that forces acting on hip were lower, if center of hip rotation was placed in the anatomic location compared with other positions. When hip centre was placed in a non-anatomic position, it is associated with increased incidence of radiolucency and migration of the components. The ideal femoral reconstruction reproduces the normal centre of rotation of the femoral head.

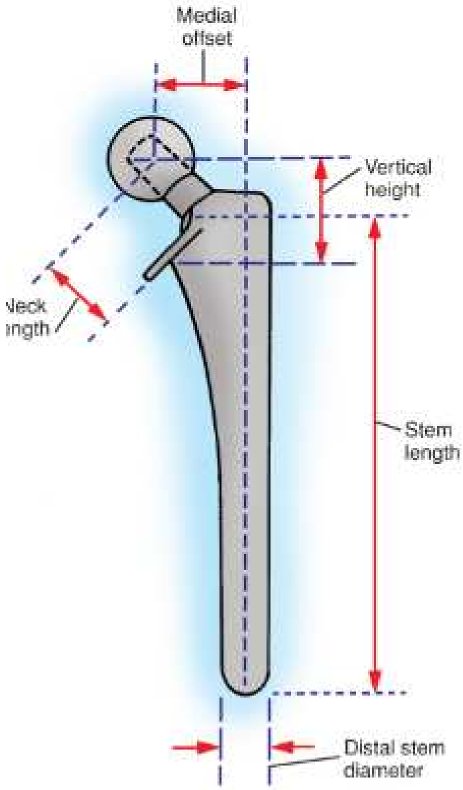


Figure27:Features of femoral component

The hip centre depends on 3 factors:

1. Vertical height 2. Offset 3. Version

The vertical height of the femoral head is the distance measured from the centre of the femoral head to a fixed point like the lesser trochanter. Restoring this length corrects the limb length discrepancy.

The medial offset is the distance measured from the centre of the femoral head to a line through femoral stem axis. Inadequate restoration of medial offset increase the jont reaction force,limp and impingement due to decrease in lever of arm of hip abductors. Although a slight increase in offset can be gained by varus placement of the stem, the adverse effect of this on fixation outweighs any potential benefits of such positioning.

Version refers to the orientation of the neck in reference to the coronal plane and is denoted as anteversion or retroversion. The normal femoral anteversion is 10 to 15 degrees and restoring of femoral anteversion is important for stability of joint. This has to be reproduced at the end of surgery. Retroversion leads to posterior dislocation and anterior dislocation after excessive anteversion.

Valgus and Varus Positioning:

A valgus position of the head and neck segment of the femoral component relative to the femoral shaft decreases the moment of bending and increases proportionately the axial loading of the stem. Though a mild degree of valgus usually is desired, it shortens the lever arm of hip abductors, tends to lengthen the limb, and the hip may dislocate superiorly, especially if the acetabular cup is too vertical.

A varus position of the head and neck segment increases the moment of bending and decreases the axial loading on the stem. This position lengthens the abductor lever arm but it must be avoided because the risk of stem failure and loosening is increased.

In general, a mild degree of valgus of the head and neck is preferred to any degree of varus; but the angle between the neck and femoral shaft should not exceed 140 degrees.

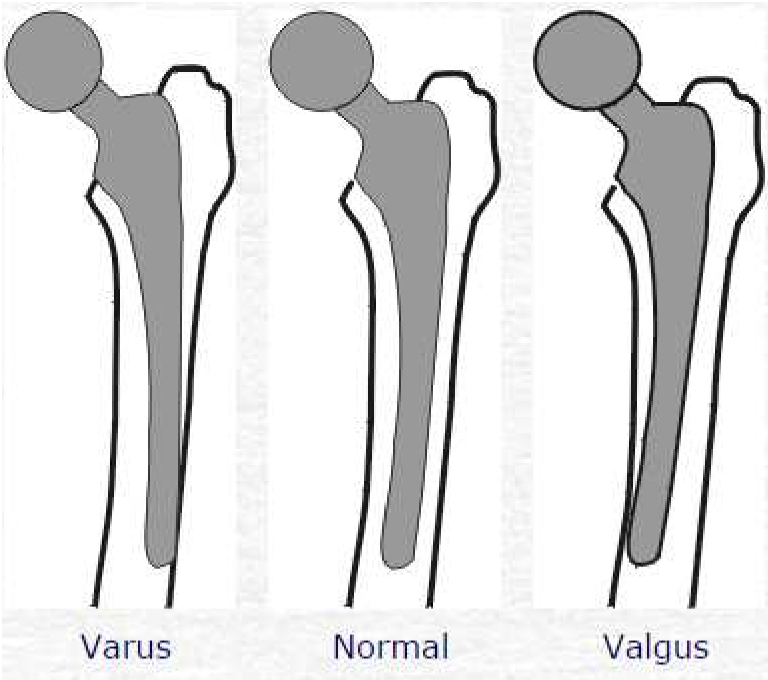


Figure 28: Positions for a total hip arthroplasty.

Multiple investigators defined a 'safe zone' of acetabular cup position,which is around 40 degrees+10 degrees of inclination and 15degrees+10 degrees of anteversion. The combined anteversion (the sum of acetabular and femoral version) is becoming more prevalant and has been recommended as 25-35 degrees for men and 35 -45 degrees for women.For achieving combined anteversion in uncemented femoral stem,the acetabular cup must be placed in relation to stem version.Thus, some surgeons advocate preparing the femur first(rather than conventional acetabulum first technique) to have an estimate of femoral anteversion so that,the cup be implanted in a position to achieve the target combined anteversion.

IMPINGEMENT:

Impingement can cause instability,increased wear,decreased range of motion,and unexplained pain. It depends on design of prosthesis, position of implant and biomechanical and patient factors.[48,51-55.]

A prosthetic head- neck ratio <2.0 increase the risk of impingement.The head -neck ratio depends on size of femoral head,geometry of femoral neck and skirted femoral head.An acceptable head-neck ratio is achieved by using large head and provides a margin of error for combined anteversion for stability.

Factors increasing the risk of acetabular impingement are the geometry of the rim of the polyethylene,presence of osteophytes,the extended-rim liner with incorrectly positioned hood.The hood should be placed posteroinferiorly (8'0 clock in right hips and 4'0 clock in left hips)as posterosuperior is the most commom site for impingement[48,55].The surgeon controls the positioning of the prosthesis and thus an optimal limb length,offset and soft tissue reconstruction will minimize the occurence of impingement.

Soft tissue impingement can be a source of pain in patients with a THR[48].A large acetabular component overhanging medially or anteriorly,an overtly large femoral head, or the impingement of lesser trochanter with the ischium can cause iliopsoas tendinitis.The capsule can impinge between neck of prosthesis and cup,or the greater trochanter and the ilium.

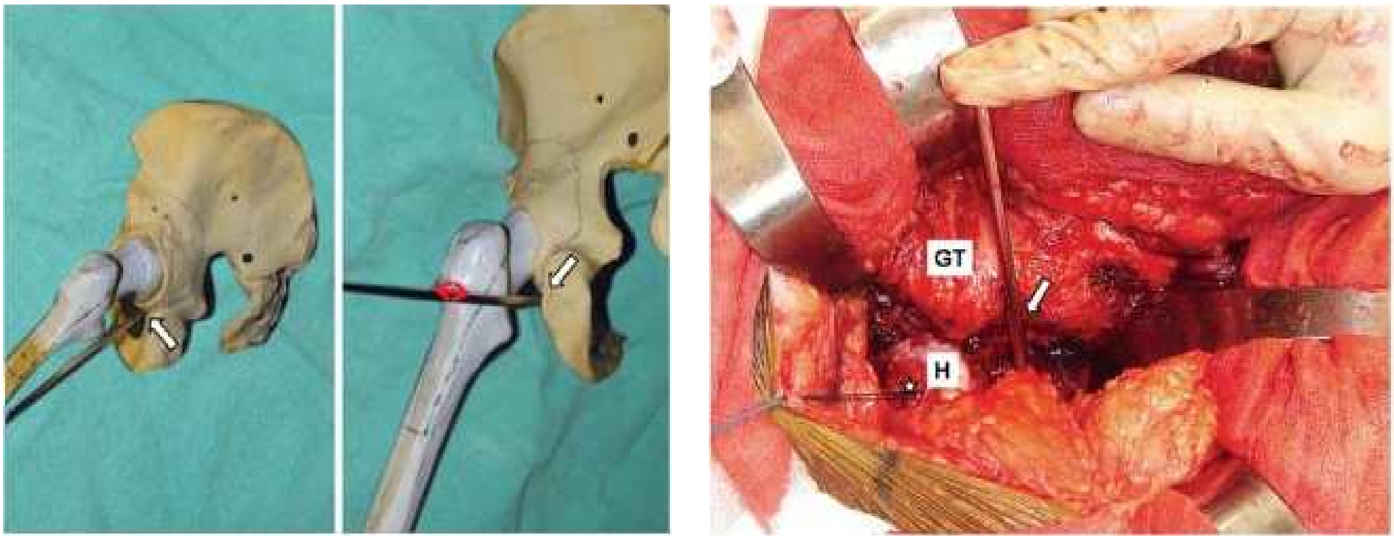
INSTABILTY:

The incidence after a primary THA is 0.2-7% and 10-25% for revision hips ,and the cumulative risk increases over time.An understanding of risk factors help minimize the risk of instability.Patient specific risk factors include female gender,older age,osteonecrosis,femoral neck fracture,dysplasia,prior surgery,obesity,a high preoperative range of motion,neuromuscular diseases and comorbidities,alcoholics and noncompliant patient. Similarly the surgical variables are the type of approach,design of prosthesis,implant position,size of femoral head,offset,soft tissue integrity,limb lengths,impingement,experience and case volume of surgeon.

INTRAOPERATIVE ASSESSMENT OF OFFSET,LIMB LENGTH DISCREPANCY,IMPINGEMENT,STABILITY AND SOFT TISSUE TENSION:

Intraoperative assessment depends on identifying the anatomic landmarks,patient positioning and its assessment before prepping and draping is crucial.The relative position of knees and feet with symmetrical flexion of hips and knees provide idea about the starting limb length relationship.Usually the superior side on lateral position normally appear slightly shorter due to adduction.

Ranawat et al[45,46] technique of intraoperative assessment ,using posterior approach with a lateral position.After initial dissection and release of short external rotators ,the inferior capsule incised to expose the posteroinferior lip of acetabulum.A Steinmann pin is inserted into the posterior infracotyloid groove,represents the groove inferior to the posteroinferior hip of acetabulum.The advantage of using this landmark is the close proximity of pin to the center of rotation of hip.The pin is placed initially at an angle of 60 deg until it touches the ischium and then made vertical and allowed to slide along the bone into the infracotyloid groove.



A B

Figure 29:A,model of hip joint showing position of steinmann pin in posterior infracotyloid groove and position relative to femur(red arrow).B,Intraoperative picture showing steinmann pin and its relative position to femur.GT:Greater trochanter;H:femoral head.

Keeping the pin vertical and viewing it end-on from above,a mark is made on GT prior to dislocation.The hip is then dislocated.

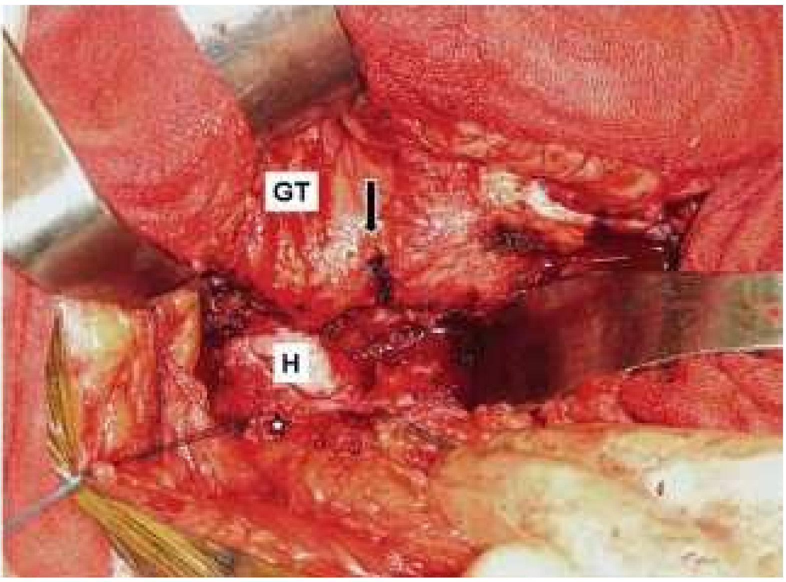


Figure30:Intraop picture showing marking on femur after removal of steinmann pin.This mark used for comparing limb length.

The CFH is marked on cautery,and its distance between the LT and GT(usually from saddle of neck)(offset)is noted and compared to the assessment done on preoperative templating.The neck resection is now completed based on preoperative templating.

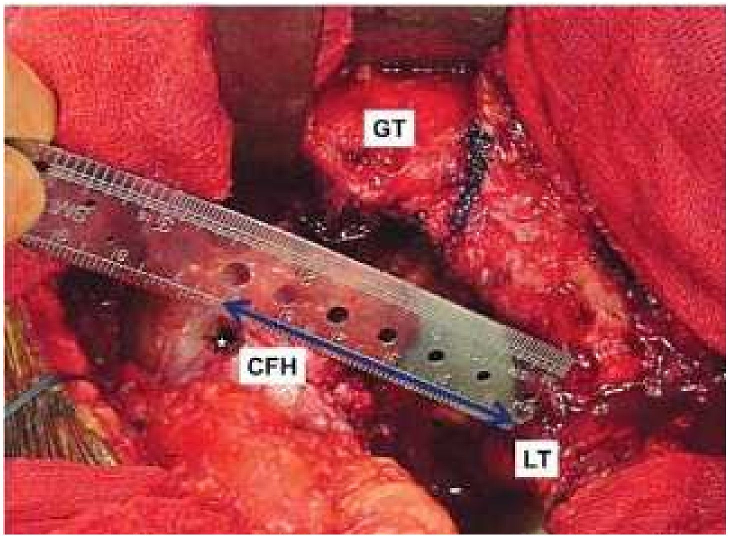


Figure 31:Intraopertive picture showing measurement between center of femoral head(CFH) and lesser trochanter(LT).Intraoperative measurement of limb length.

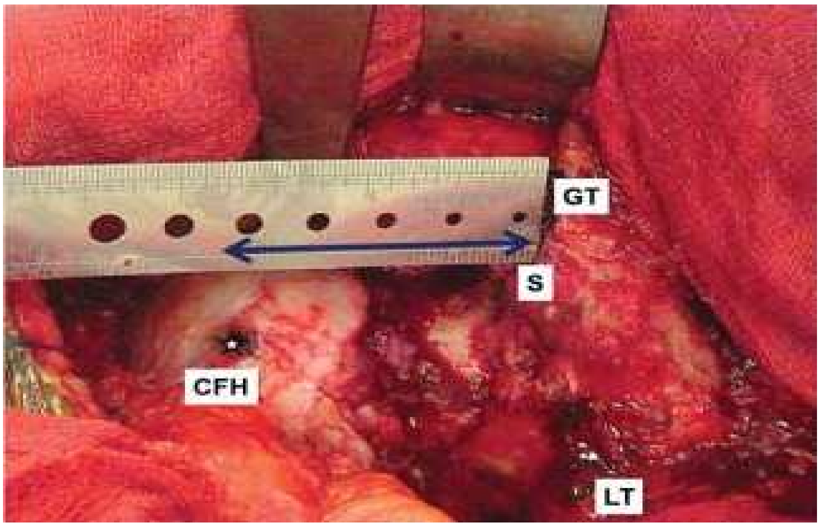


Figure 32:Intraopertive picture showing distance between saddle of neck(S)and center of femoral head(CFH).Measurement of Offset.

After bone preparation and placement of trial implants,distance from the CFH to LT and CFH to GT(offset)are reassessed and compared with pre-resection values.

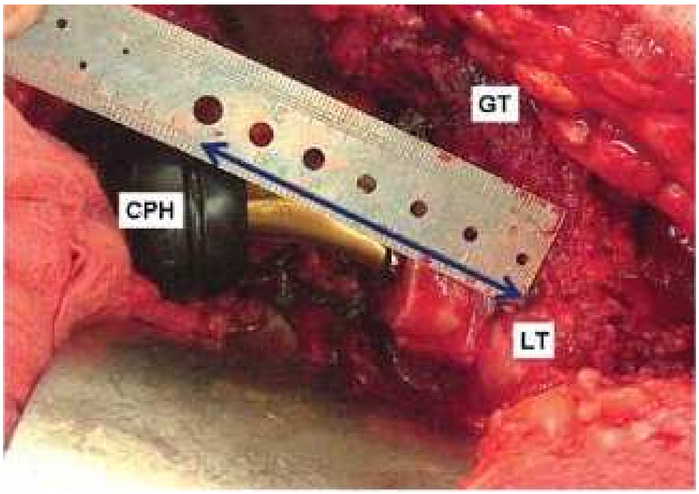


Figure 33:Intraopertive picture showing distance between center of trial prosthetic head(CPH) to the lesser trochanter(LT).compared to earlier distance for assessment of limb length discrepancy.

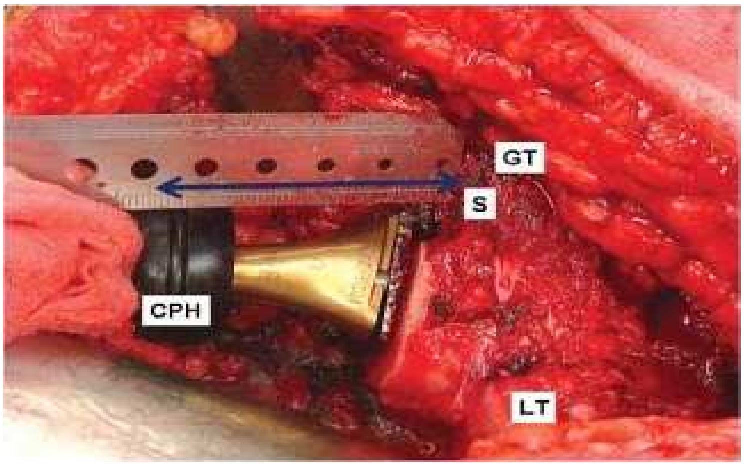


Figure34:Intraoperative picture showing distance between the saddle of neck(S) and center of trial prosthetic head(CPH).Compared to earlier distance for assessment of offset.

After trial reduction, the component position is assessed using the combined anteversion test.This test measures the angle of internal rotation required for the femoral head to be coplanar with the face of the acetabulum with 10 degrees of flexion and 10 degrees of adduction.

Figure 36:Introperative picture showing the clinical combined anteversion test.

The 'shuck test' used to determine the overall laxity.In general ,more than half of the femoral head should not disengage from the liner with direct axial traction.

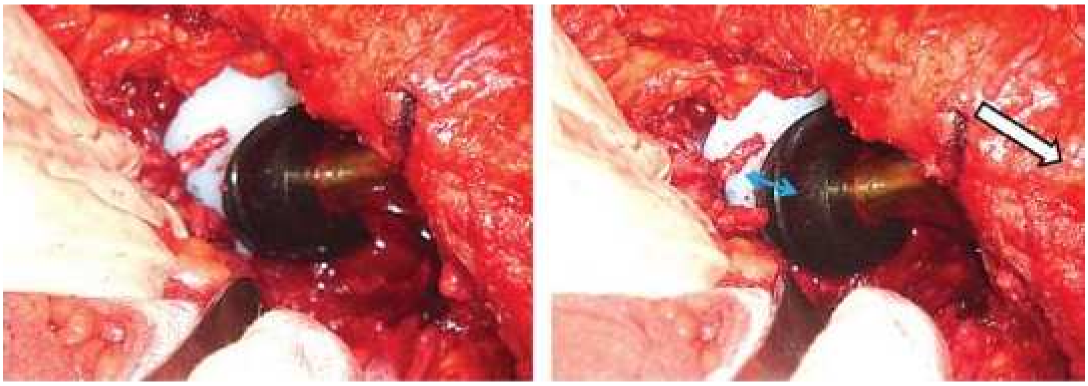


Figure 35:Shuck test-not more than half of femoral head disengage from liner.

Once adequate soft tissue balance is achieved ,Steinmann pin is reinserted,keeping the pin and leg in same position.The difference in limb length is measured noting whether the point on the trochanter has moved up or down indicating shortening or lengthening respectively.

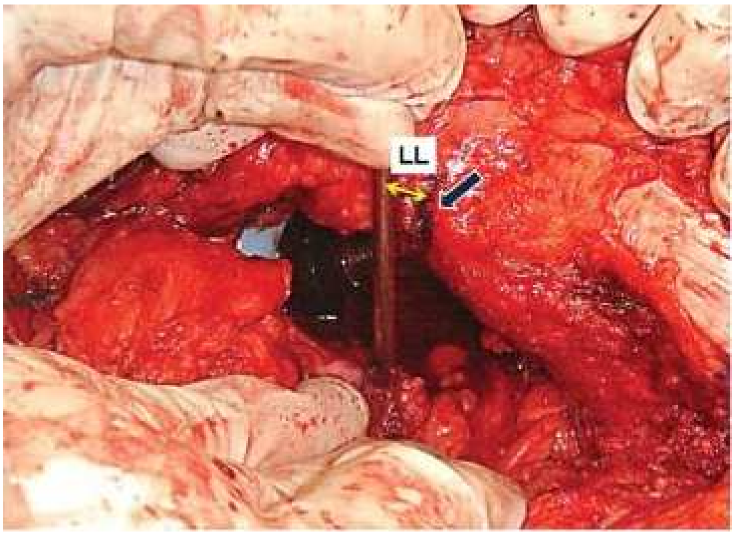


Figure 36:Intraopertive picture showing lengthening comparing the new position of Steinmann pin.

