"ANALYSIS OF ACETABULAR CUP POSITIONING AND FUNCTIONAL OUTCOME IN TOTAL HIP REPLACEMENT"

Dissertation submitted to

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BRANCH - II

ORTHOPAEDIC SURGERY

KILPAUK MEDICAL COLLEGE

CHENNAI – 600 010

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CERTIFICATE

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DECLARATION BY THE CANDIDATE

I declare that this dissertation entitled "ANALYSIS OF ACETABULAR CUP POSITIONING AND FUNCTIONAL OUTCOME IN TOTAL HIPREPLACEMENT" submitted by me for the degree of M.S. is the record of work carried out by me during the period of August 2013 to August2015under the guidance of **P**rof**. DR. R. BALACHANDRAN, M.S.Ortho., D.Ortho,** Professor, Department of Orthopaedics, Govt. Royapettah hospital and Govt. Kilpauk Medical College, Chennai. This dissertation is submitted to **The Tamilnadu Dr.M.G.R. Medical University**, Chennai, in partial fulfillment of the University regulations for the award of degree of M.S.ORTHOPAEDICS (BRANCH-II) examination to be held in April 2016.

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INTRODUCTION

INTRODUCTION

Total hip replacement, nowadays have become commonly performed reconstructive hip procedure for various hip disorders.

Even though various procedure like osteotomy Excisional arthroplasty, Arthrodesis, hemiarthroplasty are available for various hip pathology, it still poses a formidable task for the orthopaedician to give stable hip.

Excision arthroplasty gives pain free hip, but at the expense of producing an unstable gait.

The osteotomy is useful in early stage of unilateral hip pathology especially in young adult, its use is limited in end stage arthritis of hip.

Arthrodesis gives a pain free stable joint at the expenses of producing much strain on the lumbar spine and knee joint.

Hemiarthroplasy is appropriate in elderly individual as the acetabular cartilage undergoes early wear on articulation with metal. It is unsuitable for patient with involvement of acetabulum.

Considering all factor, total hip replacement has as a treatment of choice in patient with arthritis of hip and neck of femur fracture in young patients. It has overcome most of the drawbacks encountered with other procedures.

In total hip replacement, the position of acetabular cup version is one of the important factor which influence the functional outcome of Total hip replacement. The dislocation rate and good availability of hip movements are majorly depends on acetabular cup version.

AIM OF THE STUDY

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The aim of this study is an analysis of acetabular cup positioning and functional outcome in total hip replacement.

REVIEW OF LITERATURE

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HISTORICAL REVIEW

History and evolution of Total hip replacement dates way back to mid 19 th century when John Rhea Barton -1826, just attempted to give ankylosed hip a mobile one by Intertrochanteric osteotomy.

In 1840, Carnohan developed the idea of inserting interposing material after an osteotomy of the ankylosed joint.

First Total hip replacement was performed by Gluck in 1890 using an ivory ball and socket in which a cemented type material was used.

Wiles, the originator of the present day Total hip replacement, first described the stainless steel Total hip replacement in 1938.

Modern Era of Total hip replacement began when Sir John Charnley in 1960 used stainless steel replacement for proximal femur articulating with high density polyethylene acetabular implant, both component being securely fixed to the underlying bone by polymethyl methacrylate cement [PMMA].

In 1962, John Charnley performed first cemented Total hip replacement using Ultra High Molecular Weight Polyethylene [UHMPE]

and stainless steel prosthesis. Also he developed the principle of low friction Arthroplasty and advocated use of PMMA as a weight transmitting material.

Maurice Muller, another legend in orthepaedics, in 1966 developed a plastic acetabular cup with 32 mm chromium –cobalt –molybdenum femoral head.

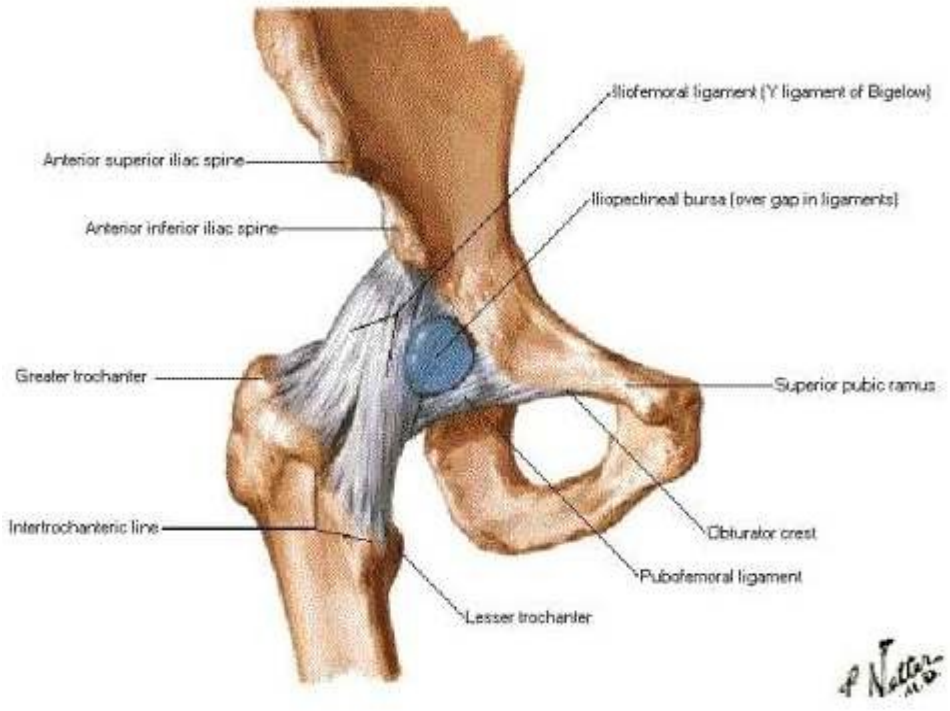
Later in 1977, he modified Total hip replacement by using a straight stem femoral prosthesis which is now in use, instead of a curved stem prosthesis.

GROSS ANATOMY OF THE HIP JOINT

GROSS ANATOMY OF THE HIP JOINT

The hip joint is a ball-and-socket joint, formed by head of the femur and cup-shaped cavity of the acetabulum. The ball-and-socket type of architecture provides it a high degree of the stability as well as a good range of movement. The articular cartilage on the head of the femur, thicker at the center than at the circumference, covers the entire surface with the exception of the fovea, to which the ligamentum teres is attached. The articular cartilage on the acetabulum forms an incomplete marginal ring, the lunate surface. Weight bearing occurs in the upper part of the acetabulum where the cartilagenous strip is widest. In lunate surface, fat is present and covered by synovium.

The articular capsule is strong and dense. Above, it is attached to the margin of the acetabulum 5 to 6 mm beyond the glenoidal labrum posteriorly and anteriorly it is attached to the outer margin of the labrum. It surrounds the neck of the femur, and in front, to the intertrochanteric line and. The capsule is much thicker at the superior and anterior. However, the capsule is thin and loose inferiorly and posteriorly. The thickened outer longitudinal fibres of the capsule form three strong ligaments around the hip joint.

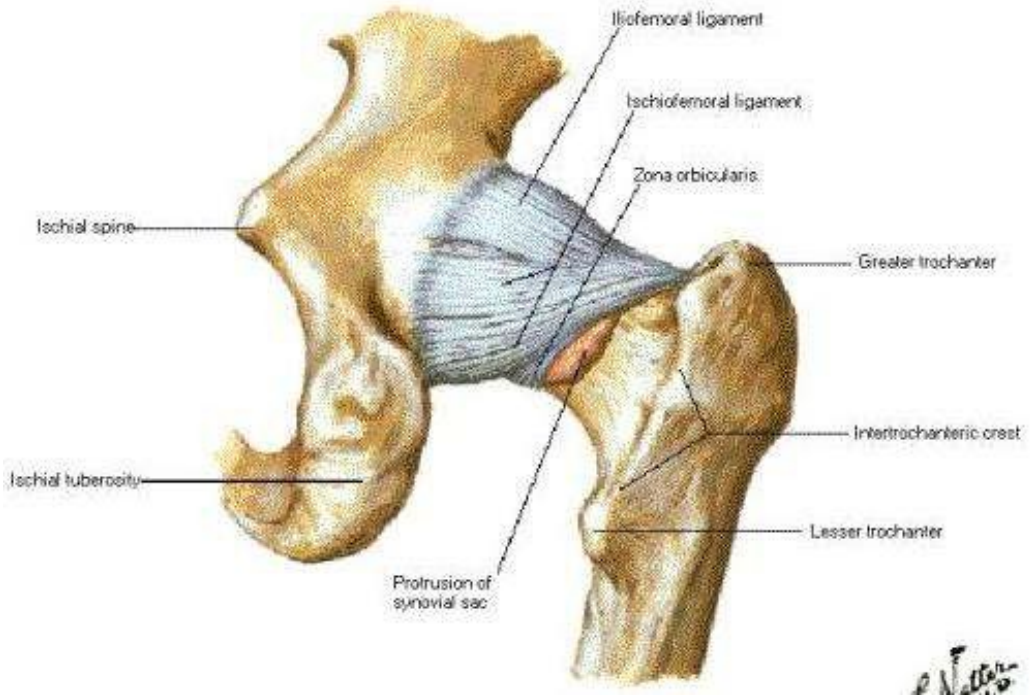


HIP JOINT – ANTERIOR VIEW

The ilio-femoral ligament/ Y-shaped ligament of Bigelow is the strongest ligament in the body and lies in anterior to the joint. It is intimately connected with the capsule. It is attached, above, to the lower part of the anterior inferior iliac spine; below, it divides into two bands, one of which passes downward and is fixed to the lower part of the intertrochanteric line; the other is directed downward and lateralward.

The pubo-femoral ligament is attached, above, to the obturator crest and the superior ramus of the pubis. Below, it blends with the capsule and with the deep surface of the vertical band of the ilio-

femoral ligament. The Ischio-femoral ligament/ligament of Bertin consists of a triangular band of strong fibers which spring from the ischium below and behind the acetabulum and blend with the circular fibers of the capsule.



HIP JOINT – POSTERIOR VIEW

The Ligamentum Teres Femoris is a triangular, somewhat flattened band implanted by its apex into the antero-superior part of the fovea on the head of femur. Its base is attached by two bands, one into either side of the acetabular notch, and between these bony attachments it blends with the transverse ligament. It is ensheathed by the synovial membrane varies greatly in strength in different

individuals. The ligament is made tense when the hip is semiflexed, adducted and externally rotated. It is relaxed when the limb is abducted.

The Glenoidal Labrum is a fibrocartilaginous rim attached to the margin of the acetabulum, the cavity of which it deepens. It bridges over the notch as the transverse ligament, and thus forms a complete circle. It is triangular on section, its base being attached to the margin of the acetabulum, while its opposite edge is free and sharp. Its two surfaces are invested by synovial membrane, the external one being in contact with the capsule, the internal one being inclined inward so as to narrow the acetabulum, and embrace the cartilaginous surface of the head of the femur.

The Transverse Acetabular Ligament is in reality a portion of the glenoidal labrum, though differing from it in having no cartilage cells among its fibers. It consists of strong, flattened fibers, which cross the acetabular notch, and convert it into a foramen through which the nutrient vessels enter the joint.

MUSCLES AROUND THE HIP

A. MUSCLES IN FRONT OF THE THIGH

Muscle	Origin	Insertion	Nerve supply	Action
Psoas Major	Transverse processes of all lumbar vertebrae and Lateral surfaces T12-L5 vertebrae	Lesser trochanter of femur	lumbar nerves L1, L2, & L3 [ventral rami]	Flexion of the hip .
Iliacus	Iliac crest, iliac Fossa, ala of sacrum, and anterior surface of sacroiliac ligament	Tendon of psoas major, lesser trochanter	Femoral nerve (L2 & L3).	Flexion of the hip joint.
Tensor fasciae Latae	Anterior part of iliac crest and Anterior superior iliac spine	Lateral condyle of tibia	Superior gluteal (L4 & L5)	Abduction medial rotation and flexion of hip; helps to keep knee extended
Sartorius	Anterior superior iliac spine.	Superior part of medial surface of tibia	Femoral nerve (L2& L3)	Flexes, abducts, and laterally rotates hip joint; flexes the knee joint.

QUADRICEPS 33FEMORIS				
Rectus Femoris	Anterior inferior iliac spine and ilium superior to acetabulum	Base of patella and by patellar ligament to tibial tuberosity	Femoral nerve (L2,L3&L4)	Extension of knee, rectus femoris also steadies hip and helps iliopsoas to flex the hip.
Vastus Lateralis	Greater trochanter and lateral lip of linea aspera of femur			
Vastus Medialis	Intertrochanteric line and medial lip of linea aspera of femur			
Vastus Intermedius	Anterior and lateral surfaces of shaft of femur			

B. MUSCLES OF THE GLUTEAL REGION

Muscle	Origin	Insertion	Nerve supply	Action
Gluteus Maximus	Surface of ilium, posterior to posterior gluteal line, dorsal surface of sacrum and coccyx and sacrotuberous ligament	Most fibers end in iliotibial tract that inserts into lateral condyle of tibia; some fibers insert on gluteal tuberosity of femur	Inferior gluteal nerve (L5,S1&S2)	Extension and lateral rotation of hip. Steadies hip and assists in raising trunk from flexed position.
Gluteus medius	External suface of ilium between anterior and posterior gluteal line	Lateral surface of greater trochanter of femur.	Superior gluteal nerve (L5&S1)	Abduction and medial rotation of hip. Steadies pelvis on the lower limb when opposite leg is raised.
Gluteus Minimus	External surface of ilium between anterior and inferior gluteal lines	Anterior surface of greater trochanter of femur		
Obturator Internus	Sacral anterior surface and sacrotuberous iligament	Greater trochanter of femur at superior surface	Nerve to obturator internus (L5&S1)	External rotators of the hip
Superior and Inferior gemeilli	Pelvic surface of obturator membrane and surrounding bones	greater trochanter medial surface	superior gemellus - Nerve to obturator internus (L5 and S1. Inferior Gemellus – Nerve to quadrates femoris	

Quadratus Femoris	ischial tuberosity	Quadrate tubercle on interochanteri c crest it	Nerve to quadratus femoris (L5 &S1)	External rotator of the hip

C. MUSCLES POSTERIOR TO THE HIP

Muscle	Origin	Insertion	Nerve supply	Action
Semitendinosis	Ischial Tuberosity	Medial surface of superior part of tibia	Tibial division of sciatic nerve (L5, S& S2)	Extension of hip; flexion of knee and medial rotation of knee.
Semimembranosus	Ischial Tuberosity	Posterior part of medial condyle of tibia		
Biceps femoris	Ischial Tuberosity; linea aspera and lateral supracondylar line of femur.	Lateral side of head of fibula;	Sciatic Nerve (L5, S1& S2)	Extension of hip; flexion of knee and lateral rotation of knee.

MOVEMENTS OF THE HIP

The hip joint, being a ball and socket type of joint allows movements in a multidirectional pattern. Grossly the movements are as follows:

Flexion – Anteriorly, Extension – Posteriorl Y, Abduction & adduction – Laterally Rotations and combination of the above - Circumduction.

When the thigh is flexed upon the trunk, the head of femur rotates about the transverse axis that passes through both acetabulae, the muscles that bring about this motion are iliopsoas - supported by Rectus femoris, sartorius and pectineus. Flexion gets arrested when the thigh is on the trunk and by the hamstrings when knee is in extension. Normal flexion is about 120° - 130^0.

EXTENSION

This is the opposite of flexion, carried out by the Gluteus maximus. The motion is limited by tension of ileo-femoral ligament. Normal range is 5° - 20°.

ADDUCTION

Adduction of the thigh produces similar movements in the femoral shaft and neck. The femoral head rotates in the acetabulum over an anteroposterior axis. Movements are brought about by- Pectineus,

adductors, gracilis. It is limited when the thigh rests upon the opposite one or if the latter is kept abducted, the tension of the gluteus medius and gluteus minimus limits the adduction. Normal range $25^0 - 35^0$.

ABDUCTION

This is the opposite of abduction and is brought about by gluteus medius and minimus assists by piriformis. It is limited by tension on the adductors and pubo- femoral ligament. Normal range 40° - 45°.

EXTERNAL ROTATION

This is carried out in flexed hip and knee at 90 and rotating the foot towards the opposite side. Gluteus maximus is the major lateral rotator. The gluteus medius, minimus, piriformis, obturator internus, gamelli and quadratus femoris serve as stabilisers of the hip.Normal range is about 40-45° as measured in both extension and flexion of the hip.

INTERNAL ROTATION

With the hip and knee flexed to 90^0, the leg being rotated away from the midline of the body produces medial rotation at the hip and is brought by anterior fibres of gluteus medius and minimus.

Normal range is 40°-45^0 in flexion and 30^0-35^0 in extension.

BLOOD SUPPLY

Arterial supply of proximal femur, Crock described into 3 groups and provided a definitive anatomical nomenclature to these vessels thus avoiding ambiguity.

1) The extra-capsular arterial ring at the base of femoral neck.
2) The ascending cervical branches of extra-capsular arterial ring on the surface of the femoral neck.
3) The arteries of the round ligament.

The extra-capsular arterial ring is formed posteriorly by a branch of medial circumflex femoral artery and anteriorly by branches of lateral circumflex femoral artery with the superior and inferior gluteal arteries having minor contributions to this ring.

The ascending cervical branches of the extra-capsular arterial ring penetrate the hip joint capsule at the intertrochanteric line at anteriorly. posteriorly they pass beneath orbicular fibres of the capsule. The ascending cervical branches pass upward under the synovial reflections and fibrous prolongations of capsule towards the articular cartilage. These arteries are called retinacular arteries. As the ascending cervical arteries send small branches into the metaphysis of femoral neck. Additional blood supply to the metaphysis arises from the extra capsular arterial ring. In the adult, there is communication through

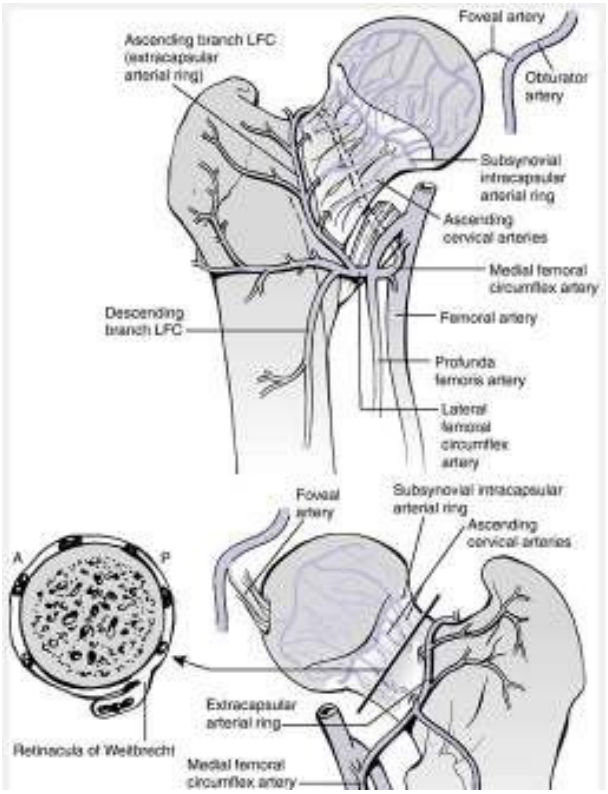
the epiphyseal scar between the metaphyseal and epiphyseal vessels when the femoral neck is intact.

This good vascular supply to the metaphysis explains the absence of avascular changes in the femoral neck as opposed to the head.

The ascending cervical arteries can be divided into four groups based on their relation to the neck of femur - anterior, posterior, medial and lateral. Of these the lateral branch supply most of the supply to femoral head and neck. At the margin of articular cartilage of the neck of femur, these vessels form a second ring – the subsynovial intra-articular ring, which can be complete or incomplete, the complete rings being more common in male specimens. At the intra –articular ring - epiphyseal arterial branches arise that enter femoral head. Once the arteries from subsynovial arterial ring penetrate femoral head they called as epiphyseal arteries.

The artery of ligament teres is a branch of obturator or the medial circumflex femoral artery. This arterial supply is often inadequate to provide nourishment to the femoral head.

Claffey reported that the artery of ligamentum teres did not make them capable of keeping the femoral head alive if all other sources of blood supply were interrupted.



VENOUS DRAINAGE OF HEAD AND NECK OF THE FEMUR

The venous outflow from femoral head and neck is by lamina capsular veins which may be double or single and pass infero-medially along the trochanteric line and towards the obturator foramen to drain into the obturator vein. The circumflex group are found as diffuse plexus in the basal part of the neck and greater trochanter and pass medialy to leave the femur at the level or proximal to the lesser trochanter and enter the common femoral vein. There is no venous drainage through the ligamentum teres.

SIGNIFICANCE OF VASCULAR ANATOMY

Femoral head blood supplied from three sources: (a) intra-osseous cervical vessels (b) the artery of the ligamentum teres (medial epiphyseal vessels); and (c) the retinacular vesse

BIOMECHANICS OF HIP JOINT:

The hip joint is a ball and socket joint, it provides the multiaxial movement in the joint. The structures responsible for stability are

1. Bony structures
2. Ligaments around hip
3. Muscles attaching around hip joint,

But ligaments and muscles less relying, bone is the major stabilizer. The bony structures responsible for the stability in walking, change of postures from sitting to standing, from standing to sitting.

Basic structures:

Bony structures plays a vital role in supporting the frame work. Cortical and Cancellous bones have their respective distinct mechanical properties. Cortical bone is solid and rigid structure, its anisotrophic feature makes the analysis difficult.

In, 1807, von weyer (anatomist), culman (an engineer) made comparison and developed the stress trajectorial bone theory by comparing the trabecular patterns of Cancellous bone in the neck of femur with the fairbrain cane.

The proportion of cortical and Cancellous bone in the neck of femur and trochanter is different, in neck 95 percent is cortical, whereas reverse in trochanter.