Assessment is made for bone-bone, metal-metal and bone -metal impingement.Offset can be determined by palpation of interval between the greater trochanter and the pelvis during movements of hip ,and clinically there should be a gap of atleast one finger breadth.Once the offset and limb length are optimized,there should be no impingement.The lesser trochanter should not impinge with the ischium in full extension of limb, and also proximal to tip of ischium by atleast one finger breadth .The GT should not impinge the ilium in flexion, adduction and internal rotation or in external rotation and abduction.The neck of prosthesis should not impinge with the the cup at physiologic range of movements..If this cannot be done , the offset may be inappropriate and increase in head/neck size is done.If limb length is correct and implants are placed in good position but there is an impingement or instability ,then a decision to increase the limb length using a high/dual offset implant,lateralized polythene or transfer of GT need to be made.

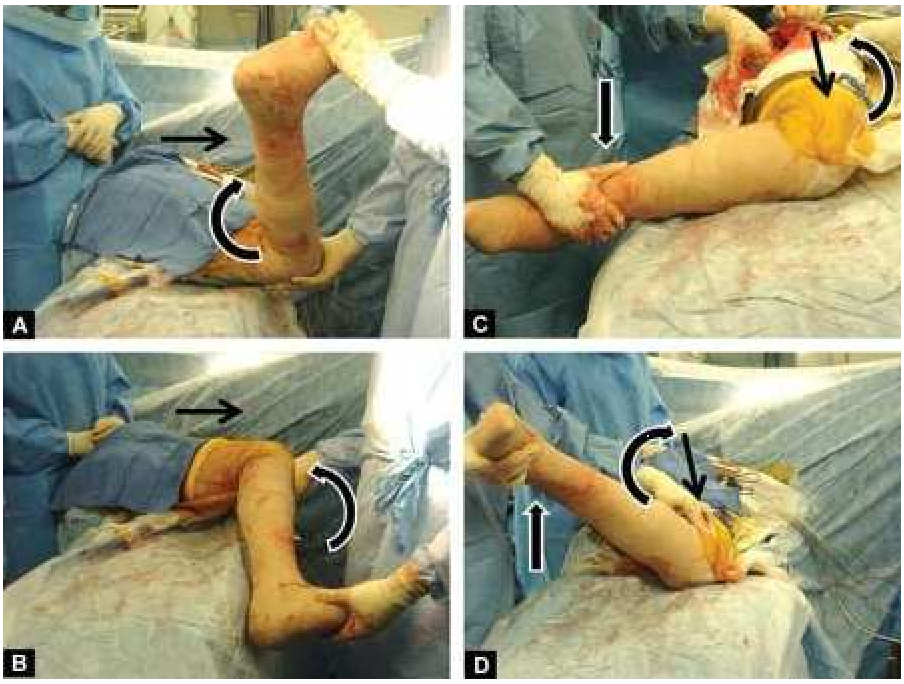


Figure 37:Intraopertive picture showing assessment of impingement and stability at various range of motion of hip.A,Flexion with internal rotation;B,Flexion with external rotation;C,Extension with external rotation;D,Extension with Internal rotation.

POST -OPERATIVE RADIOGRAPHIC ASSESSMENT OF CUP VERSION,OFFSET,LIMB LENGTH DISCREPANCY,FEMUR ANTEVERSION AND COMBINED ANTEVERSION:

The postoperative radiograph is used for analyzing the component position and alignment of total hip replacements. The anteroposterior radiograph of hip was taken with patient in supine position and beam centered over the pubic symphysis. The measurements made on anteroposterior view were acetabular inclination, lower limb length, horizontal offset, center of rotation, and stem angle - valgus/varus.

Planar anteversion is angle of plane passing through the opening of the cup in relation to the parasagittal plane of the trunk. Anterior tilt of this plane represents anteversion and posterior tilt is retroversion.Inclination can be easily measured in anteroposterior radiographs,whereas anteversion is more difficult to measure.

Measurement of anteversion of acetabular component on AP radiographs[56]:

Lewinnek's method[4]:

D1 is the distance across the short axis of an eclipse drawn perpendicular to the long axis of acetabular component.D2 is its maximum diameter.

Widmer's method[57]**:** S is the short axis of ellipse and TL is the total length of the projected cross section of the component of short axis.This method shows linear correlation for values of S/TL between 0.2-0.6.

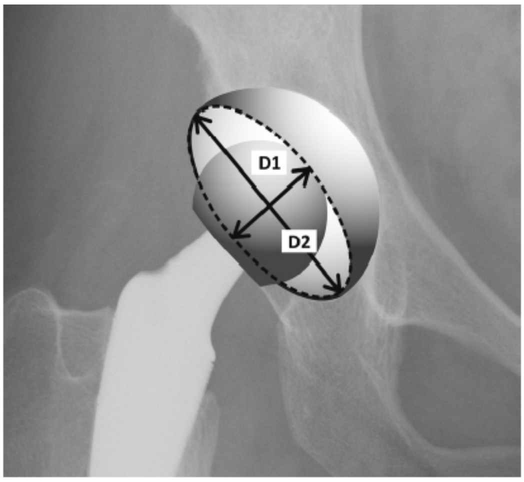
Liaw's Method[58]: β is the angle formed by long axis of component(the line from point A to B) and the line connecting the top point of ellipse and the endpoint of the long axis(the line from point A to C).

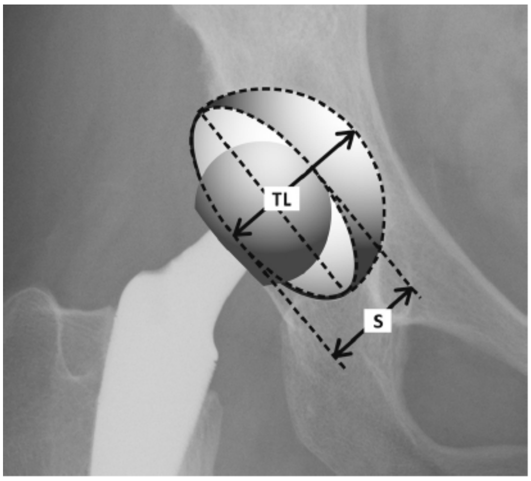
Pradhan's method[59]: D is the maximum distance across the long axis of the ellipse of the component.A line is drawn perpendicular to the long axis and intersecting the rim of the component,beginning at a point one-fifth of the total distance of the longitudinal plane.P is the distance along this perpendicular line from thelongitudinal line to the rim.

Measurement of anteversion of acetabular component on cross table radiographs: Woo and Moorey's method[60]: Anteversion is measured as the angle formed between a vertical line and long axis of base of ellipsoid projection of component.

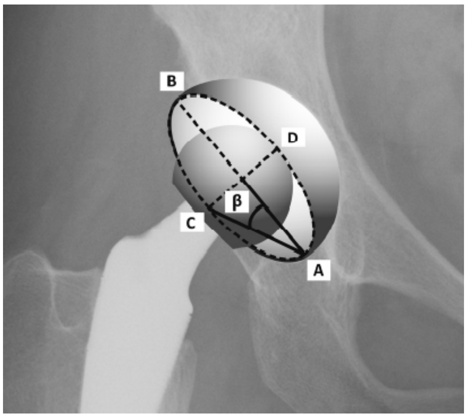
Marx et al[61] compared the accuracy of the five plain radiographic methods with CT measurements and concluded that Widmer's method had a smaller rate of errors than the others but that measurement of anteversion using plain radiographs was inaccurate due to variety of errors.

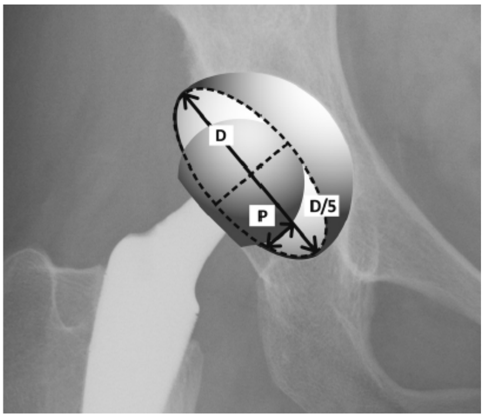
Fig 38



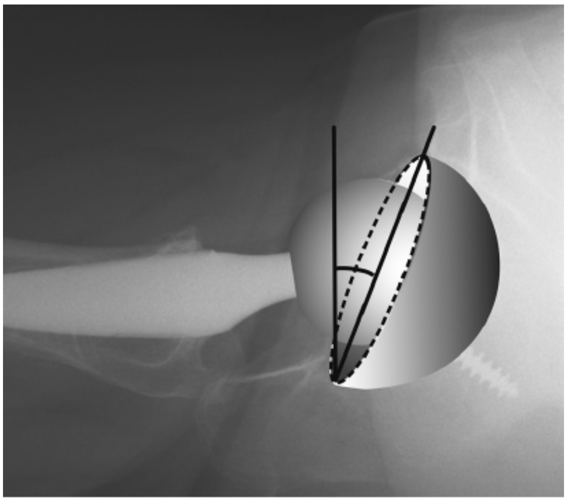


a.Lewinnek[anteversion=arcsin(D1/D2)]   b.Widmer anteversion=arcsin[S/TL]





c.Liaw anteversion=sin-1tanβ   d.Pradhan anteversion=arcsin(P/0.4D)



e)Woo and Moorey method

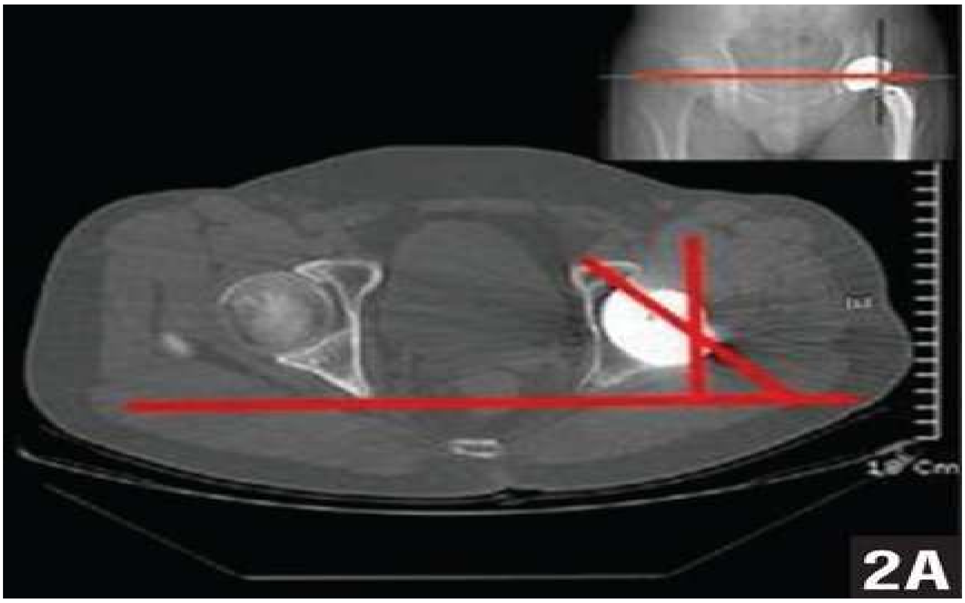


Fig 39:Measurement of inclination and anteversion of acetabular component on CT scan:

After correcting malposition of pelvis in rotation and abduction/adduction pelvic images were obtained. The angle between the line connecting the two points of the edge of the acetabular component and the inter-teardrop line was measured as radiographic inclination.

In order to evaluate anteversion, a plane was created which was orthogonal to a line drawn from the medial edge of the component to its lateral most point.In this plane ,the angle between a line perpendicular to the functional coronal plane and the tangential line across the open face of the component was measured as radiographic anteversion.

Lewinnek et al proposed the safe zone of acetabular component as 40°±10° of inclination and15°±10° of anteversion (AV) and showed a four fold increase in dislocation rate outside this zone.

Measurement of Acetabular inclination[62]:

Acetabular inclination is measured by measuring the angle between line (X) connecting the lateral and medial margins of the cup with the interteardrop line (A)drawn between the right and left teardrops.(fig 42)

Mesurement of Limb length discrepancy[62]:

Two line (B1 and B2) were drawn perpendicular to the interteardrop line connecting the most prominent on lesser trochanter on the replaced hip(B2) and on the contralateral side(B1) . Restoration of limb length was assessed by measuring the difference between the length of B1 and B2 in millimeters.

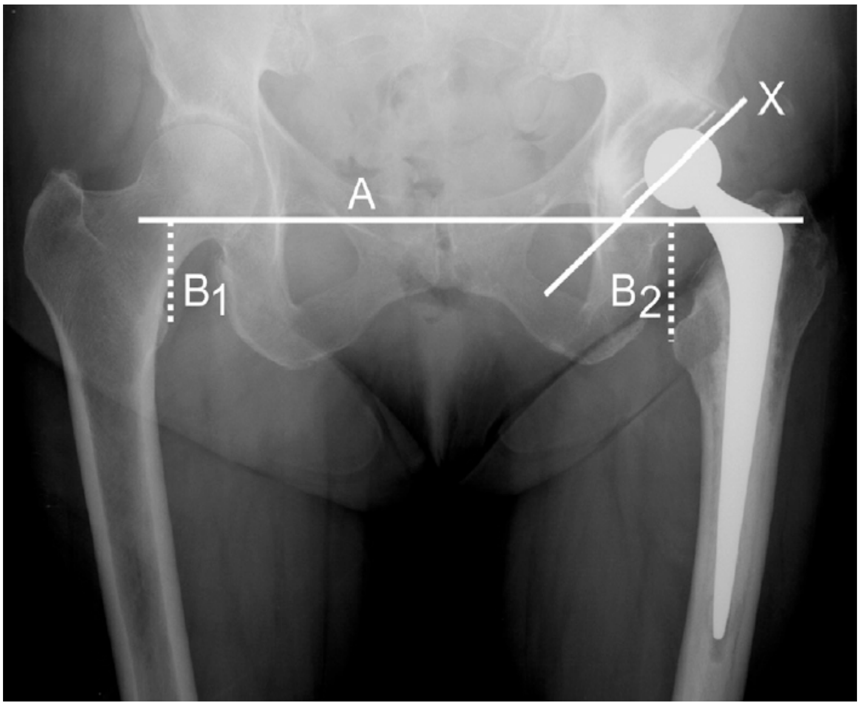


Figure 40: Method of measuring acetabular inclination and lower-limb length.

For measuring lateral offset initially two lines B and B1 drawn perpendicular to the interteardrop line.Lateral offset was measured by measuring the difference between line C(normal hip) to the line C1(replaced hip) in millimeters[62].(Fig 43).

Femoral stem angle is measured by measuring the angle between line drawn between mid femoral diaphysis(dotted line) and line drawn along the long axis of femoral stem.(continuous line)[62].Fig 43

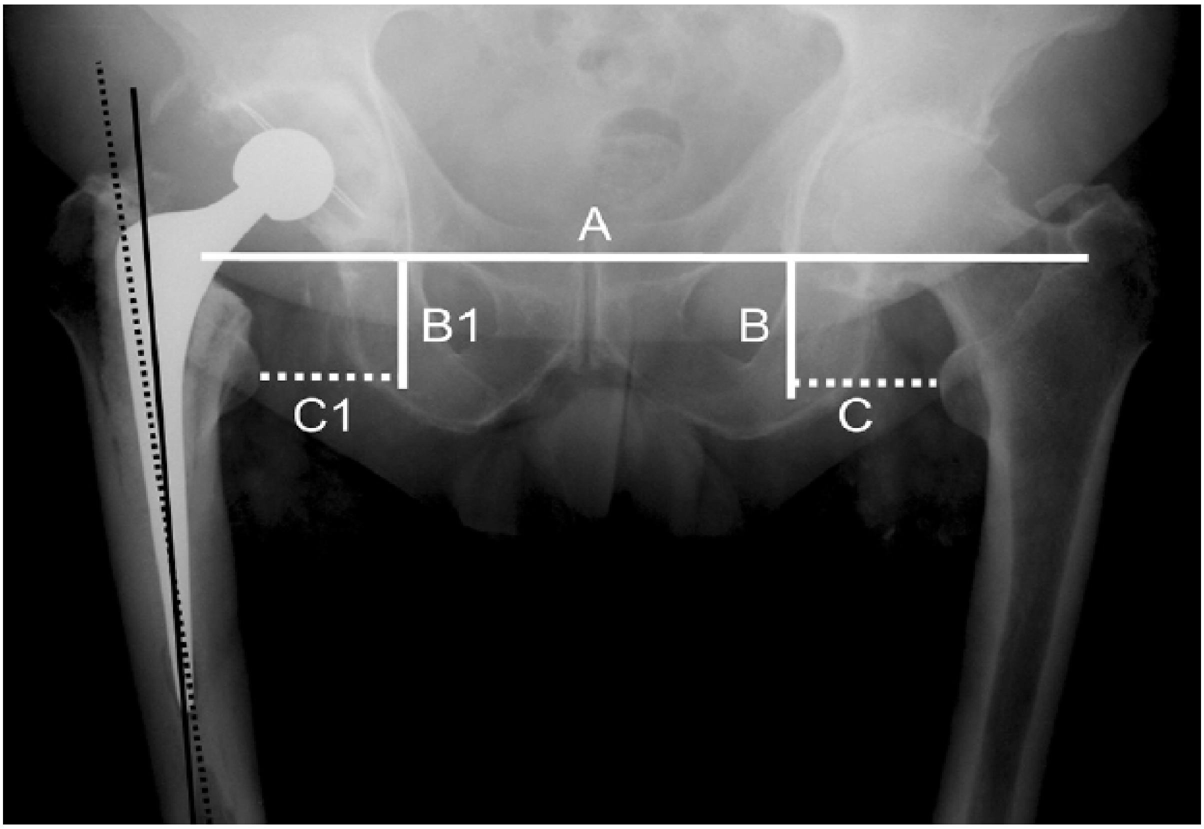
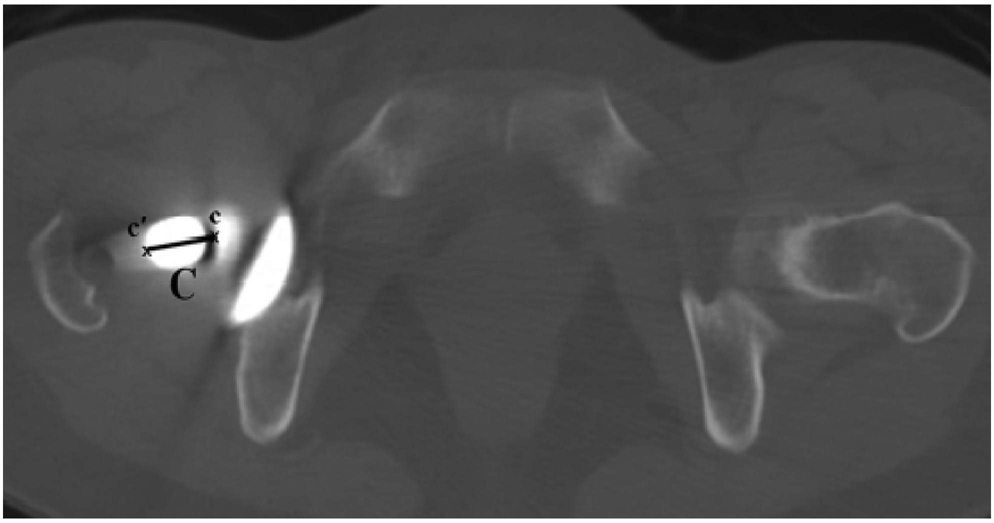


Figure 41:Method of measuring lateral offset and anteroposterior stem angle.

Measurement of Stem anteversion[63,64]:

Stem anteversion was measured from three cross-sectional CT images. The stem-neck axis was defined as the line between the centre of the modular head and the centre at the base of the trunnion of the stem. The posterior intercondylar line of the femur was defined as the line joining the posterior-most portions of the lateral and medial femoral condyles. The angle between the stem-neck axis and the posterior intercondylar line was defined as the radiological stem anteversion.

The centre of the modular head (c) was identified on the image that showed the largest circular section of the acetabular component (Fig. 44). The centre of the base of the trunnion (c′) was identified on the image that showed the largest width of the stem neck (Fig. 44). The line that connected these two centres was defined as the stem-neck axis. The image that showed the largest section of both condyles was selected and the posterior-most points of each condyle (d, d′) were identified. The line that connected these two points was then defined as the posterior intercondylar line. The angle between the axis of the stem neck and the posterior intercondylar line was defined as the CT anteversion of the stem.



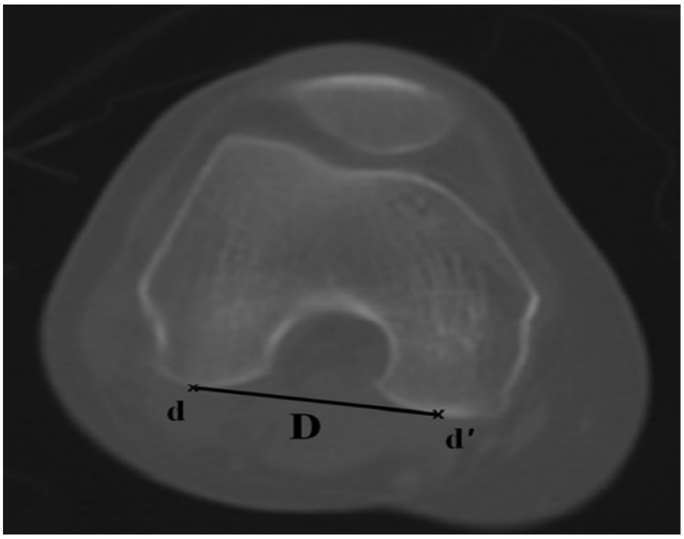


Figure 42: The CT slice showing the largest width of the stem neck is selected and the centre of the base of the trunnion (c′) is marked. A line (C) is drawn between the two centres, which is the stem-neck axis. Figure 3c – the CT slice showing the largest section of both condyles is selected and the posterior-most point of each condyle (d and d′) is marked. A line (D) is drawn between these two points, which is the posterior intercondylar line of the femur. The angle between the axis of the stem neck and the posterior intercondylar line is the CT anteversion of the stem.

Combined Anteversion[3,7]:

Impingement of bone-on-bone or cup and stem is the major cause of pain, dislocation and increased wear in THR. Accuracy of acetabular cup and stem anteversion, ensure proper mating of cup with femoral head without impingement between them in all range of motion. This requires the technique of combined anteversion.