Paul calculated the direction and magnitude of force across femur head in walking and gait. Under normal circumstances, maximum compression on the medial aspect of the neck than lateral aspect of neck. There is no tension force in the neck at rest. On loading and in unphysiological conditions tension produced in the lateral and superior aspect of femur neck. So, compression is the major loading configuration of proximal femur with tension only in abnormal conditions. The multi axial movement in the low friction joint makes the tension in neck less negligible.

Articular cartilage:

Articular cartilage is very important in

1. Load transmission
2. absorption of energy
3. joint lubrication

The contact and weight bearing area is demonstrated by greenwald. Bullogh et al. described the importance between articukar surfaces. The friction coefficient between articukar surfaces in the range of 0.005 - 0.01. To achieve this advantageous level, which reduces the wear to very minimum, many theorie shave been put forward.

Muscles and ligaments:

The arrangements of muscles and ligaments around hip provide sthe support, movements, prevent abnormal movements, proprioception, absorption of energy after fall.

Factors acting on hip joint:

The factors acting on hip joint are

1. Body weight
2. Muscle forces around hip

The force exerted by the movements across joint is described bty rydell, in terms of magnification factor to body weight.

One leg standing = 2.5 * body weight

One leg support with cane in opposite hand - force = body weight

Standing with 2 legs : force = ½ body weight to each joint

Running : force = 5 times * body weight.

ANATOMY OF THE HIP PERTINENT TO TOTAL HIP REPLACEMENT

ANATOMY OF HIP AS PERTINENT TO TOTAL HIP REPLACEMENT

FEMUR

The anteversion, the neck shaft angle and the relation of femoral medulla with reference of the greater and lesser trochanter are of importance as regards to the upper femur.

ANTEVERSION

The anteversion is the angle at which the faces in the coronal plane with reference to the long axis of the femur. Normal anteversion is 9 -16 degrees.

NECK –SHAFT ANGLE

This is the orientation of the head and neck to the shaft in sagittal plane .This can seen easily in AP radiogragh. The is the angle formed between the line through the long axis of the femoral shaft and the line through centre of the head and neck. This angle is 125-135 degrees. An increase in the angle is called valgus and a decrease is called varus.

RELATION OF THE FEMORAL MEDULLA TO THE TROCHANTER AND THE FEMUR

The medullary cavity starts at the lesser trochanter and flows down to femoral condyles. The narrowest part of the medullary canal is the isthmus.

ACETABULAR VERSION

The acetabular version, anteversion is 10-20 dedrees and the optional acetabular inclination is 45^0 to improve the stability.

ACETABULAR DEPTH

Normal acetabulam is spheroidal with a considerable depth. But in patients with CDH or septic dislocation of childhood, the acetabular roof slopes out laterally leaving a shallow acetabulam. All attempts must be made to locate the true acetabulam and deepen it to sufficient depth to reach the true anatomical and mechanical axis.

ACETABULAR WALL THICKNESS

The acetabular wall doesn't have equal all around. It is quite weak inferomedially and in some cases it may be like egg shell. The thickest portion being the pelvic flare where in illium and pubis blend.

Articular cartilage in the acetabulam present in a horse shoe shaped area called Lunate surface which has to be denuded for cementing the cup.

APPLIED BIOMECHANICS

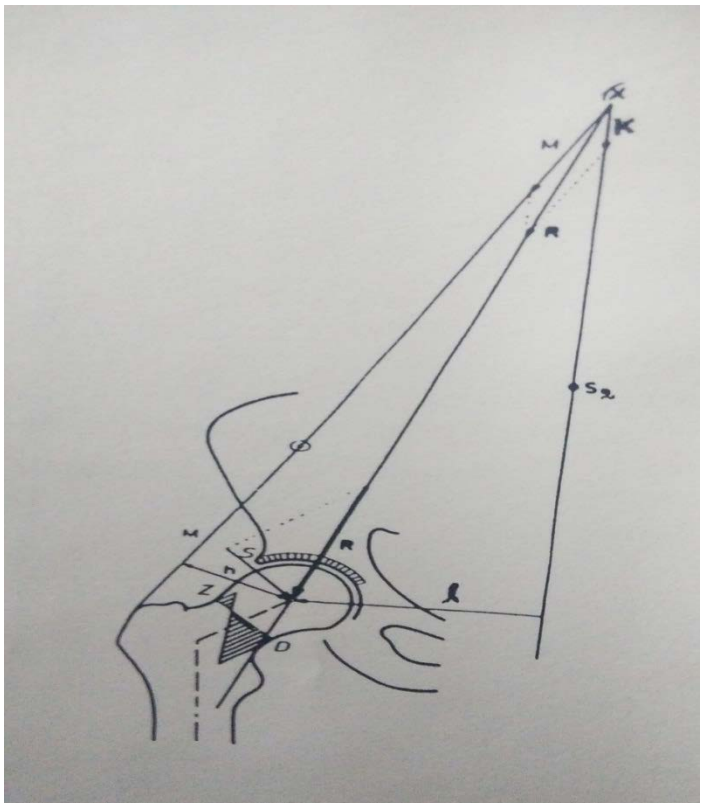
FORCES ACTING ON HIP

In normal joint, stress distribution depends on the magnitude and direction of resultant force transmitted through the joint. Shear forces are negligibly small in normal joint because of the extremely low coefficient of friction.

Hip joint load is a function of body weight, activity level, muscular force and the distance from the body's centre of gravity to the center of the femoral head.

In a normal hip, the partial mass of the body is concentrated at its centre of gravity S_2 and exerts a force ' **K'** which acts on the hip joint with the lever arm ' **I'**.

Force **'K'** is counterbalanced by force **' M'** exerted by the abductor muscles with lever arm **'h'** which is one third length of ' **I'**.


K
M
R
S_2
M
R
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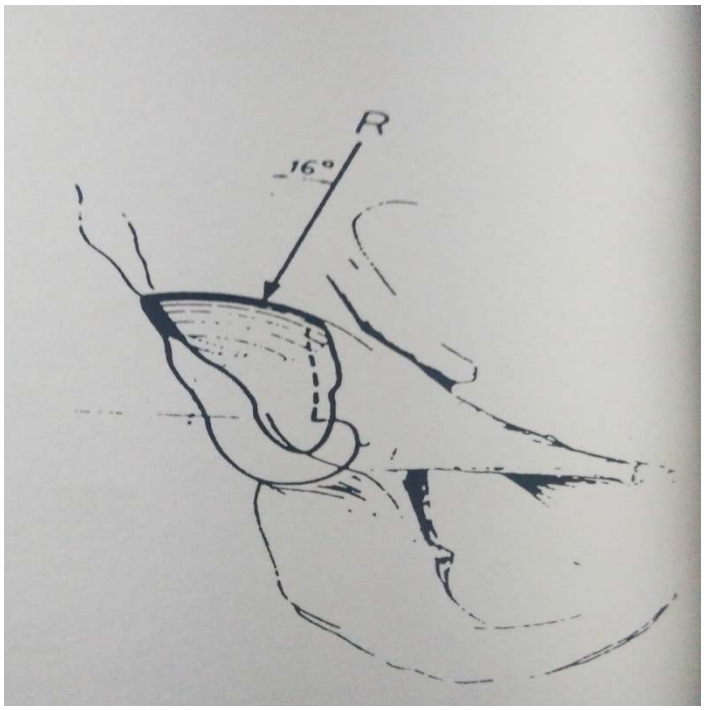

R
16°

The resultant **'R'** of force **K** and **M** inclined at 16^{o} to the erpendicular acts along a line passing through centre of femoral head and the intersection **X** of force **K** and **M**. This creates articular compressive stress in the joint on the acetabular side, the magnitude of compressive stress decreases as it radiates from the joint surface in the bone of pelvis.

The force acting on the head creates a bending moment leading to compressive stresses in medial aspect of the neck and tension stresses on the anterior aspect.

In simple walking this force acts on the hip altering anterior to posterior and posterior to anterior. This produce a torsional effect on the stem.

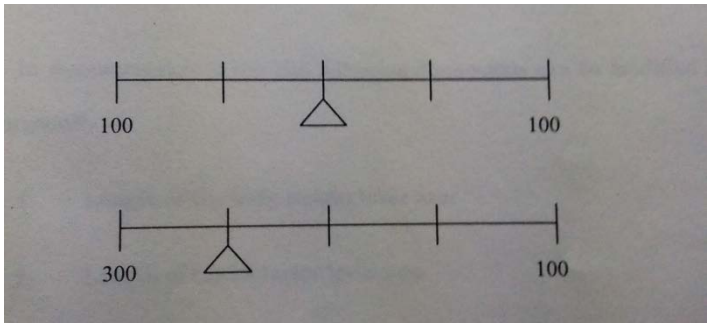
The total load on the hip joint is created more by the abductor muscle than by the mere weight of the body. The ratio of the length of the body weight lever arm to that of abductor level arm is 2.5: 1 .

The load and direction of action of force on the femoral head prosthesis varies with

1. The change in the length of the body weight lever [centre of rotation to mid line of the body]
2. Length of the abductor lever [trochanter to centre of prosthesis head]
3. Offset of the prosthesis [perpendicular distance from centre of prosthesis head to axis of femur]
4. Varus or valgus alingnment of the prosthesis in femur.

CENTRALISATION OF HEAD LENGTHENING OF ABDUCTOR LEVER ARM

If the site of fulcrum changes from a ratio 1:1 to 1:3 the abductor force has to rise to maintain equilibrium .Load on fulcrum also rises.



The lever arm of abductor may be shortened in arthris. In these situations the ratio of lever arm of the body weight and abductors may be 4:1 and hence increase the total load on the hip.

Charnley recommended the shortening of body weight lever arm by deepening of the acetabulum [centralization of femoral head] and lengthening of abductor mechanism. This will decrease the total load on the hip by as much as 30%.

Deepening of acetabulum should not be more than 0.5 cm. when the femoral prosthesis had been implanted in exaggerated in valgus, it will decrease the moment of bending and increases proportionately the axial loading of the stem. However valgus portion shorten lever arm of abductor mechanism and so more abductor force will be required.

A varus position even though increases abductor lever arm must be avoided since it increases shear forces hence risk of loosening and stem failure.

In reconstruction of the hip following dimensions can be modified by the surgeon.

1. Length of the body weight lever arm.
2. Length of the abductor lever arm.
3. Offset of the prosthesis.
4. Varus or valgus alignment of the prosthesis in femur.

COMPONENTS OF TOTAL HIP REPLACEMENT

COMPONENTS OF TOTAL HIP REPLACEMENT

BIO MATERIALS

Bio materials should be

1. Bio stable – should withstand hostile atmosphere of biological maleu.
2. Bio compatable – least antigenic ,non toxic, no tissue reaction

STAINLEES STEEL

Forged steel has higher yield strength but low fatigue strength. Commonly used steel is AISI -316L.

COBALT BASED ALLOYS

They are highly resistant to corrosion. It causes minimal tissue reaction. Fatigue fracture may occur but to lesser extent than stainless steel.

TITANIUM BASED ALLOYS

They have excellent corrosion resistant and fatigue strength.

They have high co-efficient of friction results in large amounts of wear particles. Hence not used in joint surface.

CERAMICS

Aluminium oxide is being used for modular femoral head because of its excellent frictional and wear characteristics with polyethylene.

COMPONENTS OF TOTAL HIP REPLACEMET

FEMORAL COMPONENT

Parts include head, neck, collar and an option platform. It is usually made of metal alloy. Co -cr-mo alloy, stainless steel alloy, titanium alloy.

SIZE OF HEAD

Small head allows medialisation of fulcrum and lengthening of power arm. A small head also reduces frictional torque thus alleviating strain on cement bone interface. Disadvantage of small head is that, it tends to subluxate at extreme range of motion.

NECK DESIGN

It should allow angular motion without impinging on socket rim.

a. Small the diameter of neck, greater the range of motion without impingement.
b. Greater the recession of neck, greater the range of motion without impingement.

Usual neck length varies from 25-50 mm.

STEM OFFSET

It is the distance from the center of the femoral head to a line through the axis of the distal part of stem. Inadequate restoration of this limits the moment of abductor muscles and increased joint reaction force, limping and impingement.

MODULAR HEAD

Neck length is adjusted by using modular heads with variable head sizes. This modularity is available only in Muller's system.

ACETABULAR CUP

It is made up of UMHWPE.

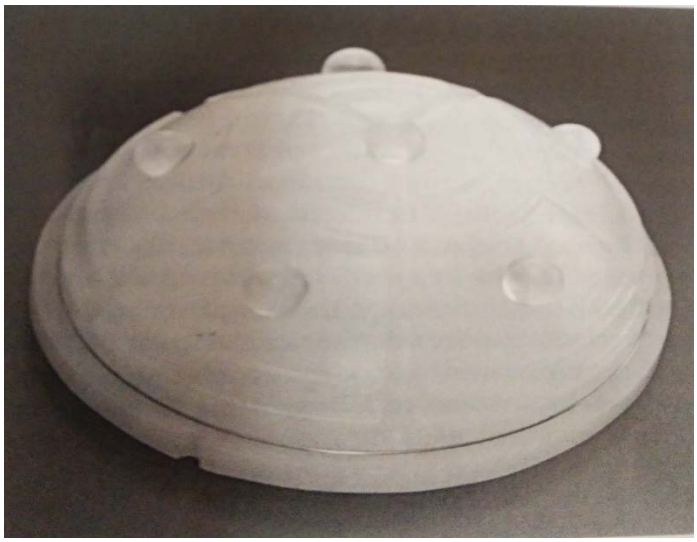
Charnely cup has 22mm diameter.

Muller cup has 32mm diameter.

In cemented acetabular cup

It has got metallic rings for radiological identification of its position.

Vertical and horizontal groove are presented over the outer surface to increase the stability within cement mantle. A flange at the rim of the component aids in pressurization of the cement as the cup is pressed into position.



In cementless acetabular cup is coated with porous coated over their entire surface for bony ingrowth.

Instrumentation typically provides for oversizing of the implant 1-2 mm larger than the reamed acetabulum as the primary method of press fit –fixation.

PRE OPERATIVE REDIOLOGICAL ASSESSMENT

PRE OPERATIVE RADIOLOGICAL ASSESSMENT

Both anteroposterior view and lateral view were taken.

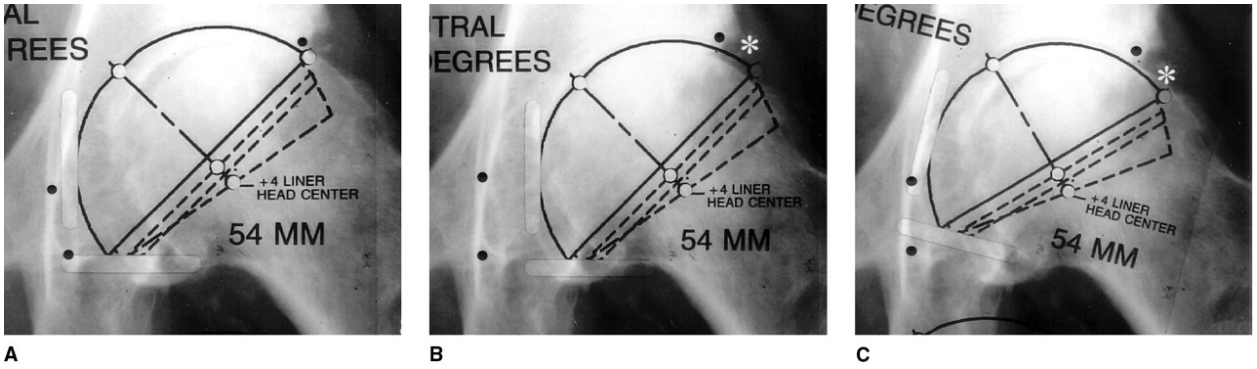
AP VIEW - for both hip joints and proximal femur assessment.

LATERAL VIEW –for ipsilateral hip and proximal femur assessment. X rays taken with 1O ^{o} internal rotation for pre operative assessment and templanig.

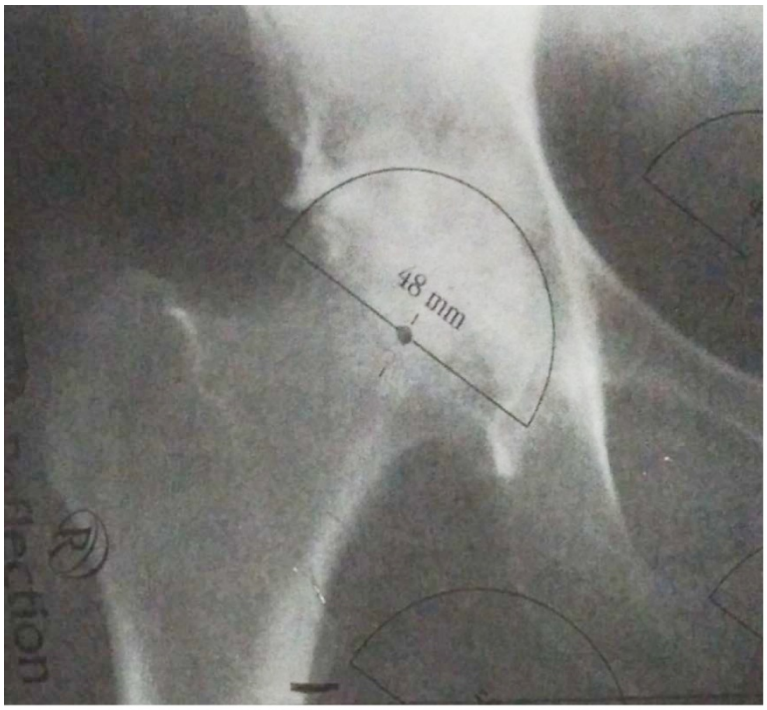
AIM OF PRE OPERATIVE X RAYS WERE

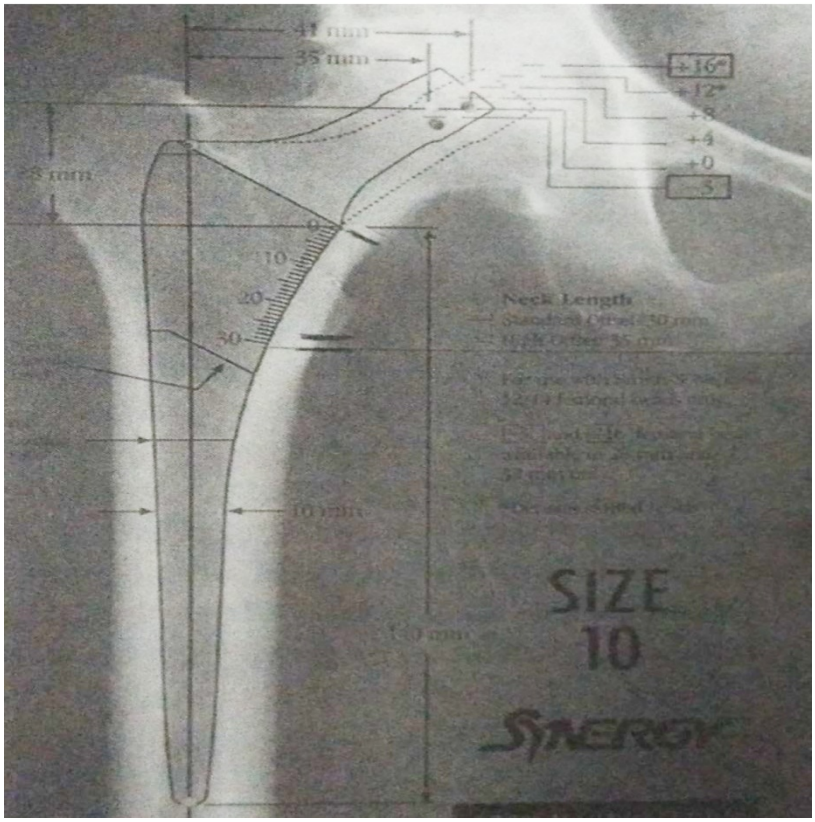
1. To determine the size of implants.
2. To restore the anatomical and biomechanical centre of rotation of hip joint.
3. To restore the limb length discrepancy.
4. To anticipate any acetabular defect requiring grafting.

TEMPLATING



A B C


48 mm


41 mm
35 mm
+16°
+12°
+8
+4
+0
-5
9
10
20
30
SIZE
10
SYNERGY

Tempalating helps in selection of the type of implant that provides the best fit, implant size, neck length and medial offset.

X rays was taken with magnification markers and corresponding template used. A horizontal line drawn along the inferior margin of both ischial tuberasities. The vertical distance from this line to top of the lesser trochanter of each hip is measured. The difference between two measurement gives the limb length discipancy. The acetabular template that matches the contour of acetabular subchondral bone most closely placed over X ray. The acetabular template is placed just lateral to lateral edge of tear drop at 45^{o} angle in such a way to span the distance between tear drop and the superolateral margin of acetabulam.

The centre of acetabular components marked on X rays that corresponds to new centre of rotation of hip.

POST OPERATIVE ASSESSMENT OF ACETABULAR CUP

ASSESSMENT OF ACETABULAR CUP

The cup anteversion is defined as the angle between the acetabular axis and the coronal plane.

Among various methods to measure the acetabular cup version in both X Ray and CT, the CT scan measurement is the best. CT scan measurement has high accuracy and more reliability.

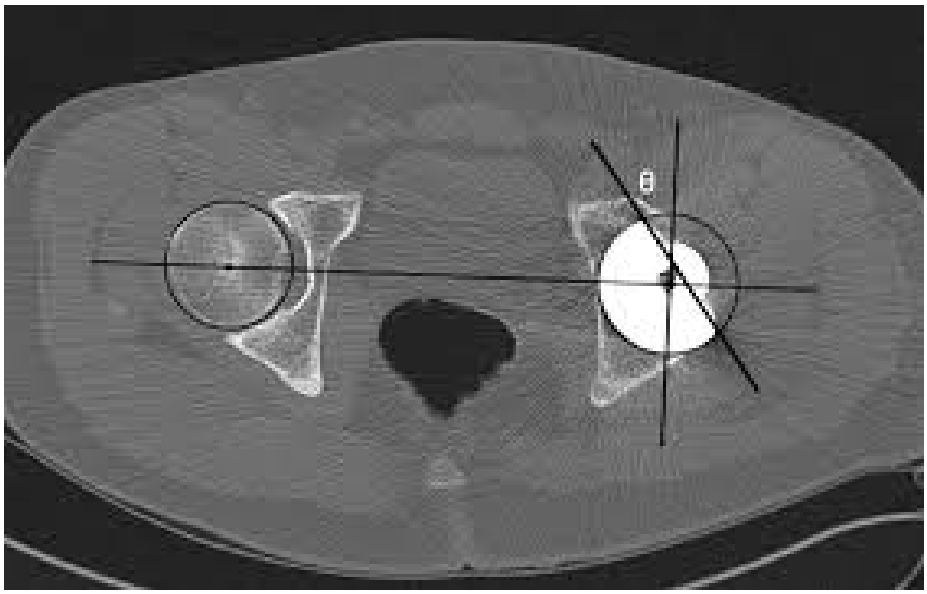
In CT scan modified Murray's concept is used.