Combined anteversion in the hip is the sum of acetabular and femur anteversion. In total hip replacement it is the sum of stem and cup anteversion. McKibbin,in his study on infant cadavers, first defined this term and proposed 30 to 40 degrees of combined anteversion as normal, with 15 degrees of femur anteversion. Combined anteversion is lower in men than women. In a cadaveric study ,they proposed the mean combined anteversion of men as 29.6 degrees and women 33.5 degrees, mean femoral anteversion as 11.6 degrees (men were 11.1 deg and women 12.2deg) . Mathematical models confirmed that to avoid impingement ,combined anteversion is the major measurement. Normal combined anteversion for men is between 25 and 35deg and up to 45 deg for women.

Combined anteversion has its relevance with the use of uncemented implants. The uncemented femoral stem must have a stable press fit for bone fixation, as adjusting the femoral stem anteversion is less with them compared to cemented stems,which can be rotated in femur to 10- 20 degrees of anteversion.The uncemented stems are limited by variable geometry of proximal femur, the anteroposterior isthmus at region of lesser trochanter, the anteversion of bone and the posterior fin of bone in Dorr type A and B bone .

The combined anteversion technique ensures elimination of stem-on-cup impingement in cementless stem ,if correct hip length and offset is restored with correct coverage of cup . Correct coverage of the cup is obtained by medializing the hip centre with inclination below 45 degrees and the metal edges flushed with the bone (except posterior-superior). Elimination of impingement minimizes wear and optimize the stability of implant .

METHODOLOGY

Study design:

The study was carried out on 40 patients of Uncemented Total Hip Replacement done on Government Rajaji hospital,Madurai Medical college from September 2012 to September 2014.This study was a prospective study. Patient follow up was for a minimum of 6 months to 2 years.

The following Inclusion/Exclusion criteria were used for recruitment of patients in the study.

Inclusion criteria:

All patients who had undergone Uncemented Total hip replacement for

1)Fractue neck of femur

2)Non-Union neck of femur.

Exclusion criteria:

1) Pre -existing Osteoarthritis of hip

2)Pre -existing septic sequale of hip

3)Patients who had undergone Cemented Total hip replacement.

STUDY POCEDURES:

Patient data:

All patients underwent a standard clinical and laboratory evaluation that includes briefly about the age, sex, address ,clinical history and routine investigation which were done preoperatiely.X ray of the Hip joint with AP view was done.

Pre-op Planning:

Radiograph of the pelvis with both hips with proximal half of shaft of femur AP view was taken for all patients. The radiograph was evaluated for

1)size of the acetabulum

2)bone stock of the acetabulum

3)any protrusion and periacetabular osteophyte formation

4)the structural integrity of the acetabulum

5)size of the femoral canal.

Templating was done for the aectabular and femur components. The appropriate acetabular cup size, and anteversion was determined. On the femoral side, using a template, appropriate neck length, offset and stem size of the implant is chosen.

Surgical Approach: Posterolateral approach to hip

Post operative protocol:

The hip is kept in 15degrees of abduction by a pillow to maintain abduction and prevent excessive flexion in the recovery room.

First post op day, check X-rays are taken. The patient is taught static quadriceps exercises, knee and ankle mobilization exercised and made to sit.

Second post op day dressing changed and smaller dressing is applied. Gait training was started using a walker with weight bearing to tolerance. Drains were removed 24 to 48 hours after surgery.

IV antibiotics were given for 5 days switched over to oral antibiotics for further 5 days more.DVT prophylaxis was given in the form of Low molecular weight heparin/Heparin for first five days after surgery.

12th post op day sutures are removed and discharged from the hospital to be reviewed after one month.

Patients were advised

- Not to squat
- Not to sit cross- legged
- Not to use Indian toilets
- Not to cross lower limb across midline for a period of six weeks.

FOLLOW UP:

The patients were followed up at 6weeks,3 months ,6 months, 1 year and 2 year.

Clinical assessment:

The clinical and functional outcomes were evaluated by Modified Harris Hip Score.

Grading of score :

Excellent -90 -100

Good -80-89

Fair -70-79

Poor -60-69

Failed result < 60

Rationale of Modified Harris Hip Score Evaluation:

Pain and functional capacity are the two criteria that receive heavy weightage,as they are the major indication of surgery in majority of hip problems.

,

Based on this, a point scale with a maximum of 100 points is derived with the following maximum possible scores :

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

Radiological assessment:

1) A X-ray of Anteroposterior view of pelvis with both hips

2)X- ray of the replaced hip with entire prosthesis in Anteroposterior view

3)CT scan of the Both hips and knee with axial ,sagittal ,coronal and 3D view

In **X-ray** the following variables were evaluated:

1)Cup anteversion by idmer's method

2)Cup inclination

3)Cup offset

4)Limb length discrepancy

5)Stem - varus,neutral or valgus

In the **CT scan** the following variables were evaluated:

1)Cup anteversion

2)Cup inclination

3)Cup offset

4)Limb length discrepancy

5)Stem - varus,neutral or valgus

6)Femoral anteversion

7)Combined anteversion.

STATISTICAL ANALYSIS:

To find out the significant mean differences between two groups,the independent sample 't' test was used.In our study 't' test has been used to find out significance of restoration of cup offset and leg length with Harris Harris Hip Score.

To find out the mean differences between more than two groups,one way ANOVA(F -ratio) was used.This test was invented by Sir.R.A.Fisher and therefore it is known as 'F' ratio.'F' ratio isthe ratio between sum of squares within groups and sum of squares between groups.

Based on degrees of freedom values the table value is calculated.The calculated value and table value will be compared.If the calculated value is greater than table value Null hypothesis is rejected.If the calculated value is less than table value Null hypothesis accepted.

In our study, ANOVA has been used when more than two quantitative variables has been analysed with Harris HipScore.In our study ANOVA has been used to find any statistical difference in functional outcome with Acetabular Inclination,Femoral stem alignment,X-Ray anteversion,CT-Anteversion,Femoral stem version and combined anteversion with Modified harris Hip score.

To find out the relationship between two quantitative variables,Karl-Pearson's correlation co-efficient was used.In our study this has been used to study the association between X-ray anteversion and CT anteversion.

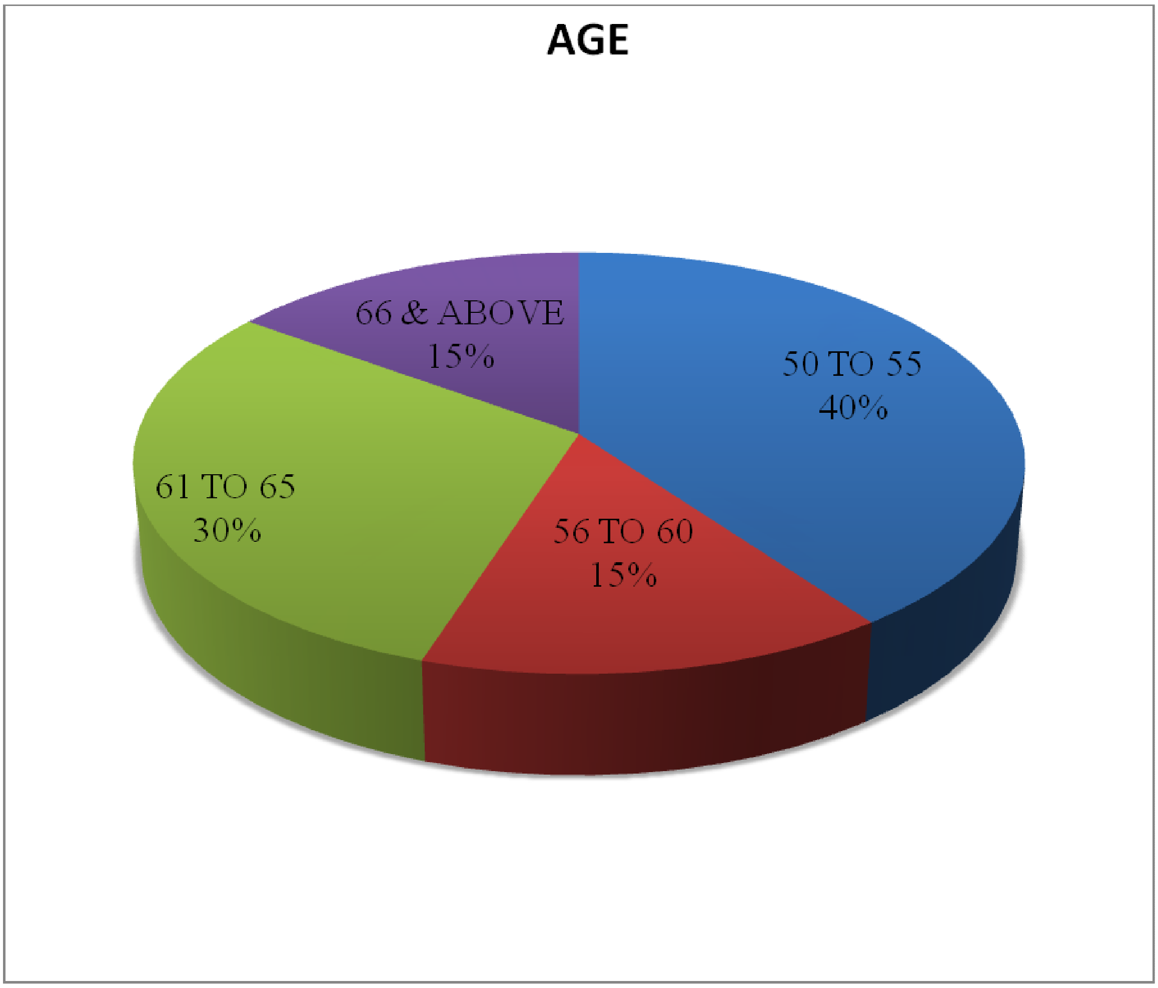
Further the value of mean,SD and percentages were also calculated.

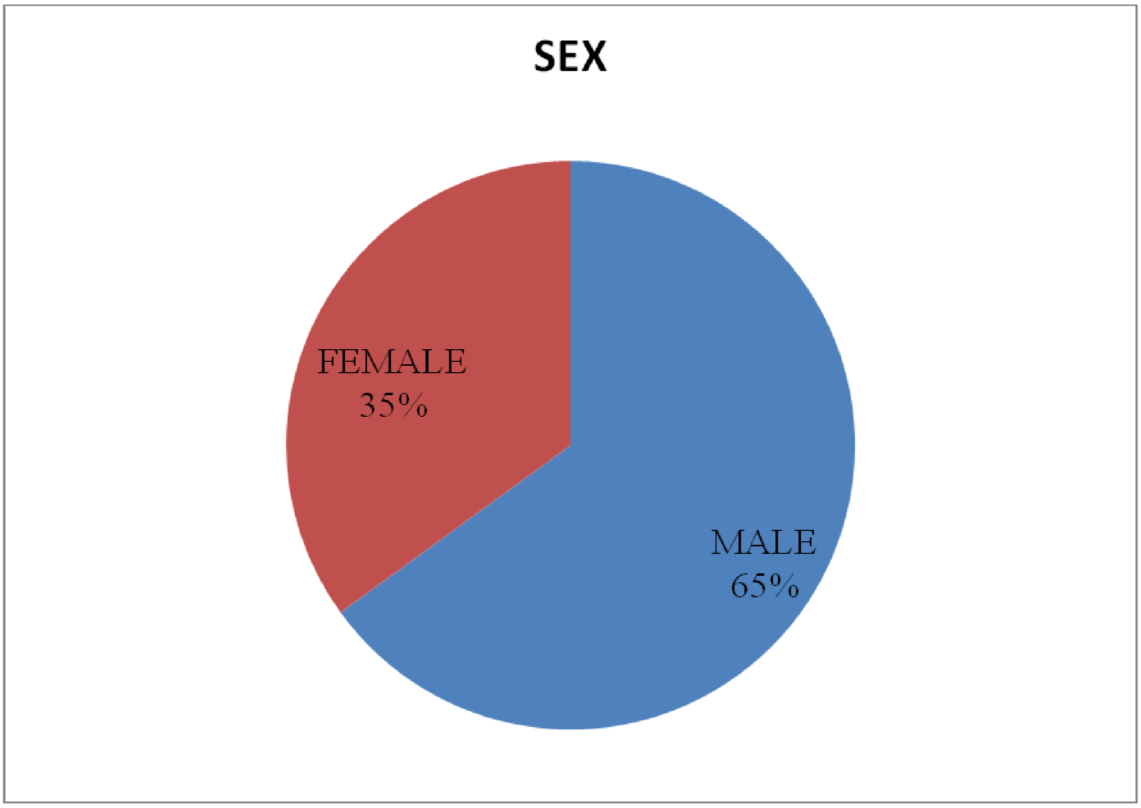
Data were analysed using SPSS v.14 evaluation version

OBSERVATION AND RESULTS:

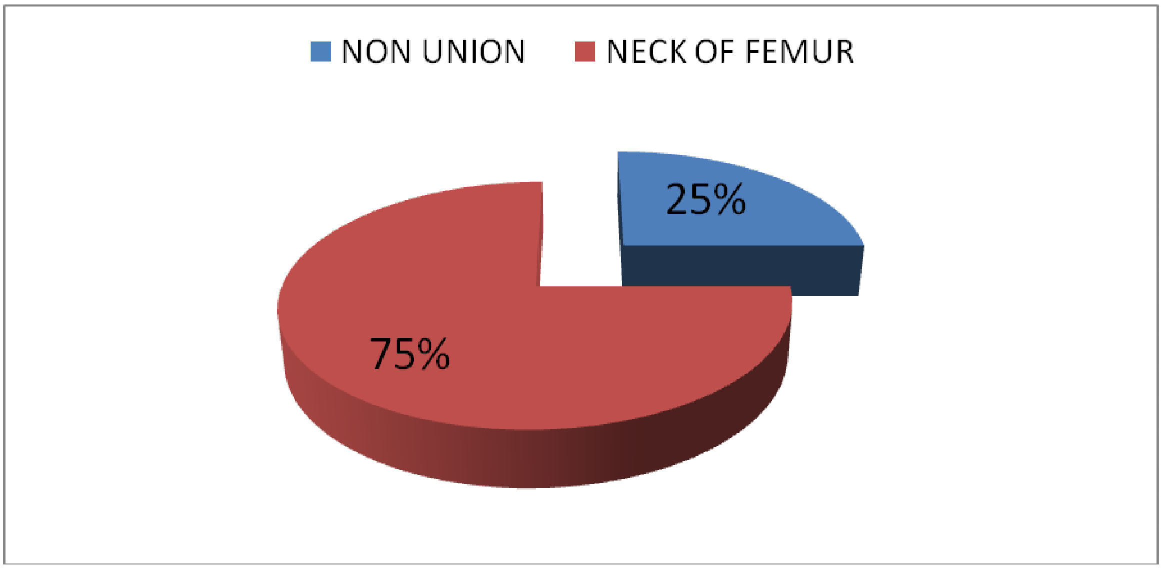
AGE & SEX:

40 patients were analysed between September 2012 to September 2014 with age group ranging from 50 to 76 with a median age of 59 with 26 males and 14 females.



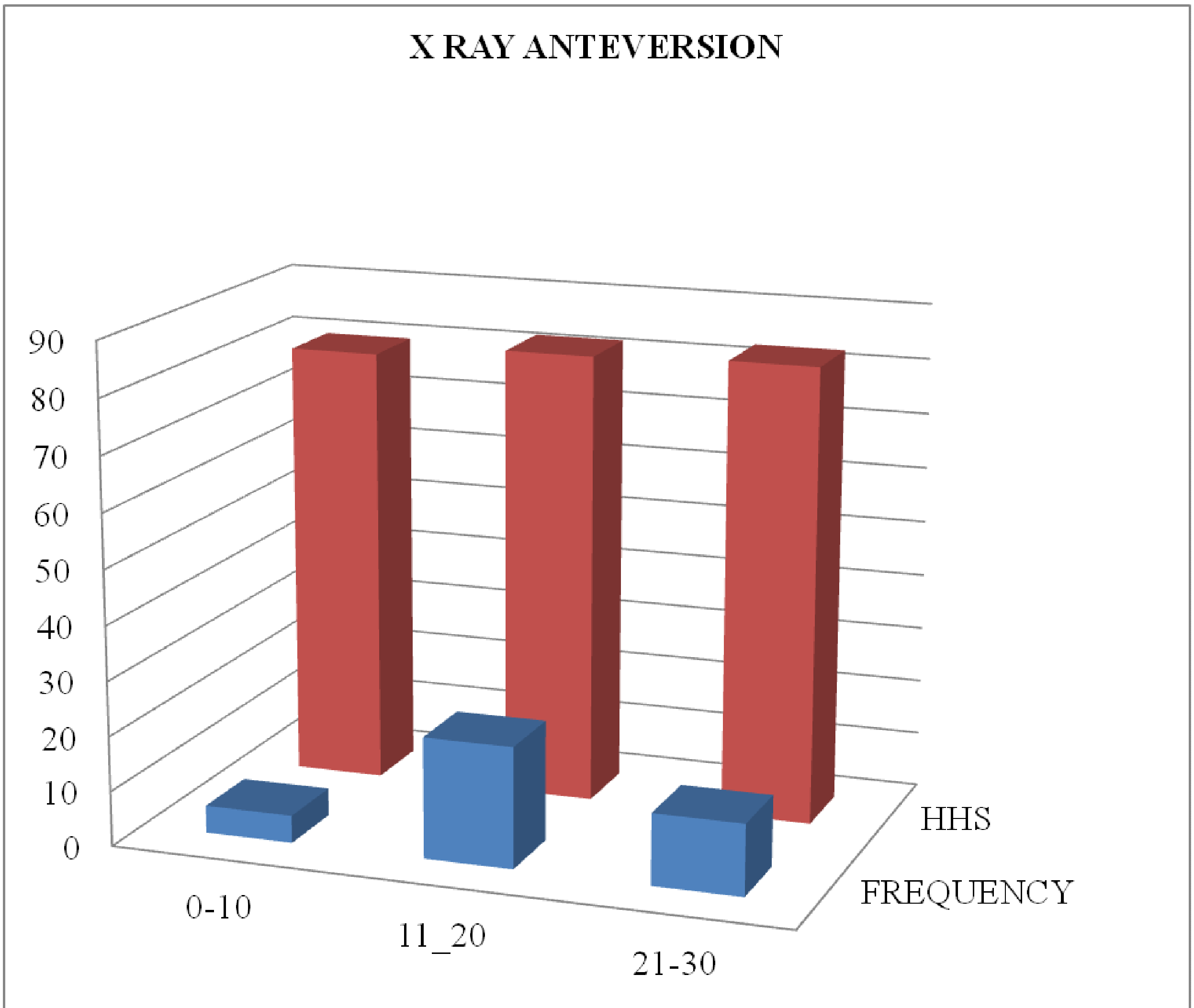


Of the 40 operated cases of Total Hip Arthroplasty 10 cases of Non union neck of femur and 30 cases of fresh fracture neck of Femur were operated.



X-RAY ANTEVERSION:

Of the 40 patients analysed by Widmer' anteversion method,anteversion ranges from 6.60 to 35.10 with a mean of 16.19 and standard deviation of 6.45.



	0-10	11_20	21-30
FREQUENCY	5	22	13
HHS	79.8	82.1	83

X-RAY Anteversion	N	Mean HHS	Std. Deviation
1-10	5	79.8	8.2
11-20	22	82.1	9.7
21-30	13	83.0	8.2

ANOVA

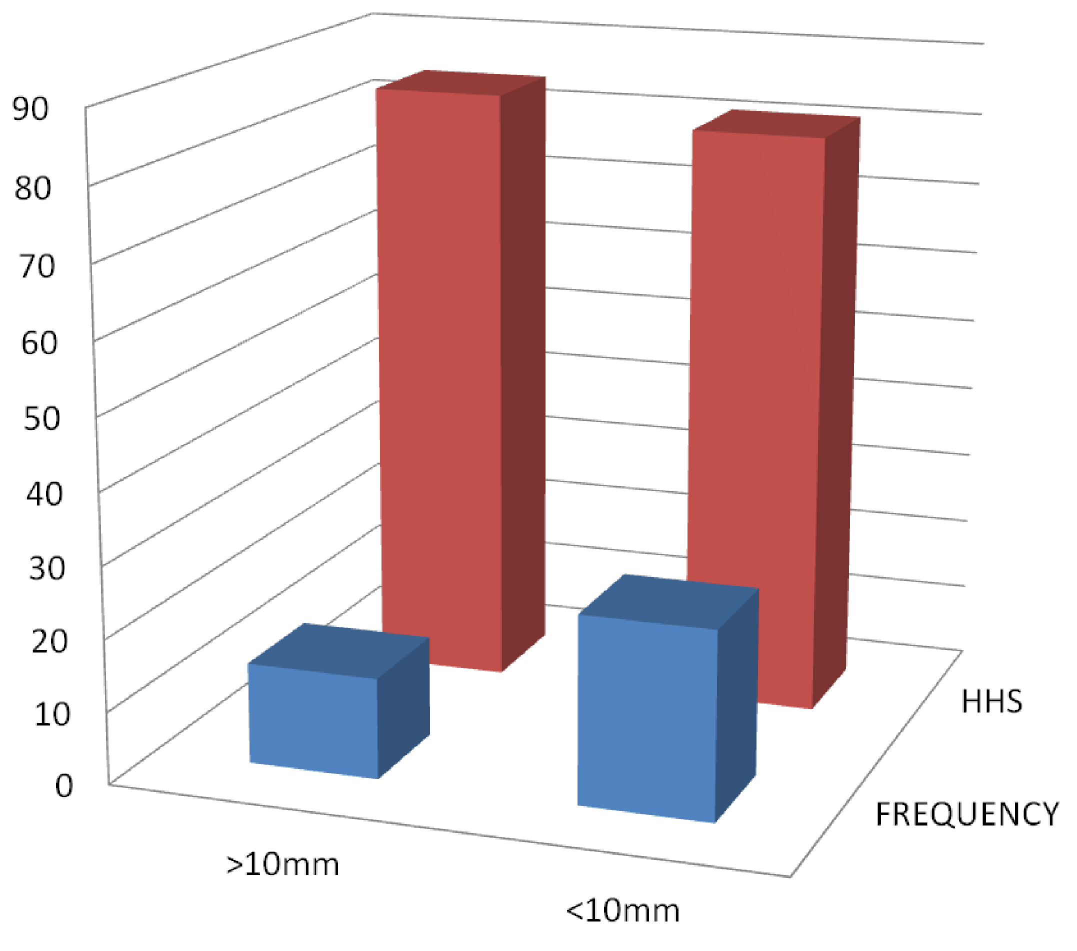
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	38.786	2	19.393	.232	.794
Within Groups	3094.314	37	83.630		
Total	3133.100	39			

By statistical analysis method of ANOVA, it was found that there exists no significant differnce between the varying angles of anteversion by Widmer's method and patient outcome by Harris hip score. (F-Ratio = 0.232 P>0.05 Not Sig)

RESTORATION OF CUP OFFSET:

The mean restoration of cup offset is 8.4mm.Cup offset was increased in all 40 patients.Offset is increased >10mm in 14 patients (35%) and increased <10mm in 26 patients.