METHOD:

In an axial cut of a CT picture, showing both hips,

Draw a first line connecting the centre of the two hips and a second line perpendicular to the first line. Third line from the most anterior point of the acetabular cup component to its most posterior point.

The angle between the second and third line is the version of acetabulum.



θ is acetabular version.

Normal acetabular version is 10 -20 degrees.

But safe zone of acetabular anteversion is 5-25 degrees.

FEMORAL VERSION

In a horizontal axial view of CT scan; showing ipsilateral hip

Draw a line from the centre of the femoral head to the centre of the greater trochanter .

A second line drawn horizontally conneting the centres of two acaetabuli.

The degree between these two lines indicate the degree of femoral anteversion [FH].

CONDYLAR VERSION

Draw a first line, tangentially along the posterior surface of the two condyles in axial cut.

The second line is drawn parallel to the floor

The true femoral anteversion is calculated with the femoral condylar version [CH].

TRUE FEMORAL ANTEVERSION

If femoral condyle is in internally rotated

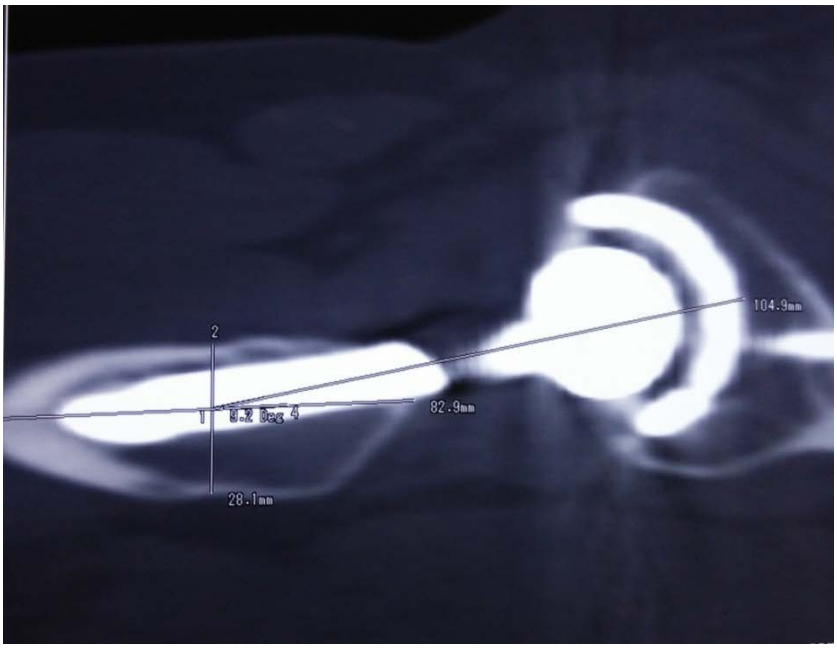
The femoral version is = FH+CH

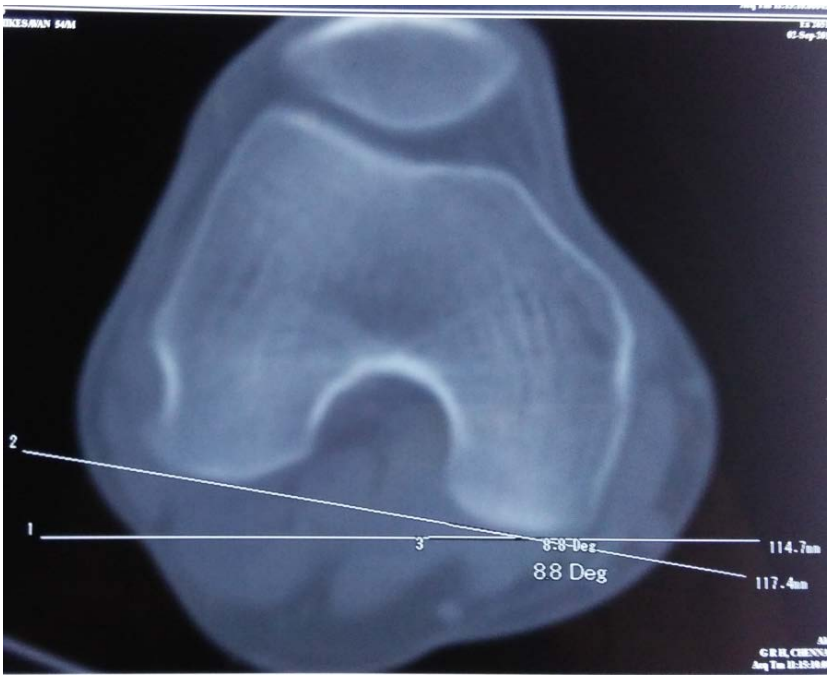
If femoral condyle is in externally rotated

The femoral version is = FH-CH

If femoral condyle is in neutral

The femoral version is - FH=CH





In the evaluation of results of THR, it has been traditional to use Hip scores, there are many functional rating systems. There are

1. ‘D’ AUBIGNE AND M.POSTEL [1954]
2. CHARNEY[1960]
3. AMSTUTZ CARROLL LARSON [1963]
4. IOWA [1963]
5. HARRIS [1969]
6. MAYO CLINIC [1984]

SURGICAL APPROACH

SURGICAL APPROACHES

Any approach should allow complete visualization of acetabulum for proper component orientation in THR .

Two major approaches

1. Lateral approach
2. Posterior approach - southern approach.

Lateral approach

Begin the incision 5 cm above greater trochanter passes over tip of trochanter and extends down along shaft about 8 cm. Incise fat and deep fascia. Incise the tensor fascia lata. Split the gluteus medius fibres. Then rise anterior flap containing anterior part of gluteus medius with underlying gluteus minimus and anterior part of vastus lateralis. Rise the anterior flap until the anterior capsule is exposed by externally rotating the limb. Make T shaped incision on the capsule. Head is delivered using head extractor.

Preparation of acetabulum

Isolate the anterior capsule by passing a curved clamp.

Retract the femur anteriorly and put a Homann retractor in the interval between the anterior lip of the acetabulum and psoas tendon. Complete the excision of the labrum. Draw the soft tissues into the acetabulum. Expose the bony margins of the rim of the acetabulum around its entire circumference to facilitate proper placement of the

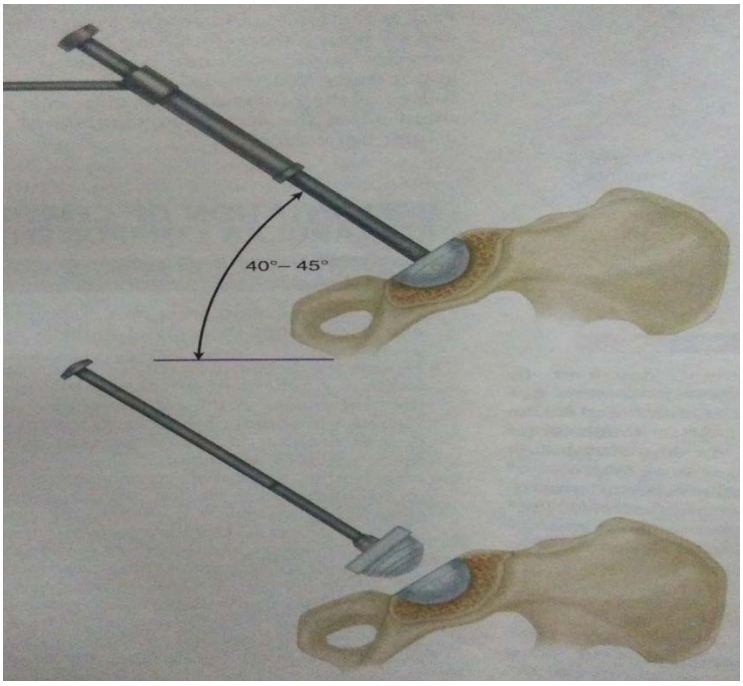
acetabular component and remove any osteophytes that protrude beyond the bony limits of the acetabulum.

The procedure for cartilage removal and reaming of the acetabulum is similar for cementless and cemented acetabular components.

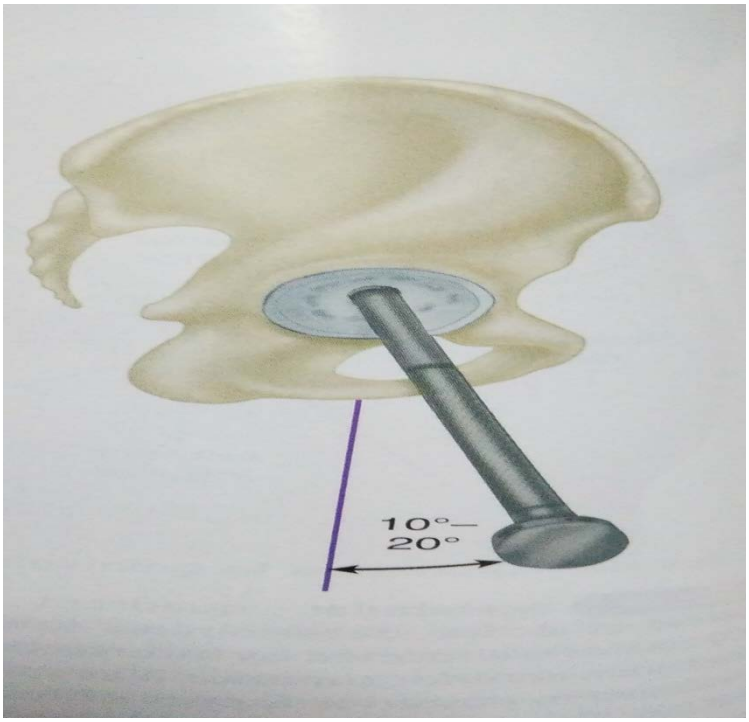
Begin with a reamer small than the anticipated final size with 40 - 50 degrees inclination and 10 - 20 degrees anteversion.

Direct all subsequent reamers in the same plane of the acetabulum. Curet any reaming soft tissue from the floor of the acetabulum. Search for sub chondral cysts and remove their contents. Fill the cavities with cancellous bone.

Beforce insertion of the acetabular component, ensure the patient remains in the true lateral position and check with trial acetabular component before final implantation in 40 -50 degrees inclination and 10-20 degrees anteversion either cementless or cemented acetabular component and polyethylene liner is inserted in to acetabular component.



Inclination 40-50 degrees



Anteversion 10-20 degrees

Preparation of proximal femur

The neck is trimmed leaving 1cm medial calcar, on which the shoulder of the prosthesis would eventually sit. The proximal femur was reamed with rasp, the length of the rasp corresponding to the stem of the femoral prosthesis. The direction of the insertion of the rasp for was ascertained by using the lesser trochanter as a guide to achieve correct seating of the femoral prosthesis in 10 -15^{0} anteversion. Select the trial neck component determined through pre operative templating, Evaluate the centre of the femoral head relative to the height of the tip of the greater trochanter.

If the neck length is satisfactory, apply a traction with the hip in slight flexion. Gently lift the head over the superior lip of the acetabulum. The reduction is carried out and check the all movements of the hip.

Posterior approach:

A curved incision is taken from 8 cm distal to the posterior superior iliac spine, extended distally and laterally, to the posterior margin of the greater trochanter. The incision is then directed distally 5-8 cms along the femoral shaft. The deep fascia is divided in line with the skin incision. By blunt dissection the fibers of the gluteus maximus are separated taking to avoid injury the superior gluteal

vessels in the proximal part of the exposure. The gluteus maximum muscle is split and short external rotators are exposed. Stay sutures are applied to the short external rotators, and a tenotomy of the short external rotators is done close to their insertion on the inner surface of the Greater trochanter. The short external rotators are retracted to protect the sciatic nerve and expose the posterior hip capsule. The capsule is incised by a T-shaped incision, and the hip flexed, adducted and internally rotated to dislocate the hip joint. Using a head extractor and bone levers, head is delivered out of the acetabulum and the

acetabulum is prepared same above manner. Then adequate acetabular component is inserted. The femoral component is also prepared same above manner, then appropriate femoral stem inserted with appropriate head .Then reduction is carry out.

MATERIALS AND METHODS

MATERIALS AND METHODS

This retrospective study was conducted at Govt. Royapettah hospital, to analyse acetabular cup placement and functional outcome in THR.

Study Population: 20 HIPS.

Method of selection: 20 patients selected randomly from MRD department who complied with our study without any drop out.

Method:

1. CT examination of acetabular cup

2. Analysis of functional outcome according to Harris hip score

This study was conducted during my training period.

All these patients were called over phone to attend the ortho OPD. This study had been done to assess the post oprative acetabular cup positioning and functional outcome of total hip replacement done for various indications. All patients were assessed post operatively with CT scan of pelvis for cup version.

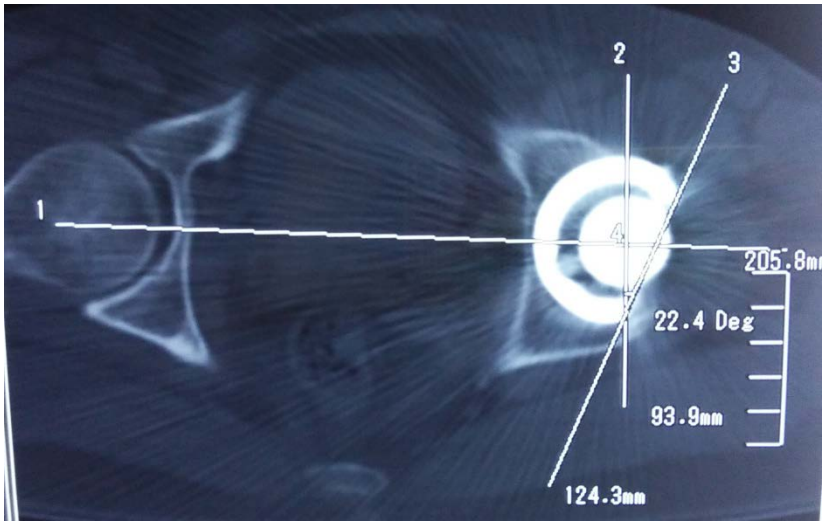
These patients were also examined clinically to analyze the functional outcome based on Harris hip score at the latest follow up. The results were compared and analysed in these randomly selected patients.

METHODS

CLINICAL EXAMINATION

All patients were assessed for functional outcome and acetabular cup position. Clinical examination at the latest follow up was evaluated with Harris hip score. The corresponding hip score were entered against the all the parameters mentioned in the hips score proforma.

CT EXAMINATION OF THE CUP POSITION



After obtaining the CT picture of the hip, the version of the acetabular cup was assessed by using the Modified MURRAY method.

The acceptable range of the cup version is 15 ± 10.

All our patients were evaluated whether they fit into this range of cup version. The patients out of this range were examined particularly in rotational movements.

MATERIALS

Total No. of patients	20
Total No. of hips	20

TABLE 1: NUMBER AND LATERALITY

Right side	12
Left side	8

CHART 1: NUMBER AND LATERALITY

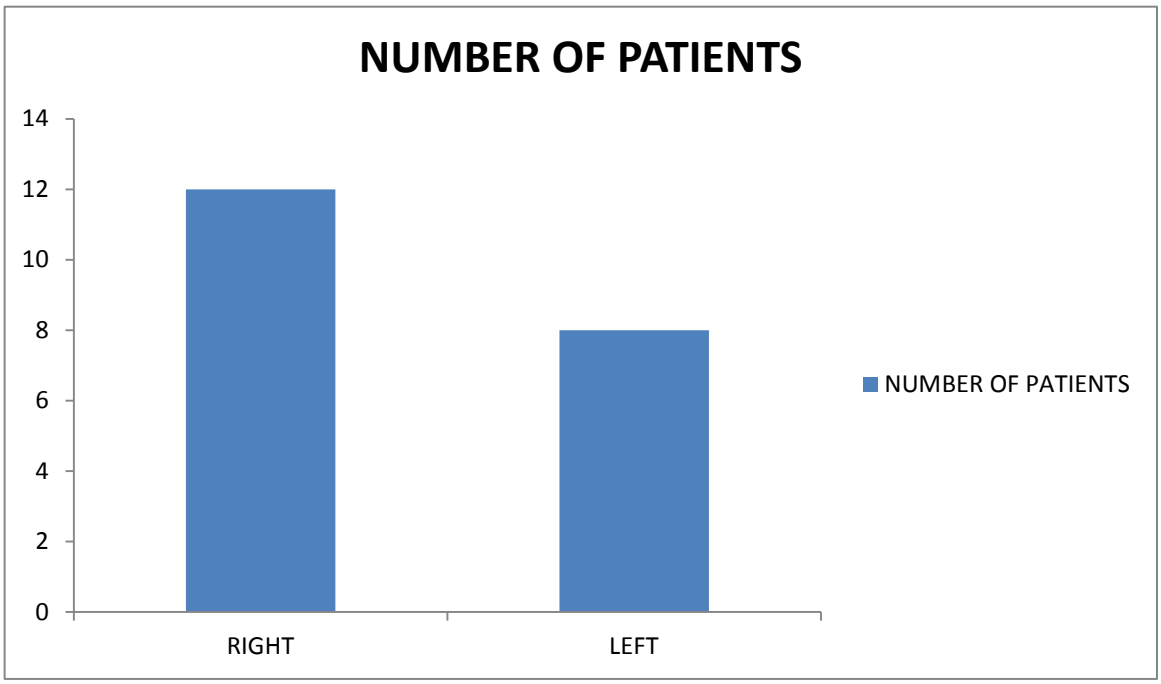


TABLE 2: SEX DISTRIBUTION

Sex	No of patients
Male	14
Female	6

CHART 2: SEX DISTRIBUTION

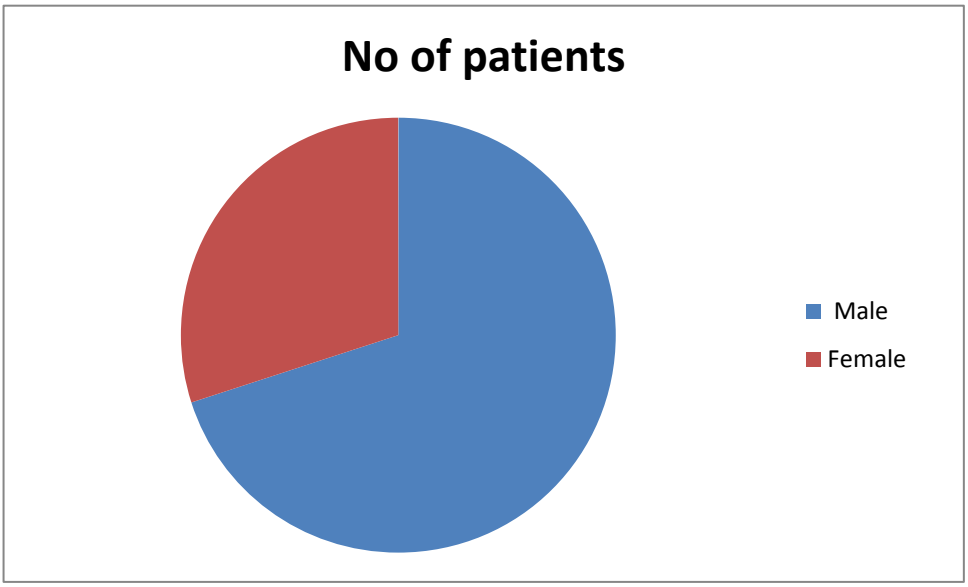


TABLE 3: AGE DISTRIBUTION

Range	No of patients
25 -30 years	1
31 35 years	4
36-40 years	3
41-45 years	5
46-50 years	3
51-55 years	2
56-60 years	1
61-65 years	1