CUP OFFSET Vs HHS



	>10mm	<10mm
FREQUENCY	14	26
HHS	84.2	81

CUP OFFSET	N	Mean HHS	Std. Deviation
DECREASED <10 MM	26	81.0385	9.01324
INCREASED >10 MM	14	84.2143	8.81588

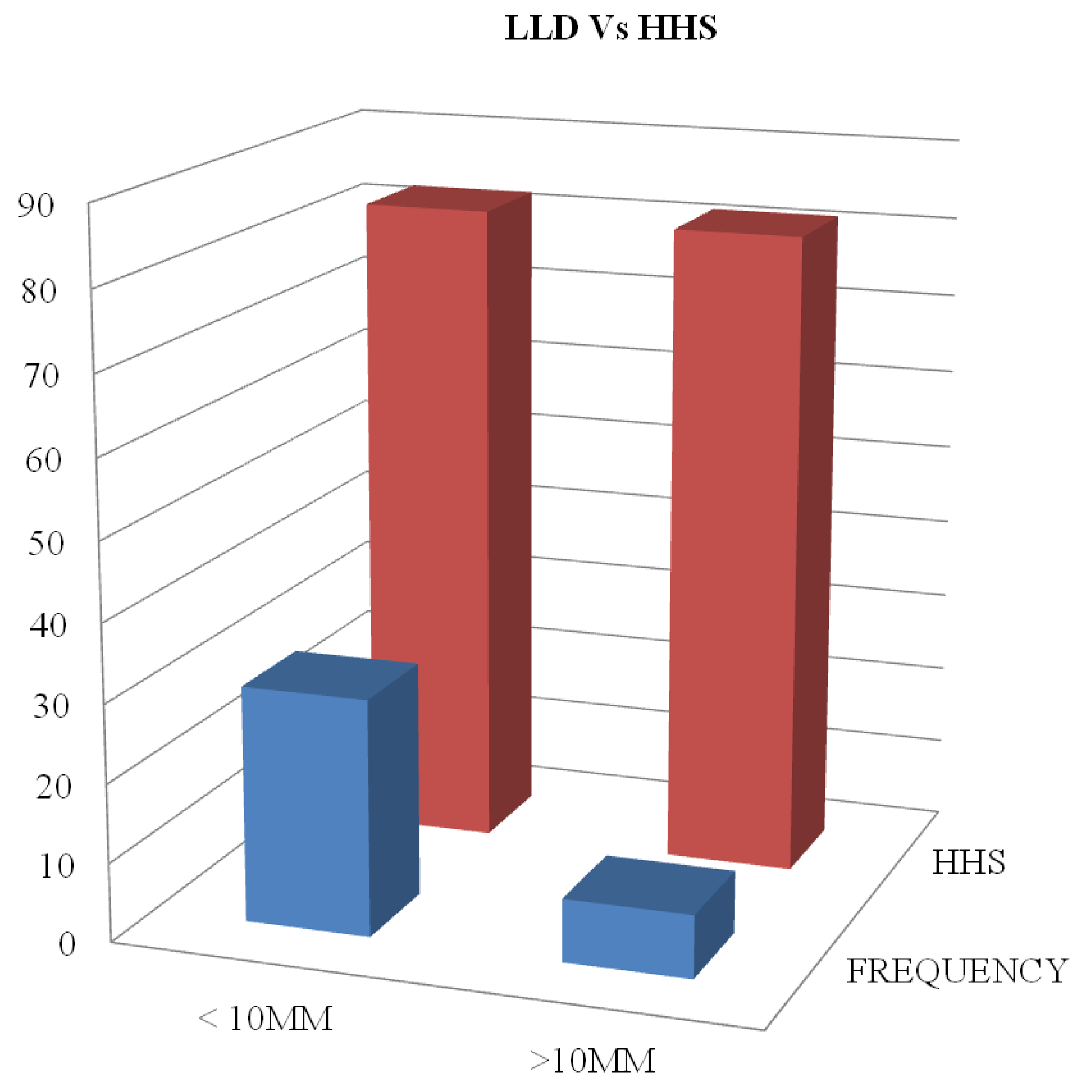
't' - TEST

	Sum of Squares	df	Mean Square	't' value	Sig.
Between Groups	91.781	1	91.781	1.147	.291
Within Groups	3041.319	38	80.035		
Total	3133.100	39			

By statistical analysis by' t'- test , it was found that there is no significant difference between patient outcome by Modified Harris hip score between patients with offset <10mm and with offset >10mm. .('t' value=1.147 p>0.05 Not Sig).

RESTORATION OF LIMB LENGTH:

The mean restoration of leg length is 6.6mm.Leg length was increased in 38 patients, with leg length increased >10mm in 8 patients and < 10mm in 30 patients.leg length was decreased in 2 patients within <10mm.



	< 10MM	>10MM
FREQUENCY	30	8
HHS	82.3	81.5

Limb length increased	N	Mean	Std. Deviation
< 10mm	30	82.3	9.6
>10mm	8	81.5	5.6

't' - TEST

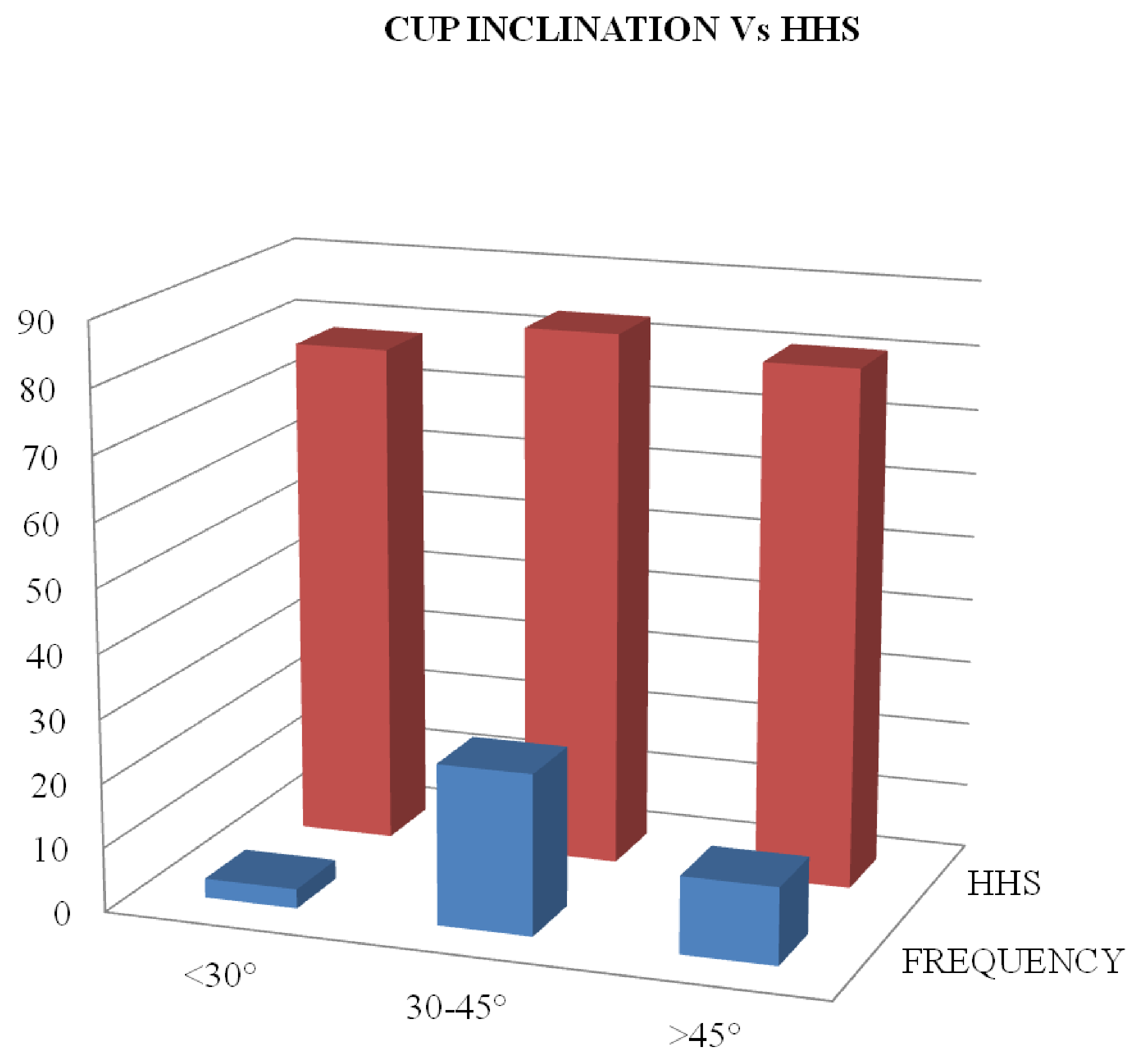
	Sum of Squares	df	Mean Square	't' value	Sig.
Between Groups	4.225	1	4.225	.051	.822
Within Groups	3128.875	38	82.339		
Total	3133.100	39			

By statistical analysis by 't' test, it was found that there exists no significant difference in patient reported outcome by Modified Harris hip score in patients with limb discrepancy either with > 10mm or <10mm. .('t' value=0.051; p>0.05 Not Sig).

ACETABULAR INCLINATION:

The mean acetabular cup inclination was 46.6°.(SD = 10.1°).The cup inclination was < 30° in 3 patients (7.5%), 30-45 ° in 25 patients(62.5%) and > 45° in 12

patient



	<30°	30-45°	>45°
FREQUENCY	3	25	12
HHS	78.3	83.3	80.6

CUP INCLINATION	N	Mean	Std. Deviation
< 30°	3	78.3	11.2
30-45°	25	83.3	8.7
> 45°	12	80.6	9.3

ANOVA

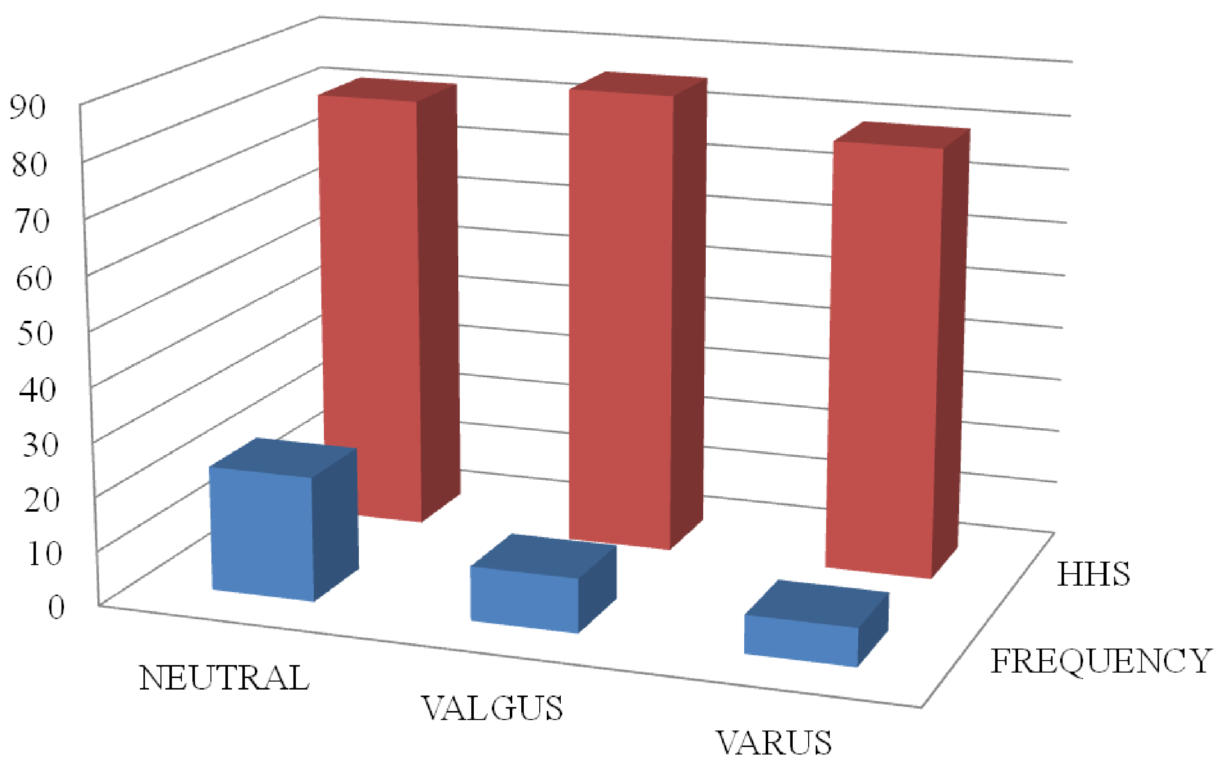
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	104.327	2	52.163	.637	.534
Within Groups	3028.773	37	81.859		
Total	3133.100	39			

By statistical analysis by ANOVA, it was found that there exists no significant difference in functional outcome by modified harris hip score between thacetabular inclination in groups <30°,30-45° and > 45°.(F-Ratio = 0.637 P>0.05 Not Sig)

ALIGNMENT OF FEMORAL STEM:

The alignment of femoral stem was neutral in 23 patients (57.5%),valgus in 10 patients (25%) and varus in (7%) patients.

FEMORAL STEM ALIGNMENT Vs HHS



	NEUTRAL	VALGUS	VARUS
FREQUENCY	23	10	7
HHS	81.4	85.6	79.4

Femoral stem	N	Mean	Std. Deviation
NEUTRAL	23	81.4	9.1
VALGUS	10	85.6	6.2
VARUS	7	79.4	11.2
Total	40	82.1	8.9

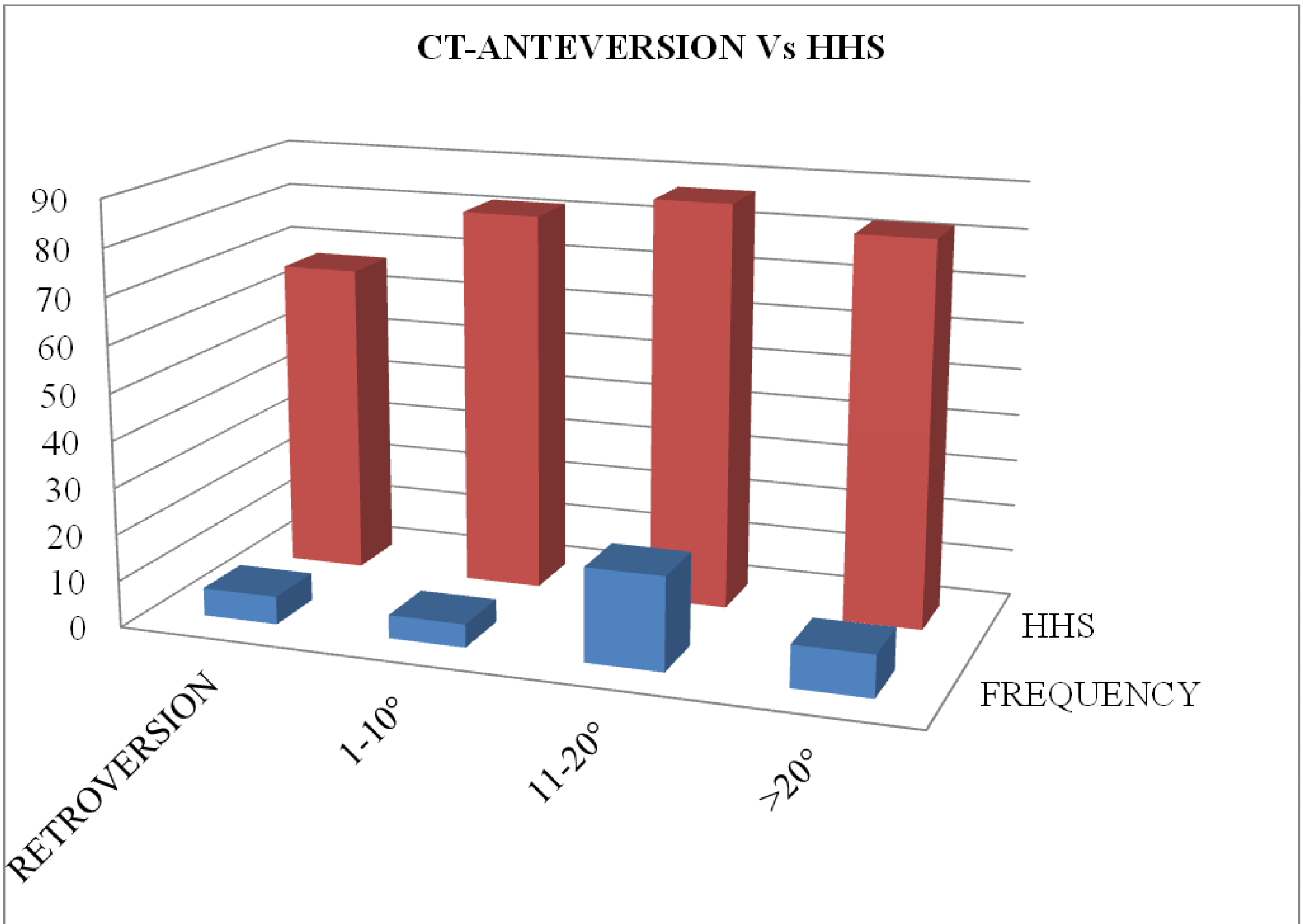
ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	181.247	2	90.623	1.136	.332
Within Groups	2951.853	37	79.780		
Total	3133.100	39			

By statistical analysis by ANOVA, it was found that that there exists no significant difference in functional outcome following alignment of femoral stem either in valgus, varus or neutral position. (F-Ratio = 1.136 ; P>0.05 Not Sig)

CT -ANTEVERSION:

The mean CT-anteversion is 13.8°(SD = 8.6°). Of the 40 patients analysed with anteversion with CT scan, cup is retroverted in 6 patients(15%),1-10° of anteversion in 5 patients(12.5%),11-20° of anteversion in 20 patients(50%) and >20° in 9 patients(22.5%).



	RETROVERSION	1-10°	11-20°	>20°
FREQUENCY	6	5	20	9
HHS	67	81.6	86.8	82.2

CT-ANTEVERSION	N	Mean	Std. Deviation
RETROVERSION	6	67.0000	2.96648
1 TO 10	5	81.6000	9.34345
11 TO 20	20	86.8000	5.69949
21 & ABOVE	9	82.2222	6.24055

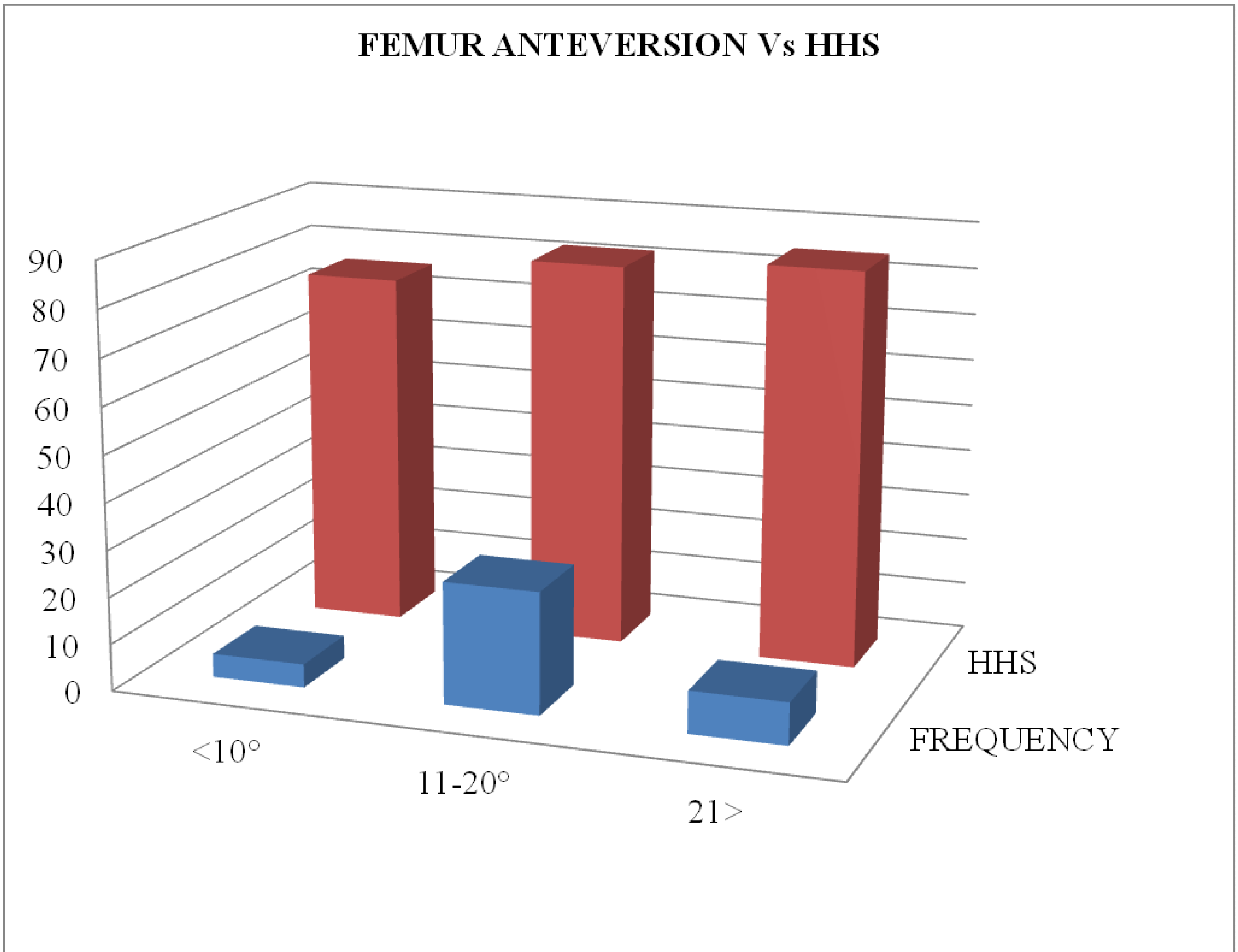
ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1811.144	3	603.715	16.441	.000
Within Groups	1321.956	36	36.721		
Total	3133.100	39			

By statistical analysis method of ANOVA,it was found that that exists a significant difference in patient outcome by Harris hip score depending on version measured in CT- scan. (F-Ratio = 16.441; P<0.05 Sig)

CT - FEMORAL STEM VERSION:

The mean femoral stem version was 17.08° (SD = 4.9 °) and it ranges from 8.5° to 29.5°. The femoral stem version was found to be less than 10° in 5 patients(12.5%),11-20° in 26 patients(65%) and > 21° in 9 patients(22.5%).