CHART 3: AGE DISTRIBUTION

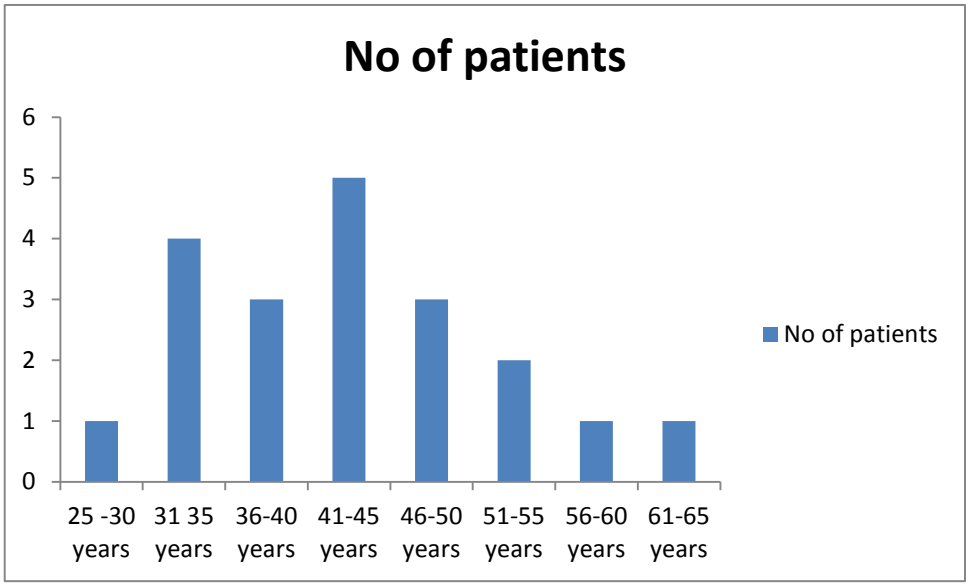
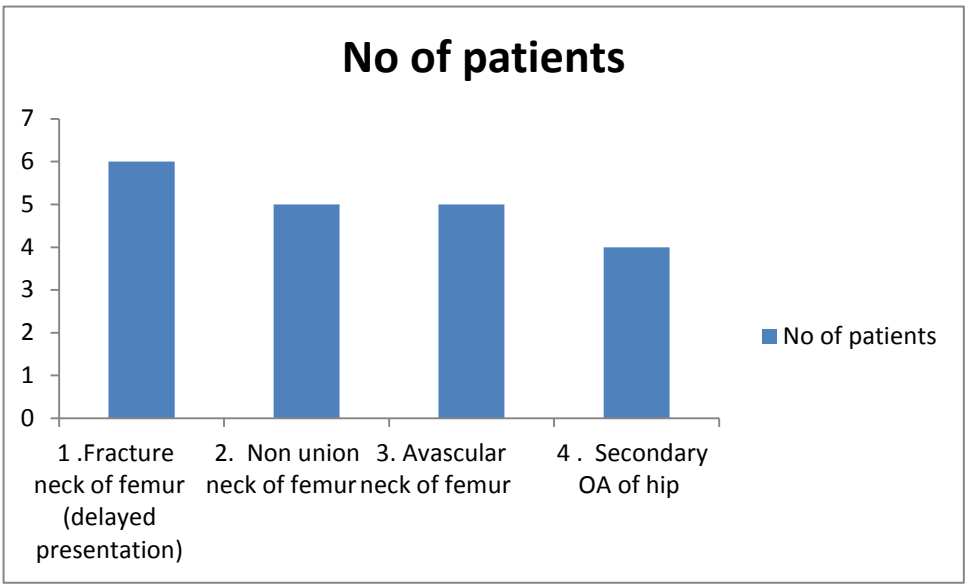


TABLE: 4 INDICATIONS

Indications	No of patients
1. Fracture neck of femur (delayed presentation)	6
2. Non union neck of femur	5
3. Avascular neck of femur	5
4. Secondary OA of hip	4

CHART: 4 INDICATIONS



FOLLOW UP

Minimum follow up - 6 months

Maximum follow up - 4 years

RESULTS AND ANLAYSIS

RESULTS AND ANALYSIS

All patients were assessed clinically using the HARRIS HIP SCORE SYSTEM [modified] for hip function in our study.