	<10°	11-20°	21>
FREQUENCY	5	26	9
HHS	76	82.3	84.8

FEMUR ANTEVERSION	N	Mean	Std. Deviation
DECREASED <10	5	76.0	7.6
NORMAL 11-20	26	82.3	9.7
INCREASED 21>	9	84.8	5.5

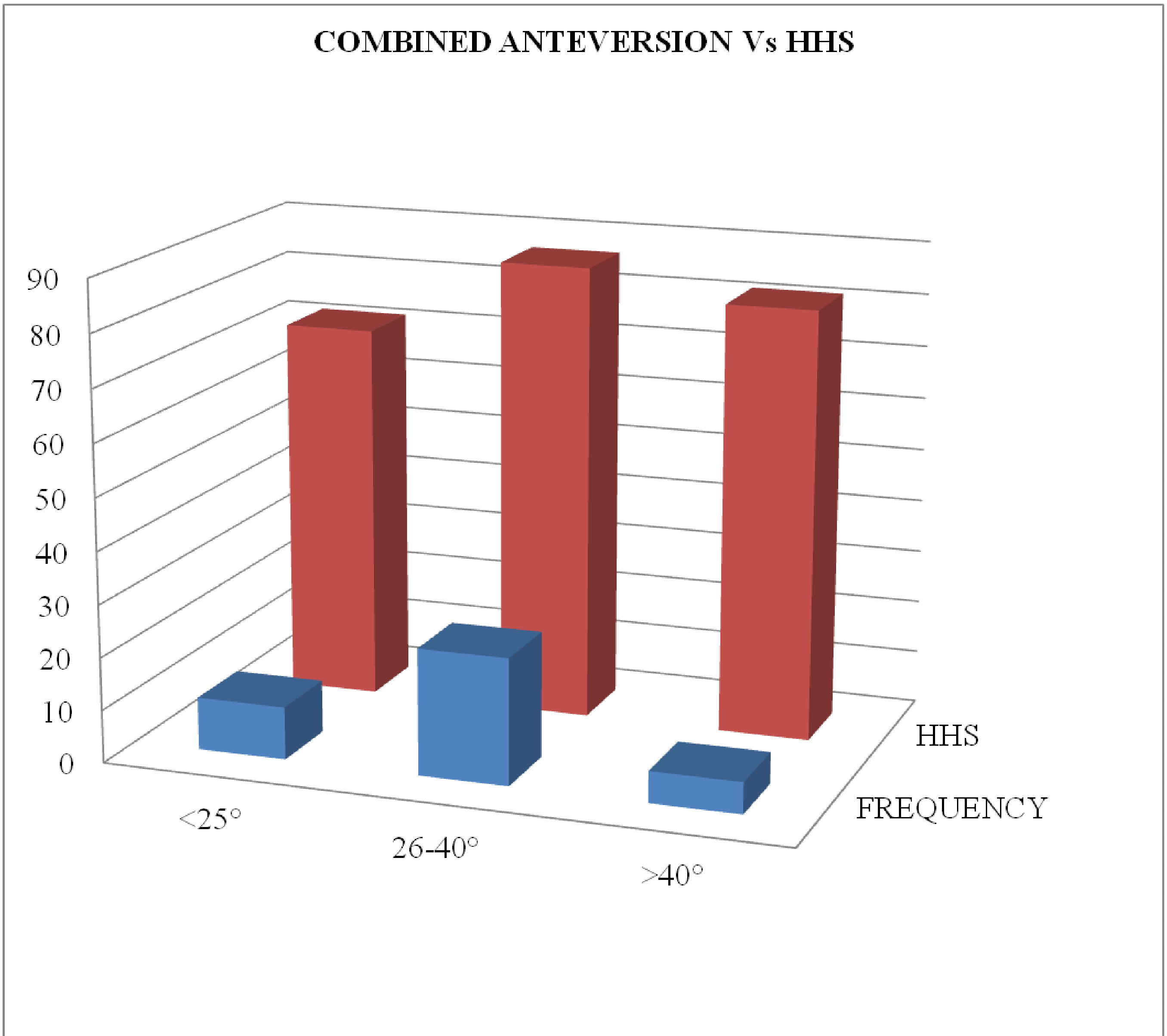
ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	258.057	2	129.029	1.661	.204
Within Groups	2875.043	37	77.704		
Total	3133.100	39			

By statistical analysis by ANOVA ,it was found that there is no significant difference between patient reported outcome by Harris hip score and femoral anteversion values.Thus it was found that femoral anteversion values have not been significant in patient outcome. (F-Ratio = 1.661; P>0.05 Not Sig)

COMBINED ANTEVERSION:

The mean combined anteversion was 29.5°(SD =12.2) and it ranges from 3.5° to 48.5°. The combined anteversion was found to be <25° in 10 patients (25%),26-40° in 24 patients (60%)and > 41° in 6 patients(15%).



	<25°	26-40°	>40°
FREQUENCY	10	24	6
HHS	71.7	86.6	81.6

COMBINED ANTEVERSION	N	Mean	Std. Deviation
DECREASED <25	10	71.7	8.7
NORMAL 26-40	24	86.6	5.3
INCREASED 41>	6	81.6	6.2

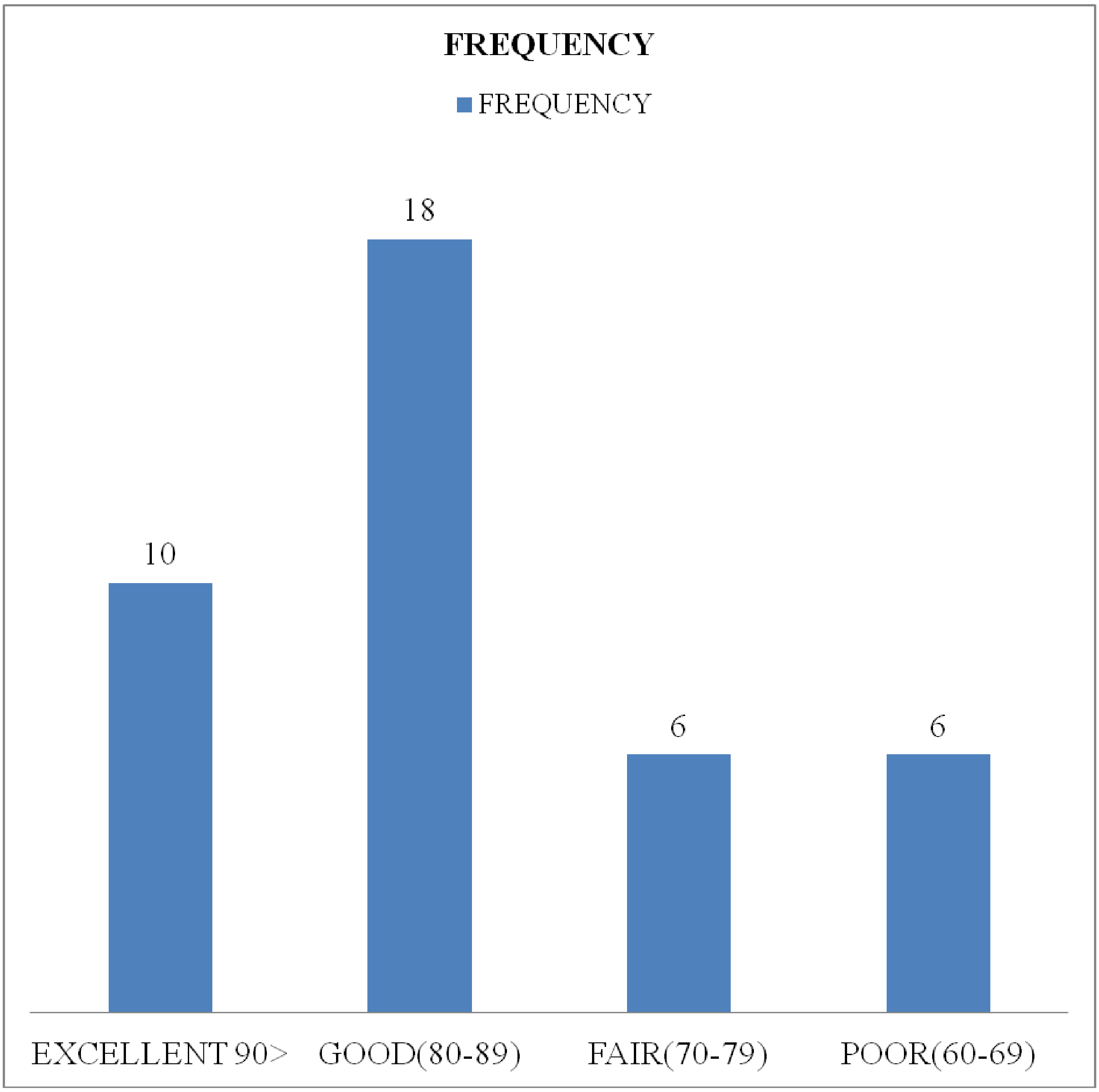
ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1574.042	2	787.021	18.678	.000
Within Groups	1559.058	37	42.137		
Total	3133.100	39			

By statistical analysis by ANOVA, it was found that there exists a significant difference between patient reported outcome by Modified Harris hip score and combined anteversion values.Thus there is a significant difference in outcome based on combined anteversion values. (F-Ratio = 18.678; $P<0.05$ Sig)

MODIFIED HARRIS HIP SCORE:

The mean Harris hip score was 82.1(SD = 8.9) with scores ranging from 64 to 94. Of the 40 patients analysed 6 patients have poor outcome (15%), 6 patients have fair outcome(15%),18 patients with good outcome(45%) and 10 patients have excellent outcome(25%).

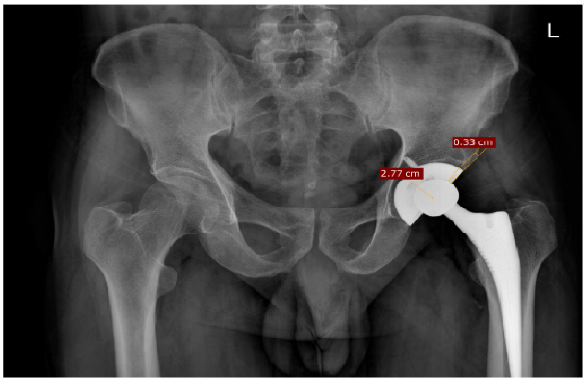


CORRELATION BETWEEN X-RAY ANTEVERSION &CT-ANTEVERSION:

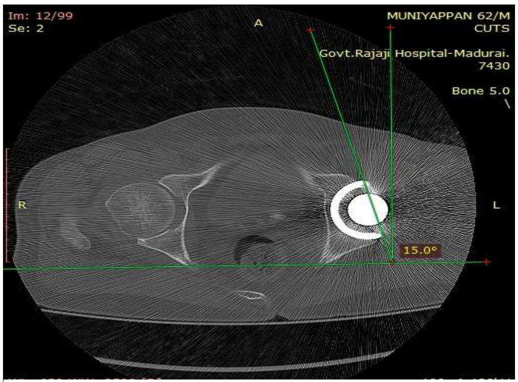
		X-RAY AV	CT-AV
X-RAY AV	Pearson Correlation	1	
	Sig. (2-tailed)		
	N		
CT-AV	Pearson Correlation	**0.555**	1
	Sig. (2-tailed)	**.000**	
	N	40	40

Karl Pearson's coefficient of correlation found that there exists a positive and significant correlation between X-ray anteversion and CT- anteversion ('r' = 0.555).P value was found to significant $p < 0.01$.

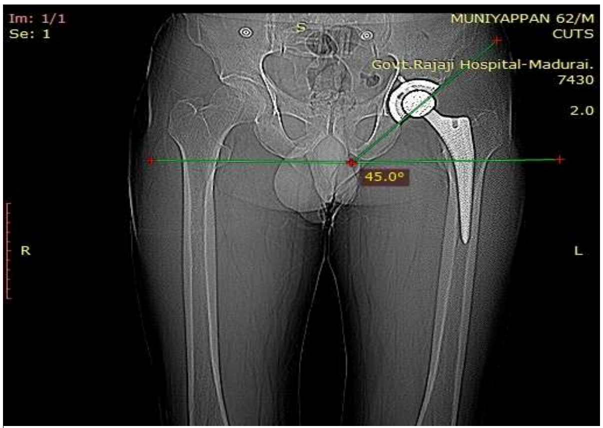
CASE 1



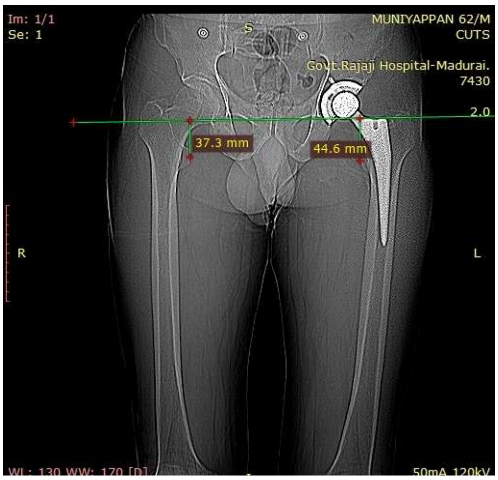
X-RAY ANTEVERSION -6.8°



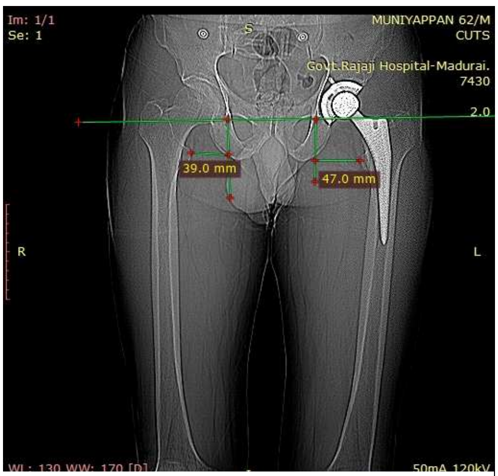
CT CUP ANTEVERSION - 15°



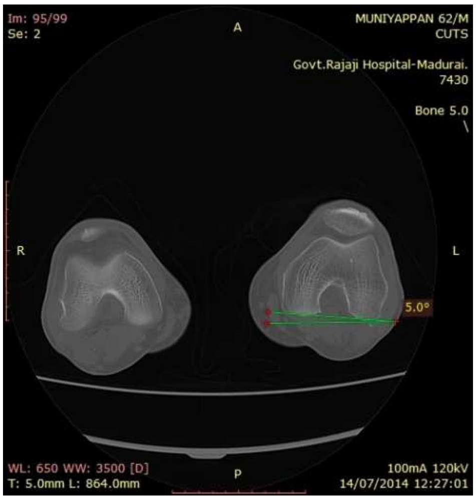
CUP INCLINATION- 45°



LIMB LENGTH DISCREPANCY-7.3mm



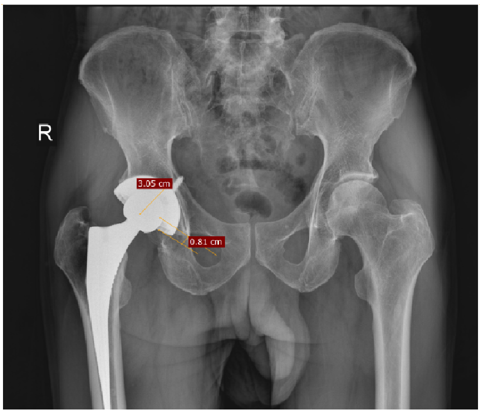
CUP OFFSET - 12mm



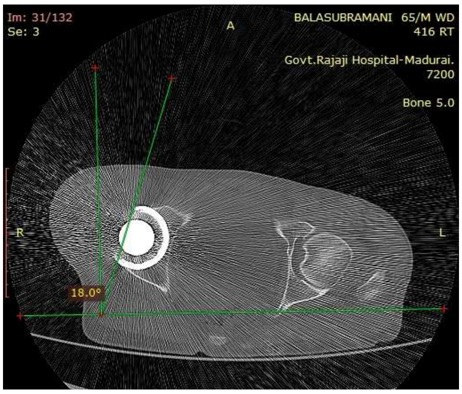
FEMORAL STEM ANTEVERSION -20.5°

X RAY ANTEVERSION	6.8°
CT CUP ANTEVERSION	15°
FEMUR ANTEVERSION	20.5°
COMBINED ANTEVERSION	35.5°
CUP INCLINATION	45°
LLD	7.3mm
CUP OFFSET	12mm
FEMORAL STEM	VARUS
MOD.HHS	91(EXCELLENT)

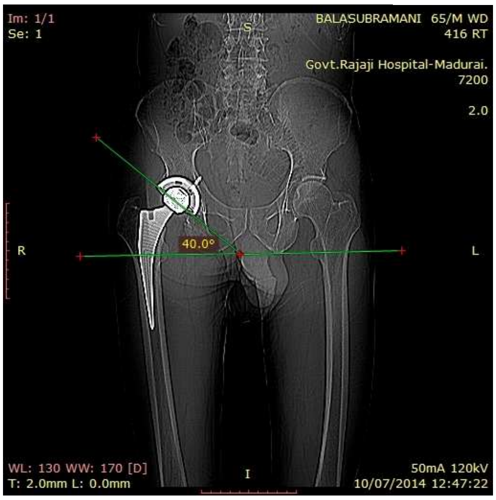
CASE - 2



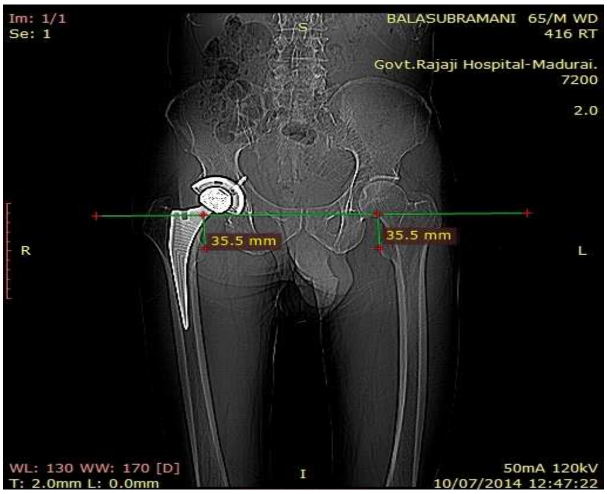
X-RAY ANTEVERSION -15.4°



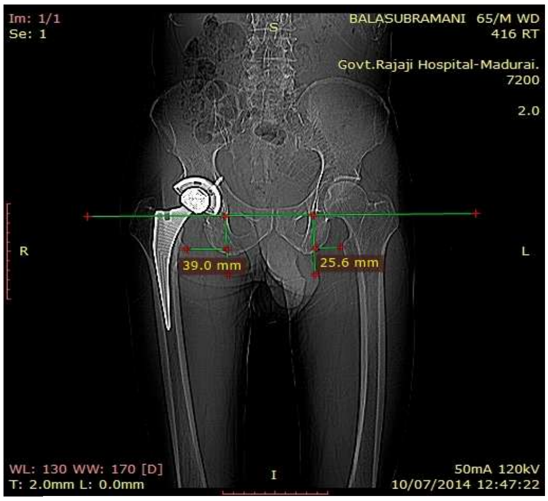
CT CUP ANTEVERSION -18°



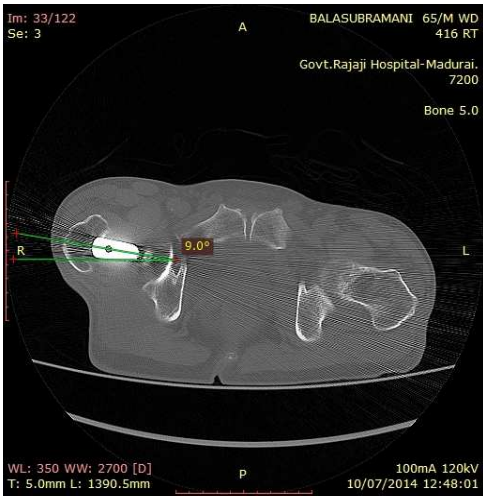
CUP INCLINATION - 40°

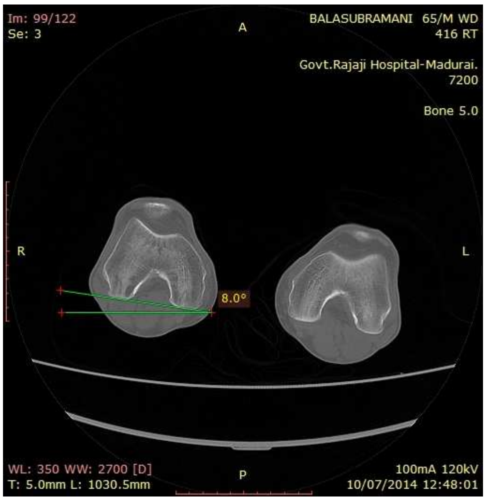


LIMB LENGTH DISCREPANCY - nil



CUP OFFSET- 14.6mm

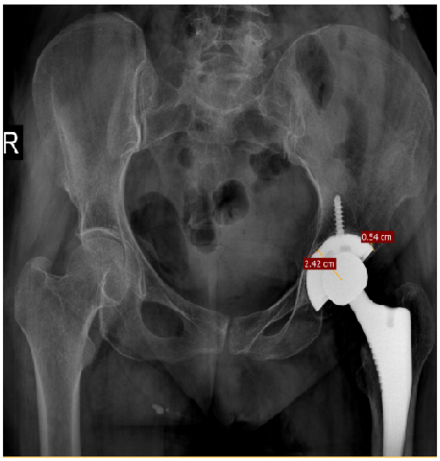




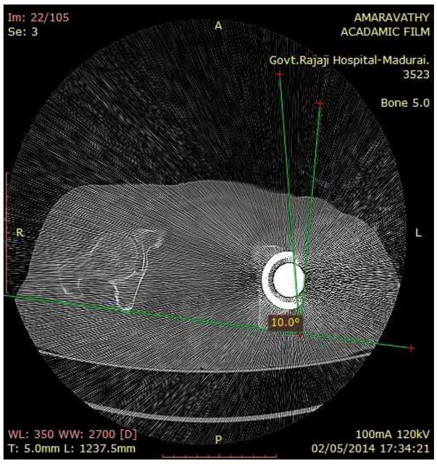
FEMORAL STEM ANTEVERSION - 17°

X RAY ANTEVERSION	15.4°
CT CUP ANTEVERSION	18°
FEMUR ANTEVERSION	17°
COMBINED ANTEVERSION	35°
CUP INCLINATION	40°
LLD	NIL
CUP OFFSET	14.6mm
STEM POSITION	VARUS
MOD.HARRIS HIP SCORE	91(EXCELLENT)

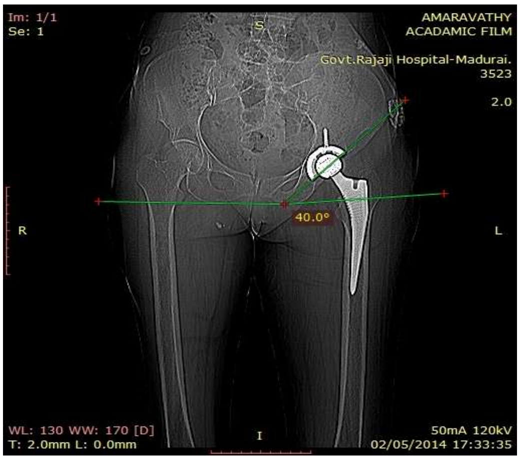
CASE -3



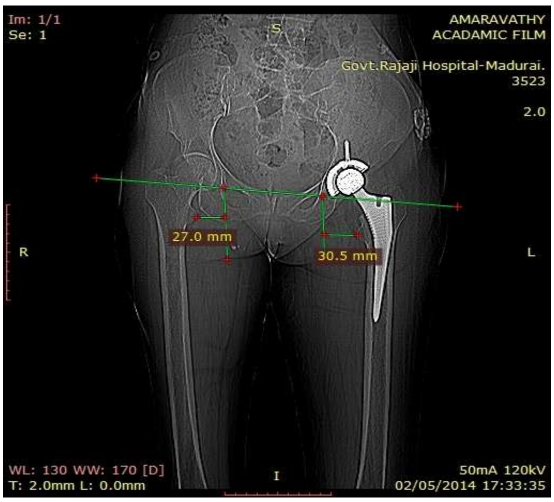
X -RAY ANTEVERSION -12.8°



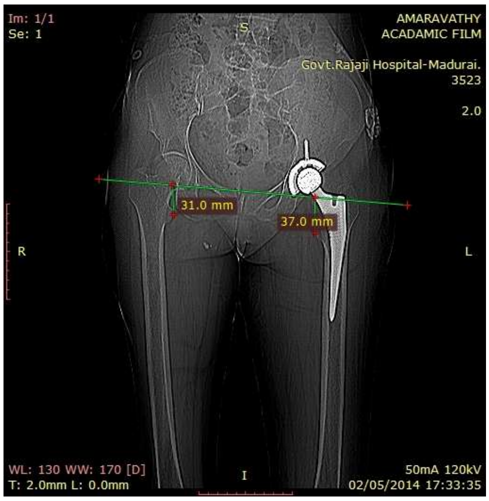
CT ANTEVERSION-10°



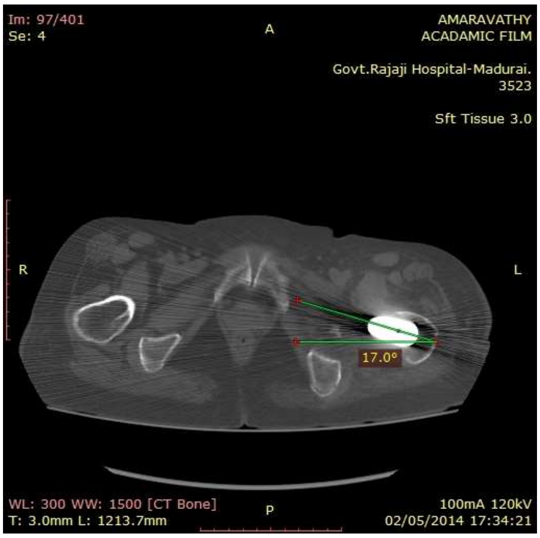
CUP INCLINATION - 40°

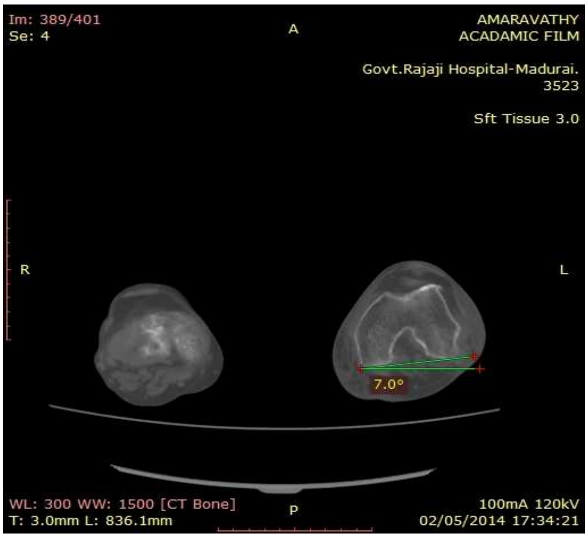


CUP OFFSET -3.5mm



LIMB LENGTH DISCREPANCY - 6mm

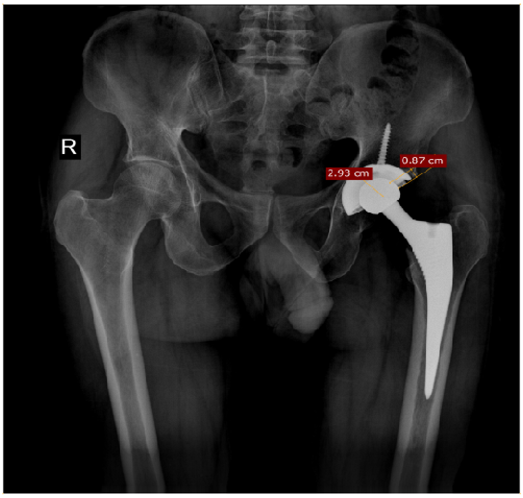




FEMORAL STEM ANTEVERSION - 24°

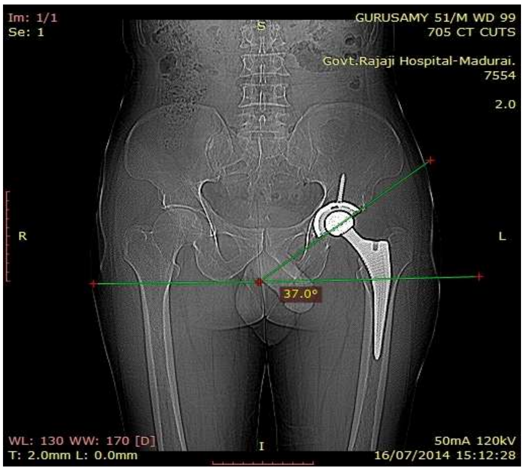
X RAY ANTEVERSION	12.8°
CT CUP ANTEVERSION	10°
FEMUR ANTEVERSION	24°
COMBINED ANTEVERSION	34°
CUP INCLINATION	40°
LLD	6mm
CUP OFFSET	3.5mm
STEM POSITION	VALGUS
MODIFIED HARRIS HIP SCORE	84(GOOD)

CASE 4

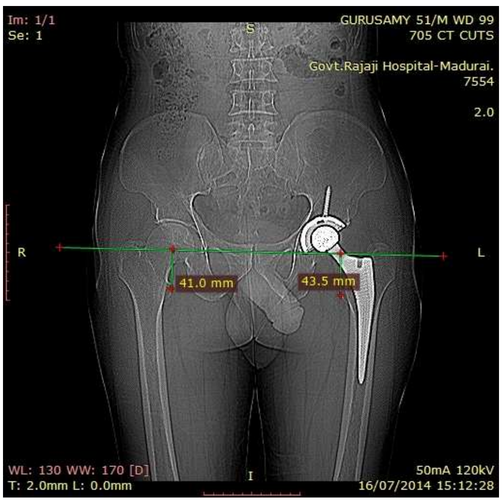


X-RAY ANTEVERSION -17.2°

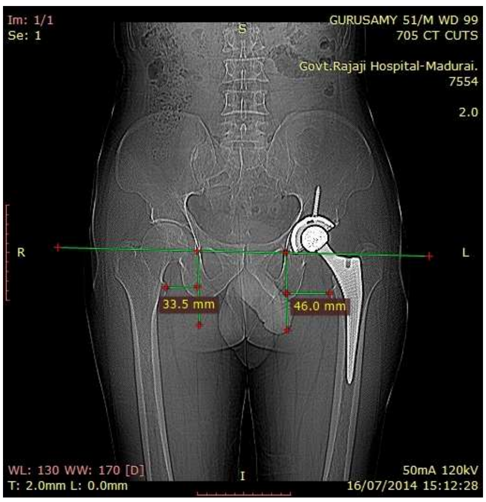
CT- ANTEVERSION - 13°



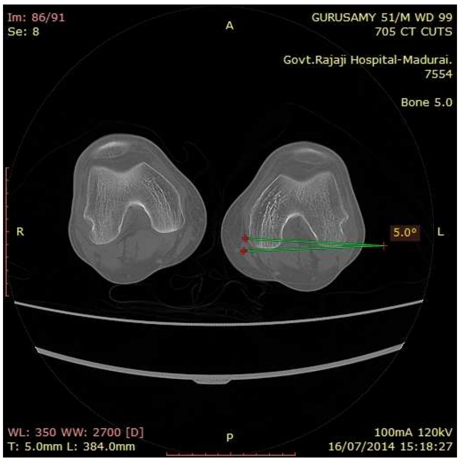
CUP INCLINATION - 37°

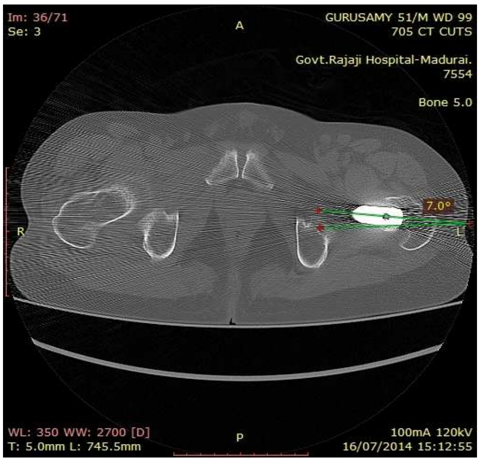


LIMB LENGTH DISCREPANCY -2.5 mm



CUP OFFSET - 12.5mm

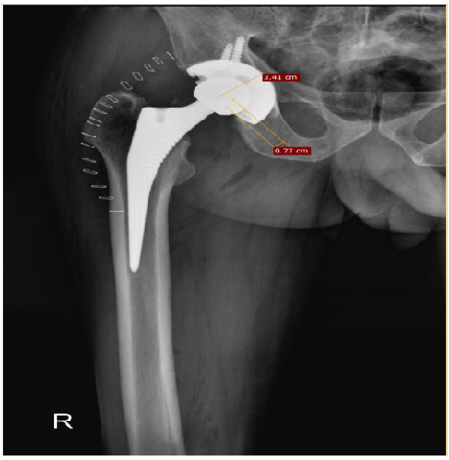




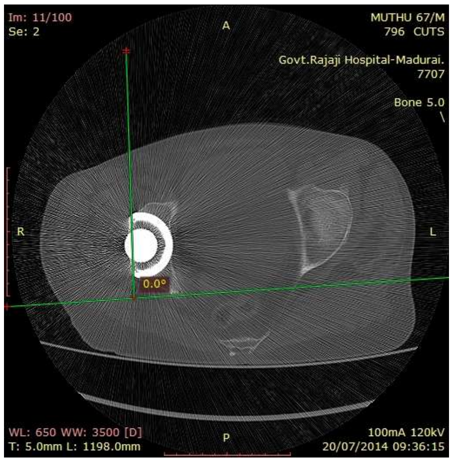
FEMORAL ANTEVERSION - 12°

X RAY ANTEVERSION	17.2°
CT CUP ANTEVERSION	13°
FEMUR ANTEVERSION	12°
COMBINED ANTEVERSION	25°
CUP INCLINATION	37°
LLD	2.5mm
CUP OFFSET	12.5mm
STEM POSITION	NEUTRAL
MOD.HARRIS HIP SCORE	89(GOOD)

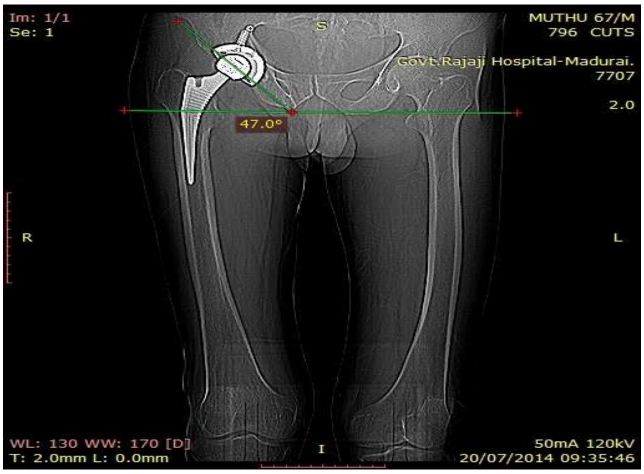
CASE -5



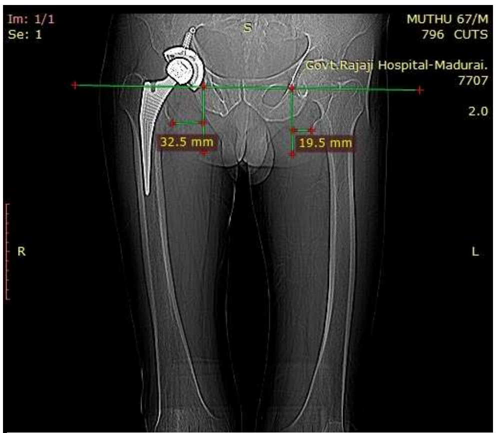
X- RAY ANTEVERSION - 13.0°



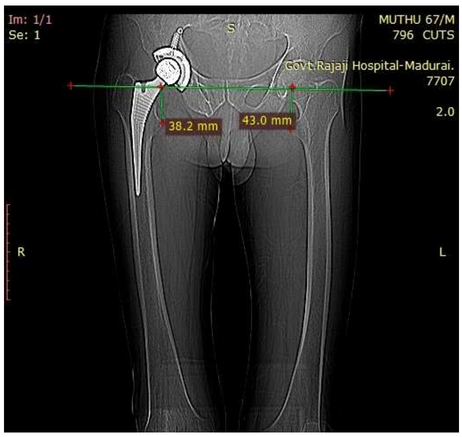
CT-ANTEVERSION - 0°



CUP INCLINATION - 47°



CUP OFFSET - 13mm

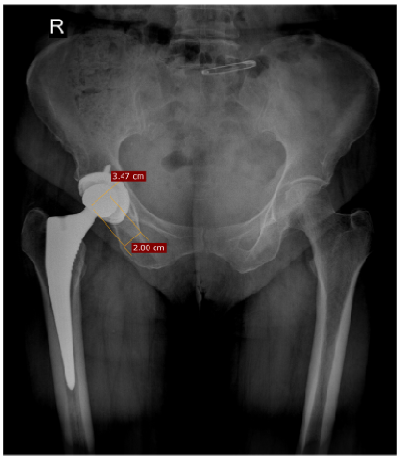


LIMB LENGTH DISCREPANCY - 4.8mm

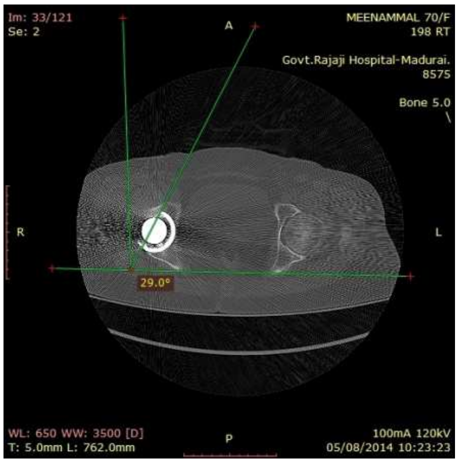
FEMORAL ANTEVERSION - 9°

X RAY ANTEVERSION	13.0°
CT CUP ANTEVERSION	0°
FEMUR ANTEVERSION	9°
COMBINED ANTEVERSION	9°
CUP INCLINATION	47°
LLD	4.8mm
CUP OFFSET	13mm
STEM POSITION	VARUS
MOD.HARRIS HIP SCORE	72(FAIR)

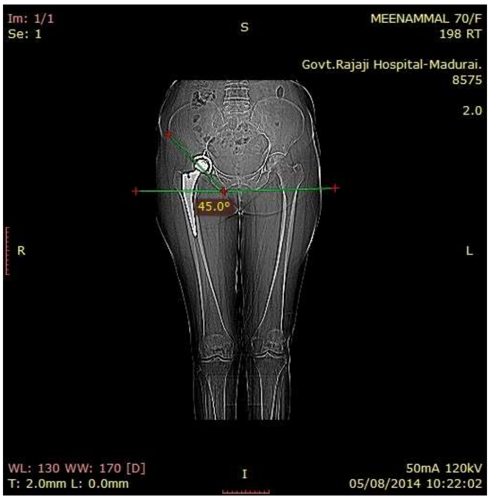
CASE - 6



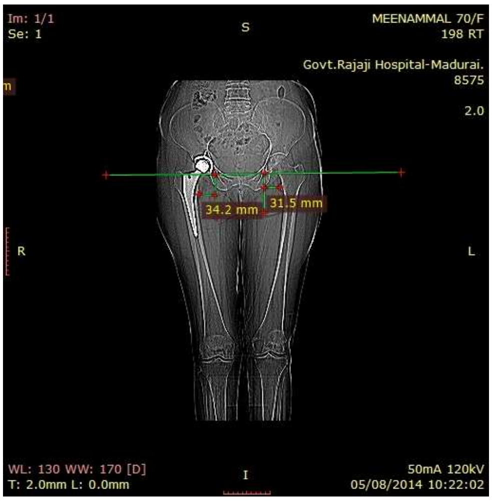
X RAY ANTEVERSION - 35.1°



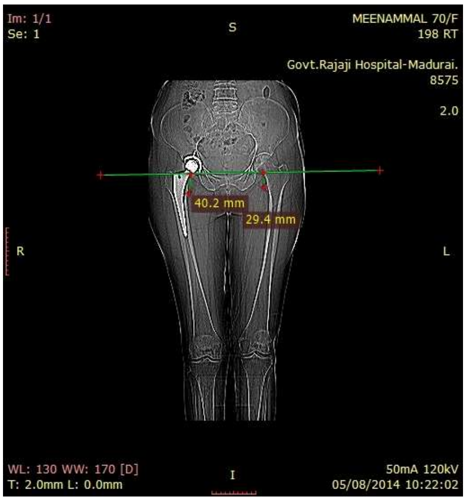
CT ANTEVERSION - 29°



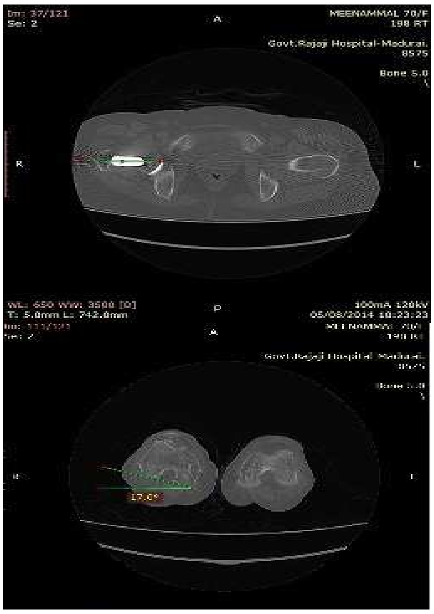
CUP INCLINATION - 45°



CUP OFFSET -2.7mm



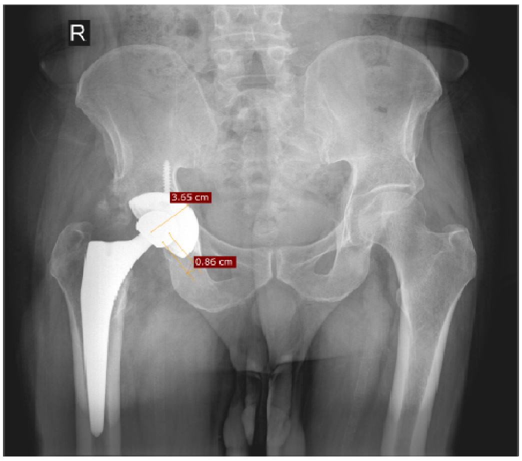
LIMB LENGTH DISCREPANCY - 10.8mm



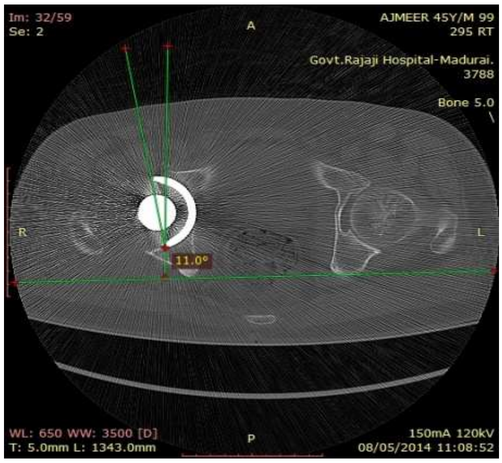
FEMORAL ANTEVERSION -17°

X RAY ANTEVERSION	35.1°
CT CUP ANTEVERSION	29°
FEMUR ANTEVERSION	17°
COMBINED ANTEVERSION	46°
CUP INCLINATION	45°
LLD	10.8mm
CUP OFFSET	2.7mm
STEM POSITION	VARUS
MOD.HARRIS HIP SCORE	72(FAIR)

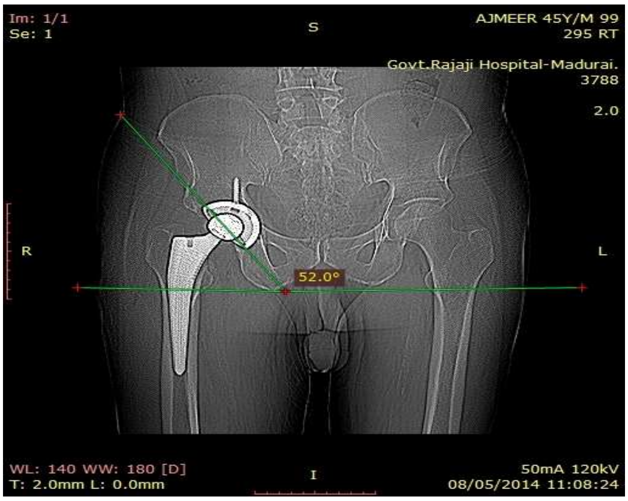
CASE - 7



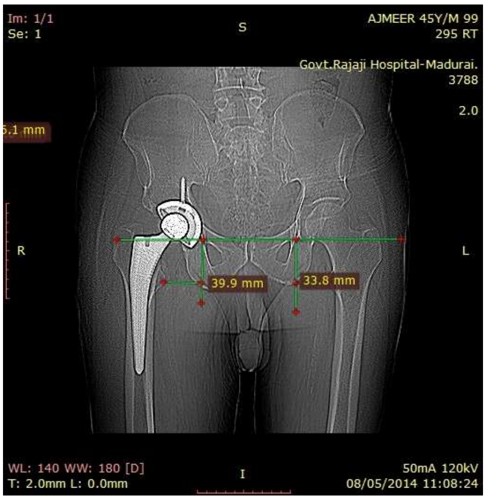
X RAY ANTEVERSION - 13.6°



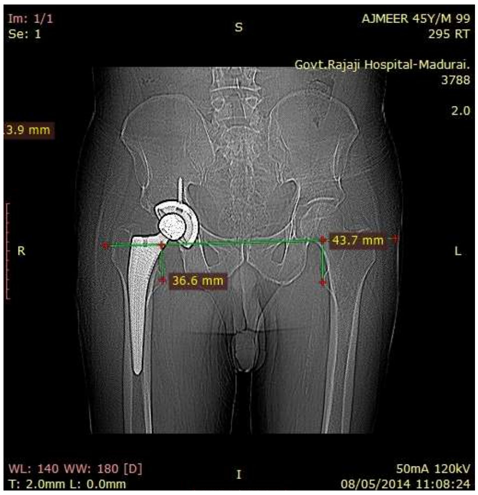
CUP -11° Retroversion



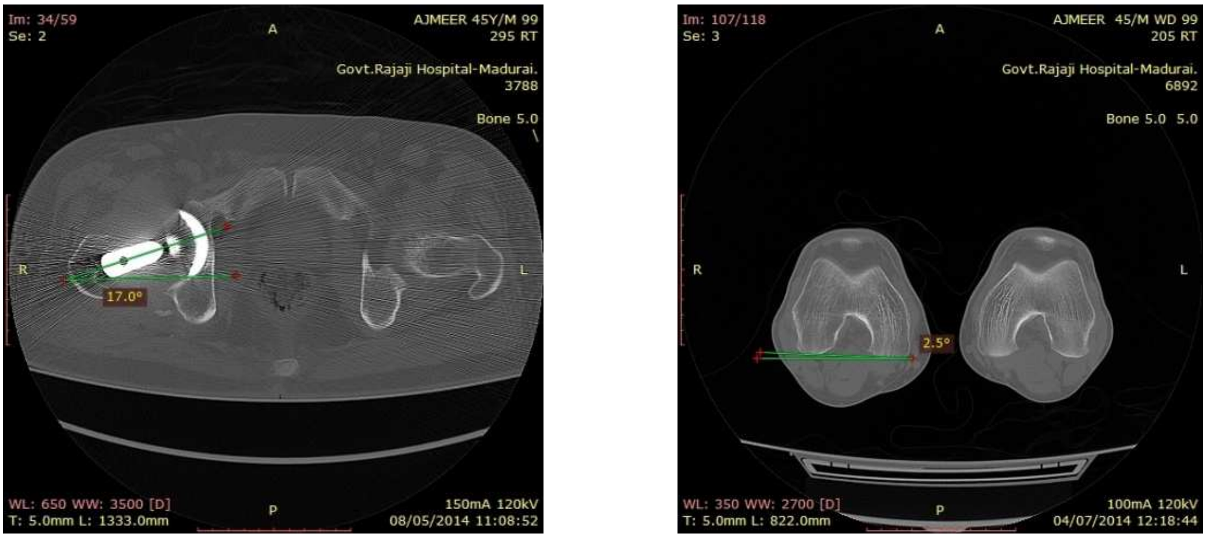
CUP INCLINATION - 52°



CUP OFFSET - 6.1mm



LIMB LENGTH DISCREPANCY - 7.1mm



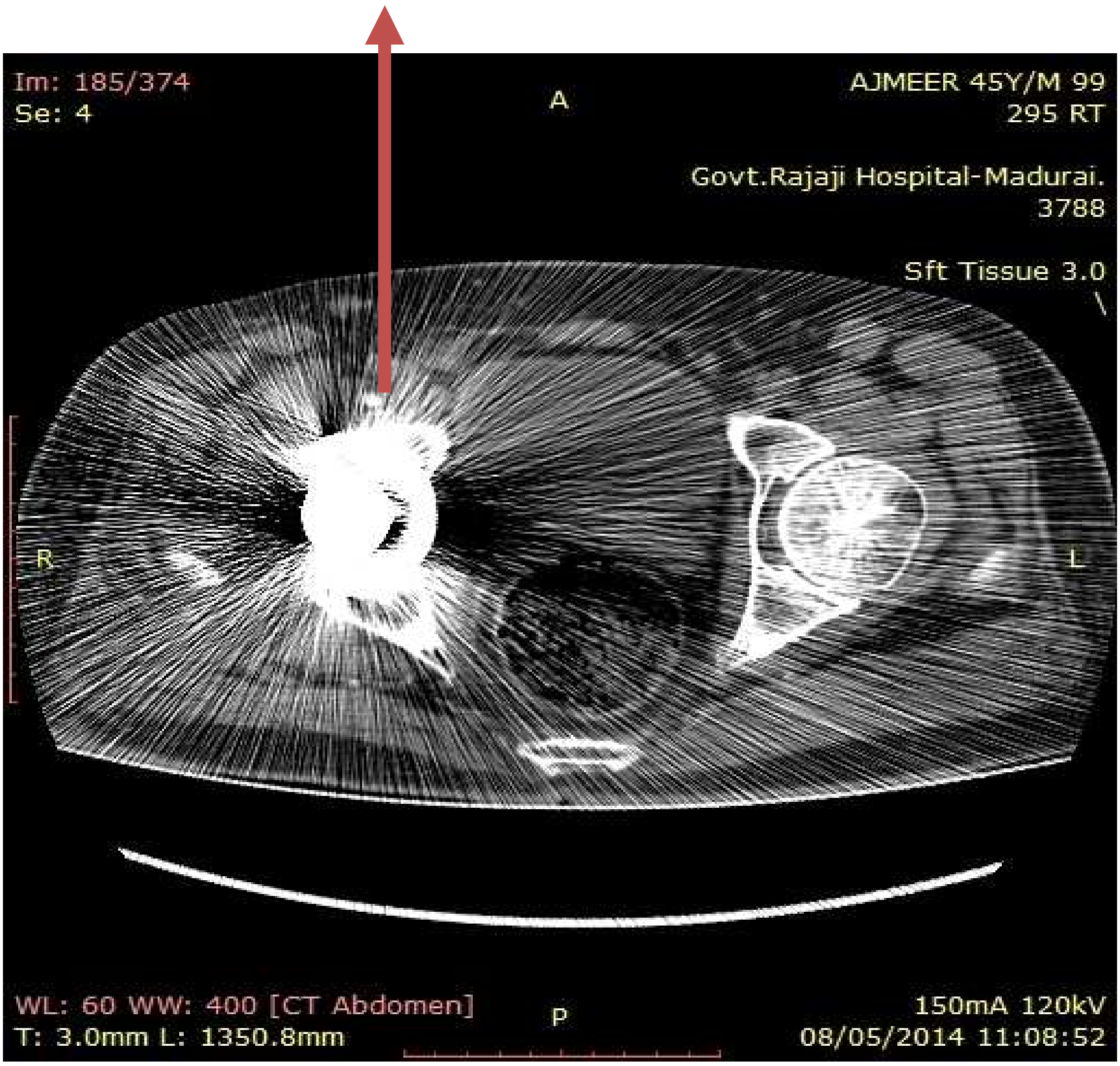
FEMUR ANTEVERSION - 19.5°

NOT ABLE TO DO STRAIGHT LEG RAISING TEST

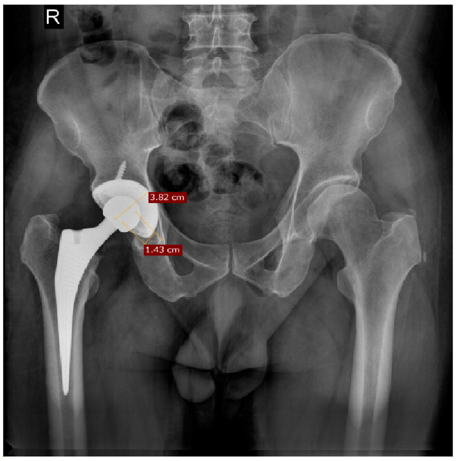
X RAY ANTEVERSION	13.6°
CT CUP ANTEVERSION	11° retroversion
FEMUR ANTEVERSION	19.5°
COMBINED ANTEVERSION	8.5°
CUP INCLINATION	52°
LLD	7.1mm short
CUP OFFSET	6.1mm
STEM POSITION	NEUTRAL
MOD.HARRIS HIP SCORE	66(POOR)

This patient with retroverted cup of 11 ° is not able to active straight leg raising test,with painful range of motion.CT scan revealed an impinging lesion in iliopsoas tendon,with calcification.

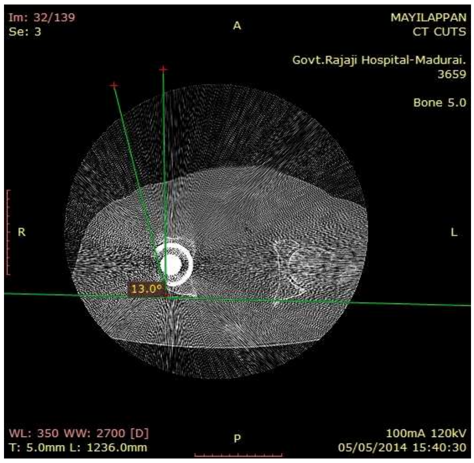
IMPINGING LESION IN ILIOPSOS TENDON



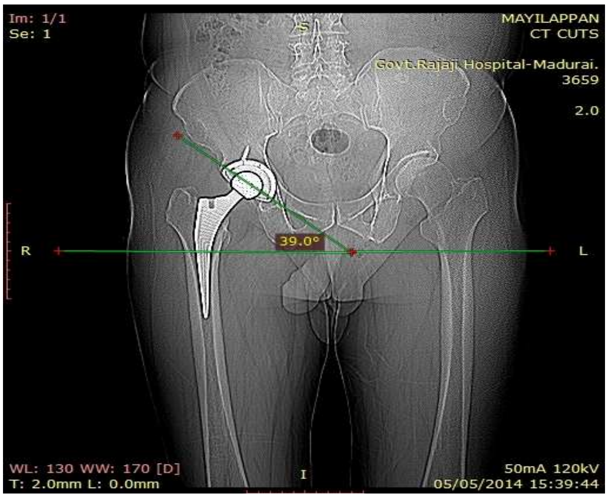
CASE - 8



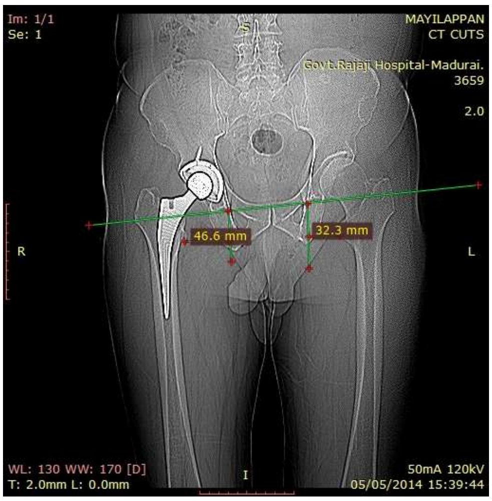
X RAY ANTEVERSION - 21.9°



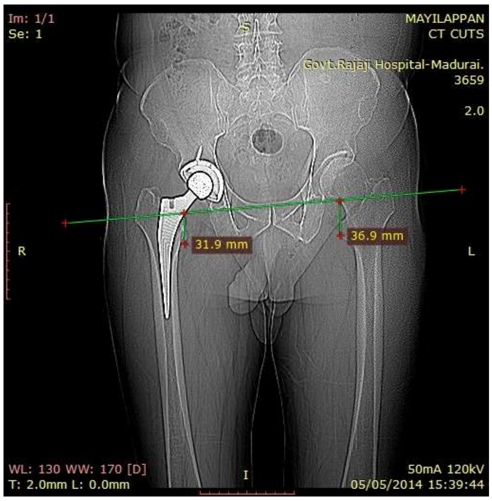
CT CUP -13° Retroversion



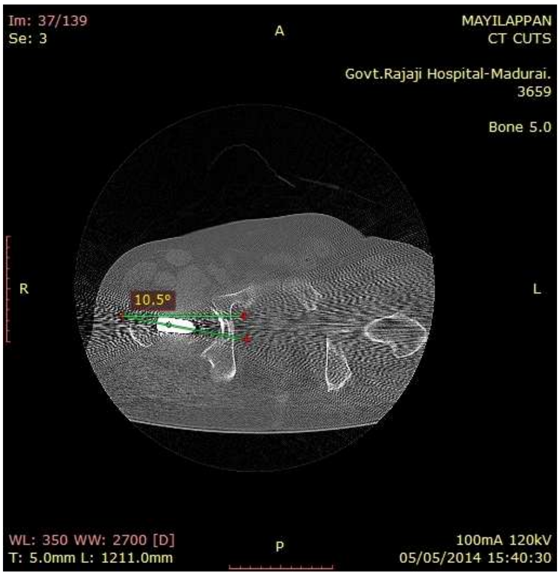
CUP INCLINATION - 41°



CUP OFFSET- 10.5 mm



LIMB LENGTH DISCREPANCY -2.3mm

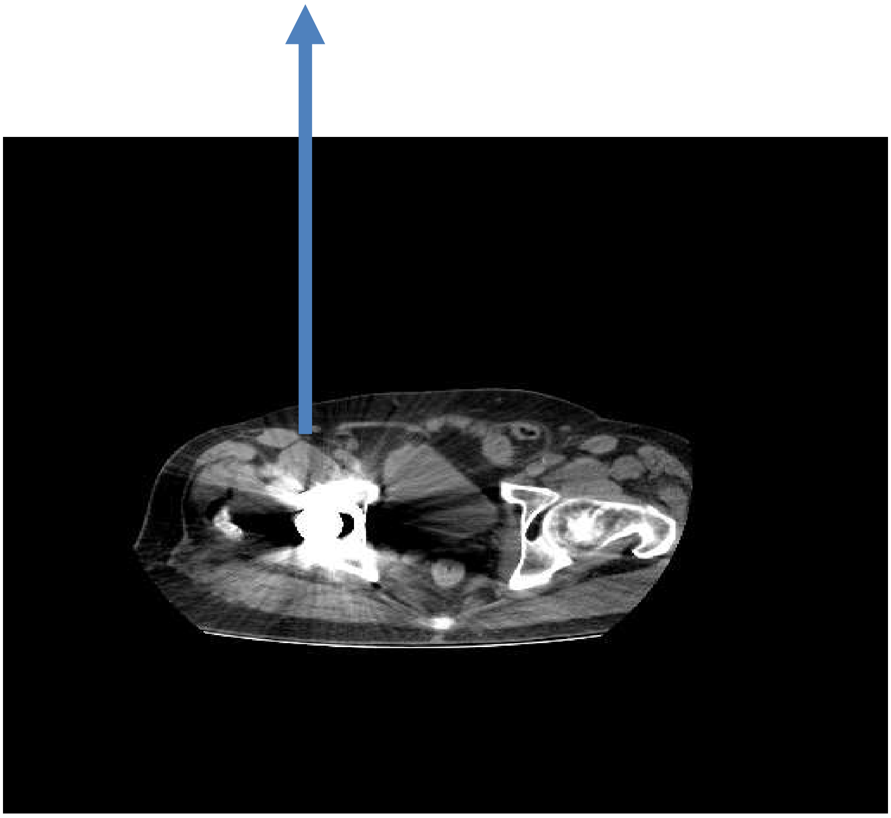


FEMORAL ANTEVERSION - 16.5°

X RAY ANTEVERSION	21.9°
CT CUP ANTEVERSION	13° retroversion
FEMUR ANTEVERSION	16.5°
COMBINED ANTEVERSION	3.5°
CUP INCLINATION	41°
LLD	2.3 mm short
CUP OFFSET	10.5mm
STEM POSTION	NEUTRAL
MOD.HARRIS HIP SCORE	64(POOR)

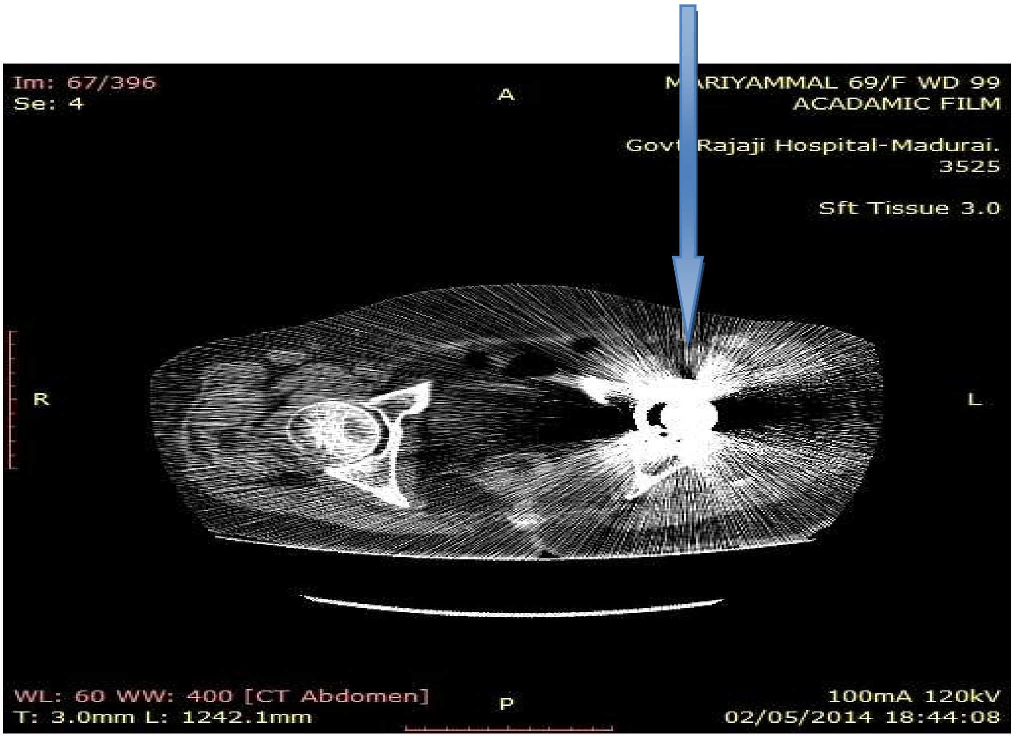
This patient with poor outcome is having retroverted cup of 13° and combined anteversion of 3.5°. This patient is not able active straight leg raising test and also pain during external rotation.CT scan reveals an impinging lesion in lesser trochanter with calcification and thickened iliopsoas tendon.

IMPINGING LESION AND THICKENED ILIOPSOAS TENDON



Another patient with poor outcome also revealed an impinging lesion in CT scan.

IMPINGING LESION OVER THE ILIOPSOAS



DISCUSSION:

Although Total Hip Replacement (THR) is considered a very successful surgical intervention, a proportion of patients experience persistent pain or disability, and/or dissatisfaction with the outcome of surgery. Our aim is to determine whether post-operative radiographic variables are predictive of patient-reported pain, function and satisfaction after primary THR.

In our study we analysed 40 cases of uncemented Total hip arthroplasty done for neck of femur fractures and non union neck of femur ,with X-rays and CT scan who turned out for follow up between the study period of September 2012-September 2014.

The post-operative radiographic variables were measured and they were statistically analysed with Modified Harris hip score to find any significant difference in functional outcome following the placement of cup and stem position in Total hip arthroplasty patients.

In our study,it was found that measurements of offset restoration,leg length restoration,femoral stem alignment, acetabular inclination and cup anteversion by Widmer's method of anteversion are not significant predictors of patient reported outcome after primary THR in neck of femur fractures.

In our study, it was found that that there exists a significant difference between CT-anteversion and combined anteversion with patient outcome following primary total hip arthroplasty in neck of femur fractures and no difference in patient outcome with Femoral anteversion.

In 2012 Hip International , Wylde et al[2] in his study of 452 THR patients ,found that offset restoration,leg length restoration,femoral stem alignment and acetabular inclination in plain radiographs were found not to be significant predictors of patient reported pain,function or satisfaction at 1-3 years of THR.

In the Journal of Bone Joint Surgery British 2002, White TO et al[66] in his study of 200 THR patients , assessed leg length 6 months post -operatively, either radiological lengthening of 35mm or shortening of 21mm ,and found that there was no association between leg length ratio and the Harris Hip Score,SF -36 or patient satisfaction.

In Journal of Arthroplasty 2008, Min BW et al[67] in his study of 98 patients with cementless primary Total hip arthroplasty with mean follow up of 7.7 years (range 5-11 years) ,with neutral, 62 hips (63%); valgus, 20 hips (21%); and varus, 16 hips (16%) published, found that there is no difference in the Harris Hip Score or the incidence of thigh pain between patients with neutral,valgus or varus alignment of femoral stem. For all hips, radiographs showed stable osseous fixation of the stem and the cup.

In Acta Orthop Scand 2002, Iwase et al[68] analysed the radiographic and clinical outcome of the ScanHip total hip arthroplasty in 72 patients after 10 years of primary Total hip Arthroplasty , found no significant difference in pain or satisfaction between patients with loose and stable components in his study published

In Acta Orthop Scand 2001,Soderman et al[69] in his study of 344 patients of primary total hip arthroplasty done between 1986-1995 were analysed using the Harris Hip Score and conventional radiographic examination as outcome measures.They found no significant differences in pain or function in patients with or without evidence of radiographic failure at 2-10 years post operatively.

All these studies found that there is lack of association between radiographic changes measured on plain radiographs and patient- reported symptoms after primary THR. These studies also support our study that there is lack of correlation between post-operative radiographic variables measured in plain X-ray and functional outcome by Modified Harris Hip Score.

In our study it was found there is significant difference in functional outcome with changes in CT-anteversion and Combined Anteversion values.Many studies have proved that ideal cup anteversion and combined anteversion is essential and critical for preventing impingement phenomenon,dislocation,accelerated wear and longevity of implant.

In our study of 40 patients,it was found that 10 patients had excellent,18 patient with good,6 patients with fair and 6 patients with poor outcome based on Modified Harris Hip Score.

Six patients with poor outcome the acetabular cup position is found to retroverted in CT scans.Of these 3 patients have been found to have calcification in iliopsoas tendon around 1 year of follow up .These patients complain of groin pain and pain during activities of daily living relieved by analgesics.

Three patients with impinging lesion in the iliopsoas tendon were found to have pain during active straight leg raising and painful and restricted range of motion.These patients also complained of pain during passive resistance during hip flexion and external rotation.

CT scans of these six patients with retroverted cups, showed 3 patients with calcification over iliopsoas tendon and all patients have been to have excessive prominence of anterior flange of acetabular cup.

All these 6 patients with retroverted cups have a combined anteversion value of less than 15° well below the normal values, ranging from 3.5° to 12°. Many studies have proved that main risk factors for impingement phenomenon[70,71,72] is implant malposition , with retroverted cups.Implant malposition also leads to decrease in combined anteversion values.

In our study, it shows that retroverted cups are the risk factor of impinging lesion and the cause of pain after THR in these 6 patients with poor outcome.

In our study, we also analysed the correlation between Widmer's anteversion method of cup anteversion and CT- anteversion.Various studies have shown that Widmers method of measuring anteversion by plain radiographs are comparable with CT-version values.In our study also both X-ray and CT-anteversion were found to be statistically significant correlation values. CT is the best method to measure version values of cup and stem and thus combined anteversion.Measuring anteversion of cup with X-rays is associated with margin of error as the version values changes with the position of patient.

LIMITATIONS :

The limitations in our study is the small sample size,and short period of follow-up.Our study is not conducted on various other hip pathologies where Total hip replacement was done,where the significance of post-operative variables with their functional outcome has to be done.

The advantage of our study is that it excluded patients with other pathologies of hip with deformity and thus exclude the bias in outcome of our study.

CONCLUSION

1) Implant position especially Cup anteversion and Combined anteversion of cup and stem is a critical factor in both short-term and long-term outcome of patients with Total hip Arthroplasty.

2)Radiographic variables Cup offset,Cup inclination.leg length and femoral stem alignment were not found be significant predictors of functional outcome of the patient based on Modified Harris Hip Score.

3)CT scan is the best method to find version of cup and stem and thus combined anteversion.

4)Retroversion of cup is one of the major cause of impingement and thus pain after uncemented Total hip arthroplasty.

5)Iliopsoas impingement is a cause of persistent pain after total hip arthroplasty in retroverted cups and is frequently underdiagnosed.

6)Cup position alone is not significant predictor of patient outcome,Combined anteversion of cup and stem is critical for long term outcome of patients with primary Total Hip Arthroplasty.

Though short term follow up our study signifies the importance of version of cup and stem and long term follow up is essential for patient reported outcome in primary Total hip arthroplasty.

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SNO	AGE /SEX	DOS	DIAGNOSIS	X-RAY AV	CT-AV	CUP INCLINATION	CUP OFFSET	LLD	FEMUR AV	CAV	Femoral stem	MOD . HHS
1	65/M	20/12/12	NON UNION NOF RT	22.3	23	82.1	Dec 0.42	4	15.5	38.5	N	76
2	63/f	14/01/14	# NOF Lt	12.8	10	40	3.5	6	24	34	valgus	84
3	63/M	03/10/13	# NOF Rt	15.4	18	40	14.6	Nil	17	35	varus	91
4	59/M	21/01/13	#NOF RT	27.6	20	59	12.6	5	18.5	38.5	N	91
5	50/M	07/11/13	Non union NOF t	17.2	13	37	12.5	2.5	12	25	N	89
6	62/M	22/01/14	# NOF Rt	10.3	12	58	8.5	8.5	19.5	31.5	valgus	91
7	65/M	22/08/13	# NOF Rt	17.4	15	42	4	4	19	34	N	84
8	51/m	31/03/14	# NOF Lt	20.1	13	52	0.8	5	17	30	N	87
9	65/m	29/01/14	# NOF Rt	21.7	13.5	56	14.3	6.8	15.5	29	valgus	86
10	50/F	30/07/13	# NOF Rt	22.4	30	45	3.8	26.6	15	45	N	85
11	52/M	16/04/13	Non union NOF Rt	24.6	25	43	13	11.1	21	46	valgus	80
12	69/F	29/04/14	# NOF Lt	11.1	3RV	59	9.9	2.4	9	12	N	66
13	61/M	03/10/13	# NOF Rt	21.9	13 RV	41	10.5	2.3 short	16.5	3.5	N	64
14	65/F	12/12/13	Non union NOF Lt	6.6	8 RV	40	5.7	2.3	14	6	N	69
15	60/m	17/03/14	Non union NOF Lt	11.0	8	39	12.0	6.6	8.5	16.5	valgus	85
16	62/M	21/11/12	#NOF Lt	6.8	15	45	12	7.3	20.5	35.5	varus	91
17	60/M	03/07/13	# NOF Rt	13.0	0	47	13.0	4.8	9	9	varus	72
18	53/M	17/10/13	# NOF Rt	20.9	24	46	13.9	5	15	39	N	91

19	58/F	23/01/14	#NOF Rt	16.0	10. 5RV	57	9.7	8.2	17	6.5	N	65
20	53/ M	14/02/13	#NOF Rt	23.8	25	51	6.0	10	23.5	48. 5	valgus	91
21	65/F	30/04/14	# NOF RT	6.8	8	54	8	11.3	24	32	varus	82
22	55/F	17/06/13	#NOF Lt	12.5	13	27	5	6.8	29.5	42. 5	N	81
23	65/ M	23/04/13	#NOF Lt	11.2	6.5	37	4.5	6.5	28	34.5	valgus	91
24	55/F	29/04/13	# NOF LT	9.8	10.5	50	17.5	4.7	15.5	26	N	82
25	50/ M	07/08/13	Non union nof Rt	14.8	13	46	9.7	13	21	34	N	76
26	75/F	17/04/14	# NOF RT	26.2	30	45	4.2	10.5	10.5	40.5	N	81
27	50/F	17/03/13	# NOF Rt	12.5	12	46	5	8	19	31	N	87
28	70/F	12/02/14	# NOF	6.6	11	40	2.9	5	8.5	19.5	valgus	75
29	62/ M	11/07/13	#NOF Rt	20.1	11	38	15.4	11.4	18	29	N	88
30	76/ M	21/08/13	#NOF Lt	24.3	14	35	12.4	12	20.5	34.5	varus	88
31	52/ M	30/05/13	# NOF Rt	18	22	63	1.2	3.7	13	35	N	82
32	52/F	26/03/14	# NOF Lt	11.1	25	42	8.5	Nil	9	34	N	82
33	50/ M	17/03/14	# NOF Rt	16	11 RV	25	6.5	2.5	16.5	5.5	varus	66
34	70/F	15/03/14	#NOF RT	35.1	29	45	2.7	10.8	17	46	varus	72
35	70/F	05/09/13	Non union nof Rt	13.0	15	55	5.4	Nil	19	34	valgus	79
36	50/ M	02/04/14	#NOF Rt	13.6	11 RV	52	6.1	7.1mm short	19.5	8.5	N	66
37	55/ m	13/02/13	Nonunion left	11.3	14	50	7.5	6.8	16	30	N	94
38	56/ M	11/09/12	#nof rt	13.2	17	42	8.5	7.4	16	33	Valgus	94
39	58/ M	17/06/13	Non union LT	14.5	16	49	7.8	6.5	18	34	N	88
40	55/ M	15/04/13	Non union Rt	14.3	19	44	5.3	4.5	18	37	N	94

MODIFIED HARRIS HIP SCORE

Pain:

_ None/ignores (44points) .
_ Slight, occasional, no compromise in activity (40 points) .
_ Mild, no effect on ordinary activity, pain after activity, uses aspirin (30 points) .
_ Moderate, tolerable, makes concessions, occasional codeine (20 points) .
_ Marked, serious limitations (10 points) .
_ Totally disabled (0 points) .

Function: Gait

Limp :

_None (11 points) .
_Slight (8 points) .
_Moderate (5 points) .
_Severe (0 points).
_Unable to walk (0 points) .

Support
_None (11 points).
_Cane, long walks (7 points).
_Cane, full time (5 points).
_Crutch (4 points).
_2 canes (2 points).
_2 crutches (1 points).
_Unable to walk (0 points).

Distance Walked
_Unlimited (11 points)
_6 blocks (8 points)
_2-3 blocks (5 points)
_Indoors only (2 points)
_Bed and chair (0 points)

Functional Activities:

Stairs
_Normally (4 points) .
_Normally with banister (2 points).
_Any method (1 points).
_Not able (0 points).

Socks/Shoes
_With ease (4 points) .
_With difficulty (2 points) .
_Unable (0 points) .

Sitting
_Any chair, 1 hour (5 points) .
_High chair, ½ hour (3 points) .
_Unable to sit, ½ hour, any chair (0 points) .

Public Transportation
_Able to enter public transportation (1 points) .
_Unable to use public transportation (0 points).

ABSENCE OF DEFORMITY(All Yes =4;Less than =0)

Less than 30° fixed flexion contracture Yes/No

Less than 10° fixed adduction Yes /No

Less than 10° fixed internal rotation Yes/No

In extension

Limb length discrepancy less than 3.2cm: Yes /No

RANGE OF MOTION:

Flexion(140°)

Abduction(40°)

Adduction (40°):

Internal rotation(40°)

External rotation(40°)

RANGE OF MOTION SCALE:

211-300° (5)

161 -210°(4)

101 - 160°(3)

61 - 100°(2)

31 - 60 ° (1)

00 - 30° (0)

Range of motion score:

Total Harris hip score :

Ref.No.8102/E1/5/2014

Madurai Medical College,
Maduai -20. Dated: 24.09.2014.

Institutional Review Board/Independent Ethics Committee
Capt.Dr.B.Santhakumar,MD (FM). deanmdu@gmail.com
Dean, Madurai Medical College &
Government Rajaji Hospital, Madurai 625 020 . Convenor

Sub: Establishment – Madurai Medical College, Madurai-20 –
Ethics Committee Meeting – Meeting Minutes - for September 2014 –
Approved list – reg.

The Ethics Committee meeting of the Madurai Medical College, Madurai was held on September 12th 2014 at 10.00 Am to 12.00 Noon at Anaesthesia Seminar Hall at Govt. Rajaji Hospital, Madurai . The following members of the Ethics Committee have attended the meeting.

1.Dr.V.Nagarajan,M.D.,D.M(Neuro) Ph: 0452-2629629 Cell No.9843052029 nag9999@gmail.com.	Professor of Neurology (Retired) D.No.72, Vakkil New Street, Simmakkal, Madurai -1	Chairman
2.Dr.Mohan Prasad, MS.M.Ch. Cell.No.9843050822 (Oncology) drbkcmp@gmail.com	Professor & H.O.D of Surgical Oncology (Retired) D.No.32, West Avani Moola Street, Madurai.-1	Member Secretary
3. Dr.L.Santhanalakshmi, MD (Physiology) Cell No.9842593412 dr.l.santhanalakshmi@gmail.com.	Vice Principal, Prof. & H.O.D. Institute of Physiology Madurai Medical College	Member
4.Dr.K.Parameswari, MD(Pharmacology) Cell No.9994026056 drparameswari@yahoo.com.	Director of Pharmacology Madurai Medical College.	Member
5.Dr.S.Vadivel Murugan, MD., (Gen.Medicine) Cell No.9566543048 svadivelmurugan_2007@rediffmail.com.	Professor & H.O.D of Medicine Madurai Medical College	Member
6.Dr.A.Sankaramahalingam, MS., (Gen. Surgery) Cell.No.9443367312 chandrahospitalmdu@gmail.com	Professor & H.O.D. Surgery Madurai Medical College.	Member
7.Mrs.Mercy Immaculate Rubalatha, M.A., Med., Cell.No.9367792650 lathadevadoss86@gmail.com	50/5, Corporation Officer's Quarters, Gandhi Museum Road, Thamukam, Madurai-20.	Member
8.Thiru.Pala.Ramasamy, B.A.,B.L., Cell.No.9842165127 palaramasamy2011@gmail.com	Advocate, D.No.72,Palam Station Road, Sellur, Madurai-20.	Member
9.Thiru.P.K.M.Chelliah, B.A., Cell No.9894349599 pkmandco@gmail.com	Businessman, 21 Jawahar Street, Gandhi Nagar, Madurai-20.	Member

The following Project was approved by the Ethical Committee

Name of P.G.	Course	Name of the Project	Remarks
Dr.L.Thamizharasan drthamizha@yahoo.com	PG in MS (Orthopedic), Madurai Medical College and Govt. Rajaji Hospital, Madurai.	**A study on post-operative radiographic factors and patient reported outcome following total HIP Arthroplasty.**	**Approved**

Please note that the investigator should adhere the following: She/He should get a detailed informed consent from the patients/participants and maintain it Confidentially.

1. She/He should carry out the work without detrimental to regular activities as well as without extra expenditure to the institution or to Government.
2. She/He should inform the institution Ethical Committee, in case of any change of study procedure, site and investigation or guide.
3. She/He should not deviate the area of the work for which applied for Ethical clearance. She/He should inform the IEC immediately, in case of any adverse events or Serious adverse reactions.
4. She/He should abide to the rules and regulations of the institution.
5. She/He should complete the work within the specific period and if any Extension of time is required He/She should apply for permission again and do the work.
6. She/He should submit the summary of the work to the Ethical Committee on Completion of the work.
7. She/He should not claim any funds from the institution while doing the work or on completion.
8. She/He should understand that the members of IEC have the right to monitor the work with prior intimation.

Member Secretary
Ethical Committee

Chairman
Ethical Committee

24.9.14
DEAN/Convenor
Madurai Medical College &
Govt. Rajaji Hospital, Madurai.

24/9/14

To
The above Applicant
-thro. Head of the Department concerned

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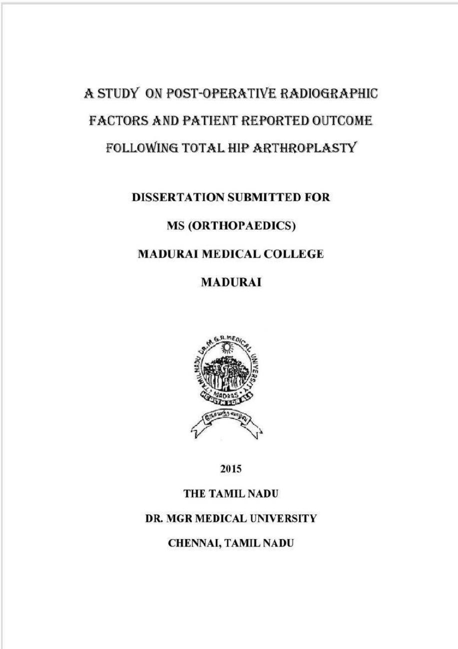

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DISSERTATION SUBMITTED FOR

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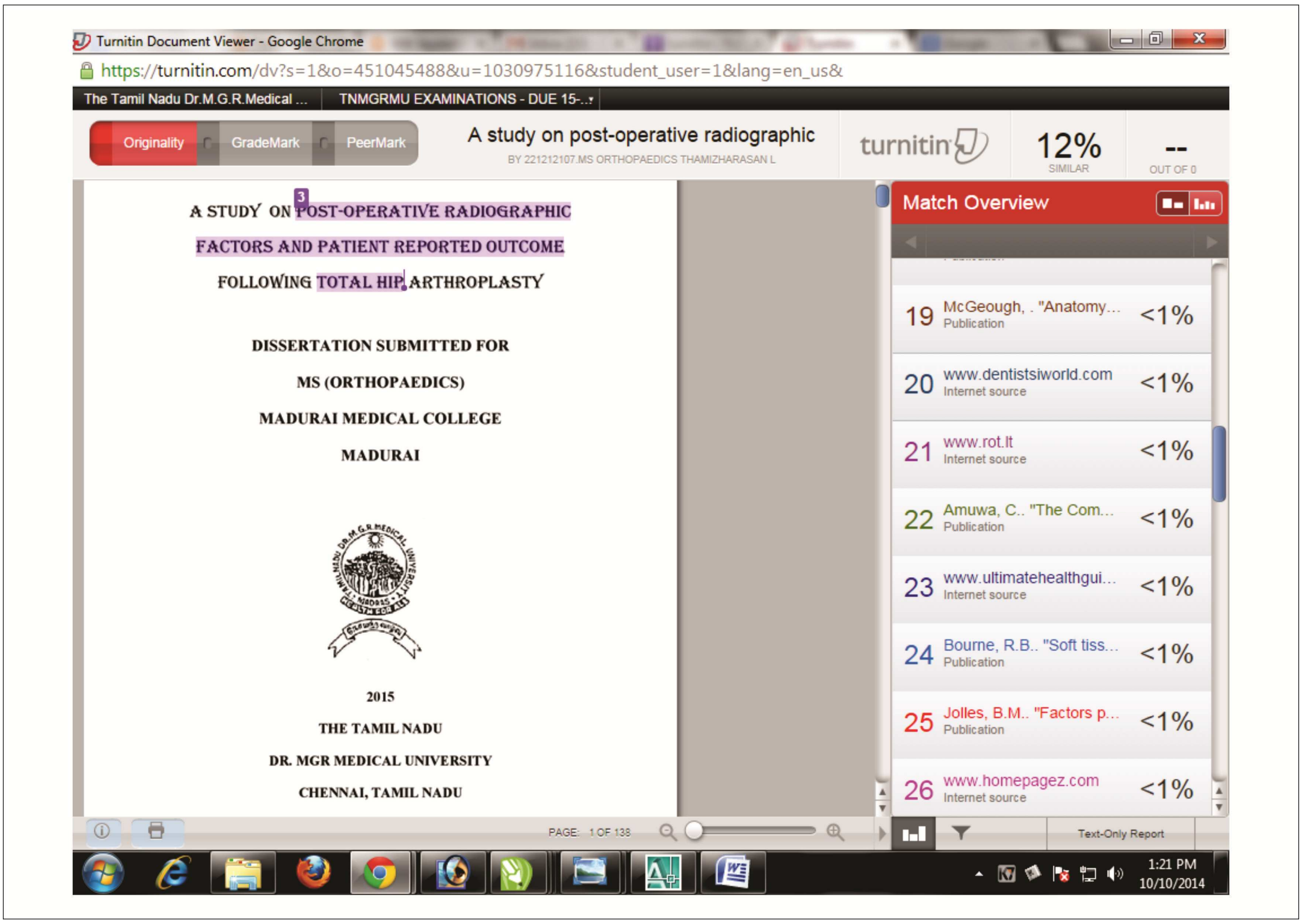
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