TABLE: 5 PAIN

	NO .OF PATIENTS
No pain	19
Mild pain	1

CHART: 5 PAIN

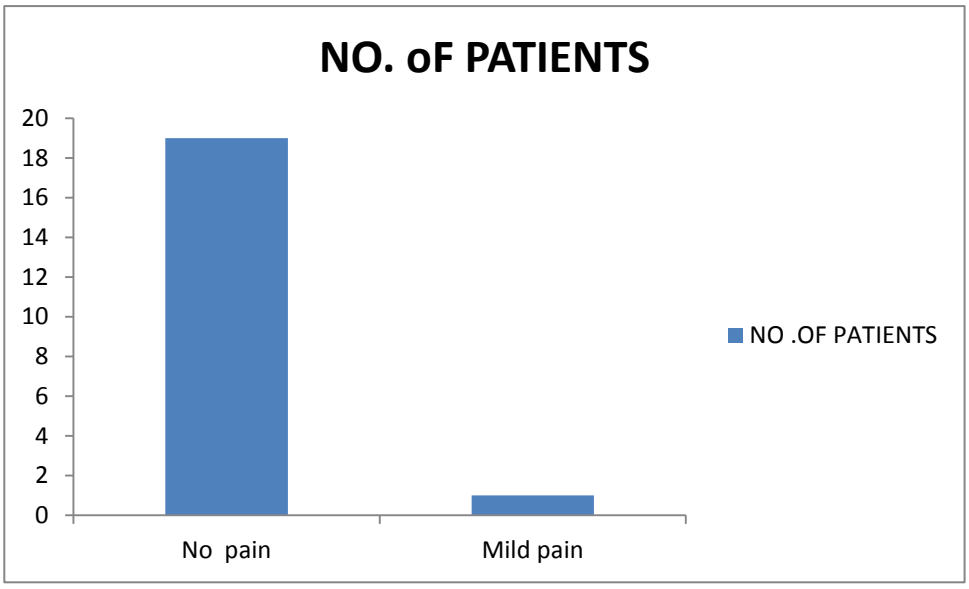


TABLE: 6 LIMPING

	NO .OF PATIENTS
None	19
Moderate limp	1

CHART: 6 LIMPING

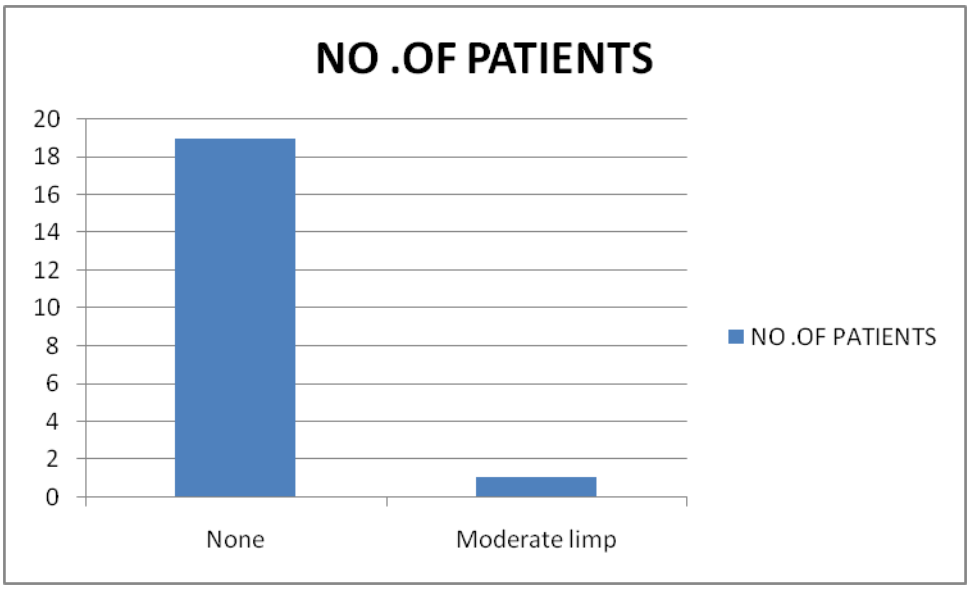


TABLE: 7 SUPPORT ON WALKING

	NO. OF PATIENTS
None	20

TABLE: 8 DISTANCE WALKED

	NO. OF PATIENTS
Unlimited	19
2 or 3 block	1

CHART:8 DISTANCE WALKED

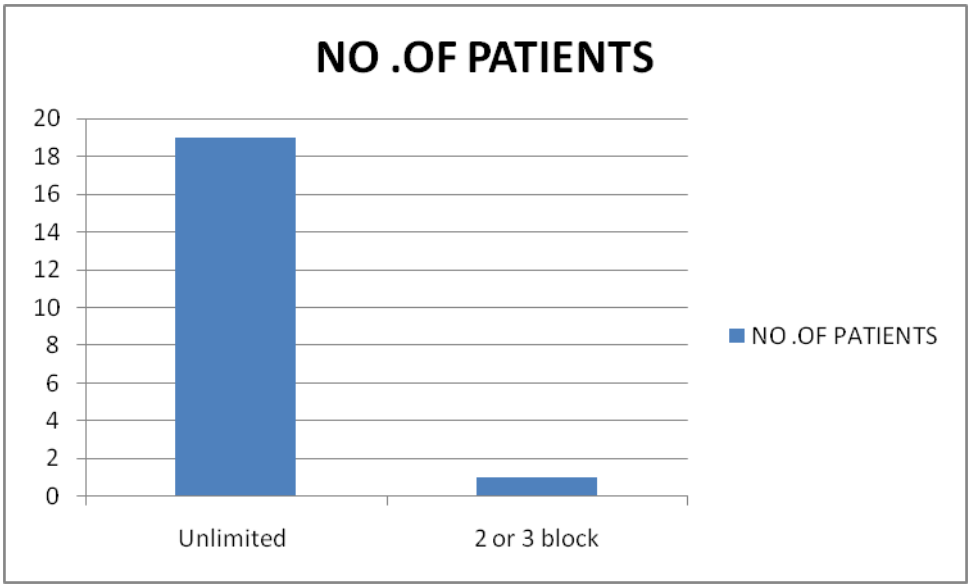


TABLE: 9 STAIRS

	NO. OF PATIENTS
Without using a railing	19
Using a railing	1

CHART: 9 STAIRS

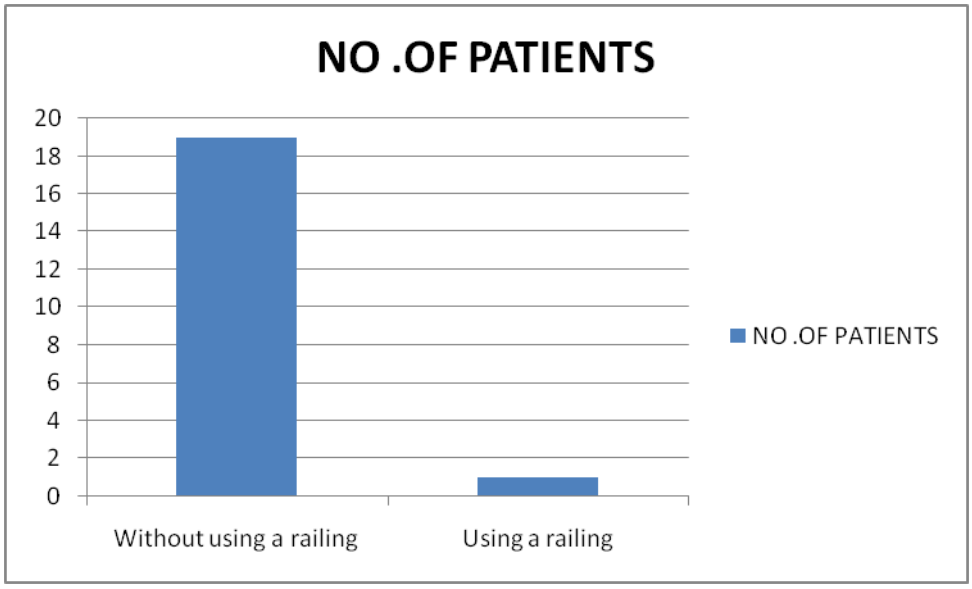


TABLE: 10 PUT ON SHOES AND SOCKS

	NO. OF PATIENTS
With ease	20

TABLE: 11 SITTING

	NO. OF PATIENTS
Comfortably in ordinary chair 1 hour	20

TABLE: 12 PUBLIC TRANSPORTATION

	NO. OF PATIENTS
Yes	20

TABLE: 13 FLEXION CONTRACTURE

	NO. OF PATIENTS
Nil	20

TABLE:14 LIMB LENGTH DISCREPANCY

LLD	NO. OF PATIENTS
Nil	14
< 3.2 cm	5
>3.2 cm	1

CHART: 14 LIMB LENGTH DISCREPANCY

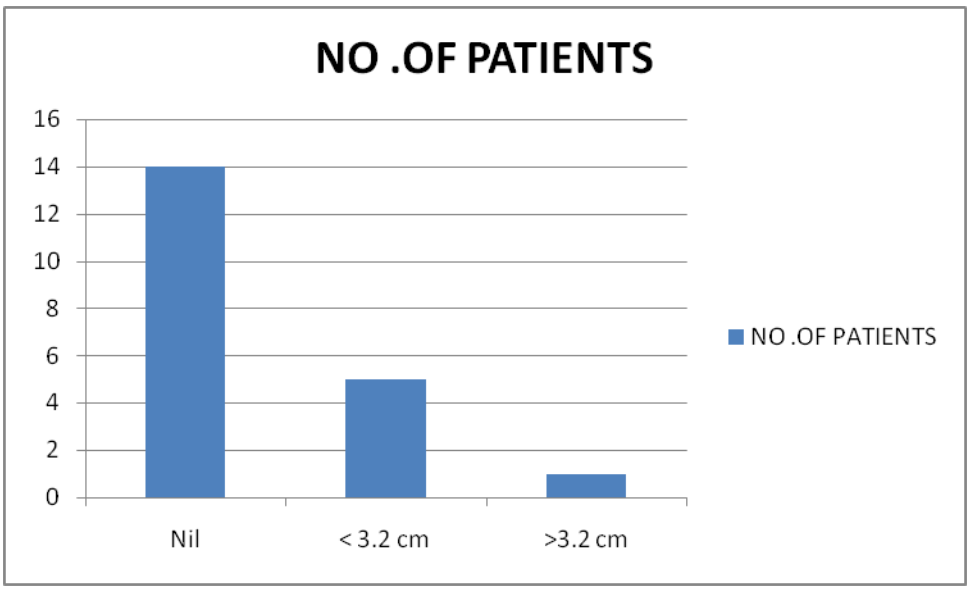


TABLE: 15 RANGE OF MOVEMENTS OF HIP'S SCORE

ROM	NO. OF PATIENTS
211-300	10
161-210	10

CHART:15 RANGE OF MOVEMENTS OF HIP'S SCORE

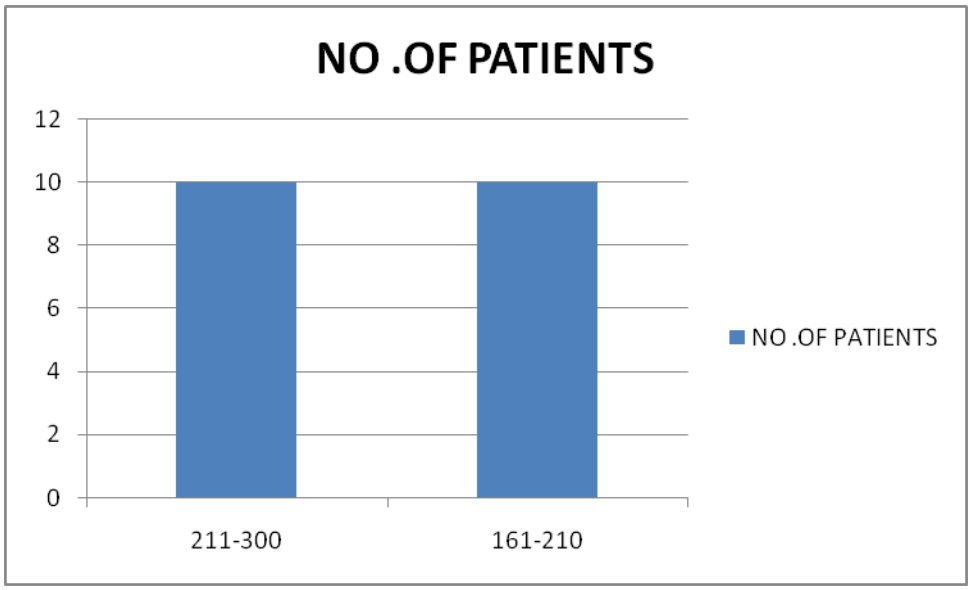


TABLE: 16 RANGE OF MOVEMENTS SCORE

ROM	HIP SCORE	NO. OF PATIENTS
211-300	5	10
161-210	4	10

CHART: 16 RANGE OF MOVEMENTS SCORE

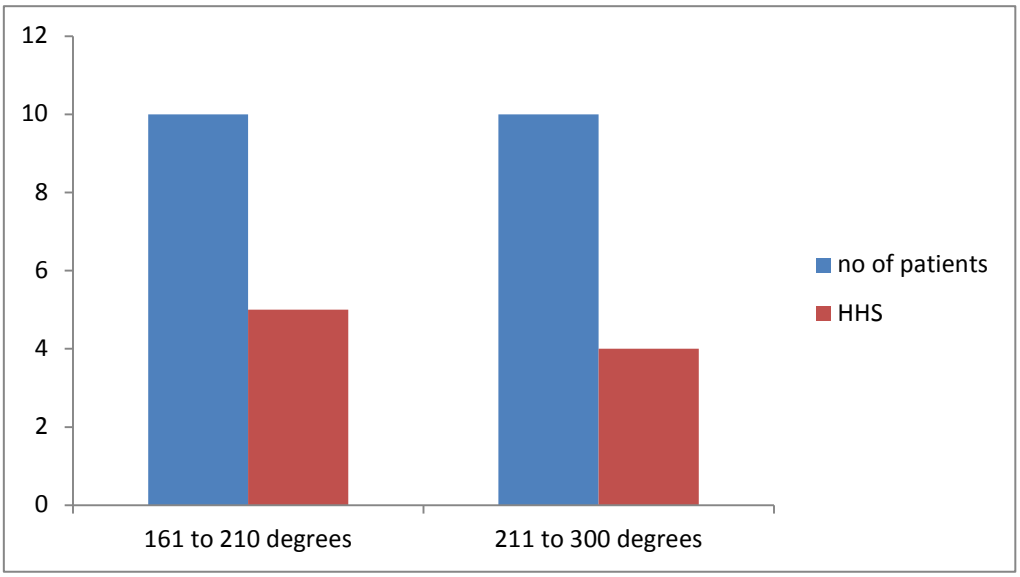


TABLE: 17 TOTAL HARRIS HIP SCORE

SCORE	NO. OF PATIENTS	OUTCOME
90-100	18	EXCELLENT
80-89	1	GOOD
70-79	1	FAIR

ACETABULAR CUP ORIENTATION AND RANGE OF HIP MOVEMENTS

TABLE :18

No. of Patient	Acetabular Cup Version	FLEX [DEG]	EXT [DEG]	ABD [DEG]	ADD [DEG]	I R [DEG]	E R [DEG]
1.	14^0	90^0	10^0	30^0	30^0	20^0	30^0
2.	14^0	100^0	10^0	40^0	20^0	10^0	30^0
3.	25^0	100^0	10^0	30^0	20^0	10^0	30^0
4.	22.4^0	90^0	20^0	40^0	30^0	20^0	40^0
5.	14.3^0	90^0	10^0	40^0	20^0	20^0	40^0
6.	**30.5^0**	**100^0**	**10^0**	**30^0**	**20^0**	**NIL**	**30^0**
7.	6.9^0	90^0	10^0	30^0	20^0	10^0	30^0
8.	16.4^0	100^0	10^0	30^0	20^0	20^0	30^0
9.	18.4^0	100^0	10^0	30^0	30^0	10^0	30^0
10.	**46.8^0**	**90^0**	**10^0**	**30^0**	**30^0**	**NIL**	**30^0**
11.	16.4^0	110^0	10^0	20^0	10^0	10^0	10^0
12.	12.1^0	100^0	20^0	40^0	20^0	20^0	40^0
13.	14.8^0	110^0	20^0	40^0	30^0	10^0	40^0
14.	16.3^0	110^0	20^0	40^0	NIL	10^0	40^0
15.	14.7^0	100^0	10^0	30^0	40^0	10^0	20^0

No. of Patient	Acetabular Cup Version	FLEX [DEG]	EXT [DEG]	ABD [DEG]	ADD [DEG]	I R [DEG]	E R [DEG]
16.	18.1^0	100^0	10^0	40^0	40^0	10^0	30^0
17.	16^0	100^0	10^0	30^0	40^0	20^0	30^0
18.	14.5^0	100^0	10^0	40^0	40^0	20^0	30^0
19.	15^0	110^0	10^0	40^0	30^0	20^0	30^0
20.	16.4^0	100^0	10^0	40^0	40^0	20^0	30^0

COMPLICATIONS:

1. We had one case of dislocation with associated sciatic nerve palsy due to retroverted acetabular cup which was corrected by revision THR. Now the patient had recovered from nerve palsy and had good functional outcome
2. Limb length discrepancy: we had significant LLD of >3.2 cm in one case, other cases had around 1 cm shortening on operated limb.
3. None of our patients had infection in our study.

DISCUSSION

DISCUSSION

Defining the optimal cup position is challenging. A good understanding of Anatomy, patient and implant related factors that affect the “optimal” cup position is mandatory. In most cases, restoring the original hip rotation centre and a “fixed standard target” of 40° of inclination and 20°of anteversion will result in a good clinical outcome.

With a better understanding of the factors affecting, optimal cup positioning, we can avoid impingement, dislocations and minimize wear in an individual patient.

From a clinical point of view, a “safe zone to avoid hip dislocations” has been defined between 40° ± 10° of cup inclination and 15° ± 10° of anteversion.

In our study average acetabular cup version is 18.15.

We used modified murray’s method for measuring acetabular version in axial CT.

This method was most commonly followed in various studies. Accuracy value of this method is very high of about 95%.

All cases had acetabular cup in anteversion.

TABLE: 19

ACETABULAR CUP VERSION [DEG]	NO. OF PATIENT
6.9-12.5	2
14- 16.5	12
18-21	2
22-25	2
>25	2

In clinical practice, a combined cup-stem anteversion between 20° and 30°.

Toshinori Masaoka, Kengo Yamamoto, Takaaki Shishido, Yoichi Katori: study of hip dislocation after total hip replacement; Journal list> Int orthop> v 30; 2006 feb

According to this author, study of hip dislocation after total hip replacement, the acetabular cup version is more important in deciding the dislocation rate and in achieving the stable hip joint.

So we in our study had one case of dislocation due to retroversion of acetabular cup and that case was revised to achieve normal version.

Also in 2 of our cases we had excessive anteversion of the cup. However these patients didn't have any dislocation at the end of 1 and half years follow up.but these patients had no internal rotation movements.

Effect of Cup Orientation on Impingement

After hip arthroplasty, impingement of involuntary contacts between bony structures or prosthetic components can occur in extreme hip positions. Beside increased range of motion caused by excessive joint laxity, soft tissue or prosthetic impingements can follow alterations of hip biomechanics or changes in the orientation of the acetabulum and the femoral neck.

Bony impingement is often due to incorrect restoration of leg length or combined offset or, to inadequate femoral orientation. It is not related to the orientation of the cup around the hip rotation centre. Bone-on-bone impingement occurs mostly during hip flexion and squatting and can cause pain and dislocation.

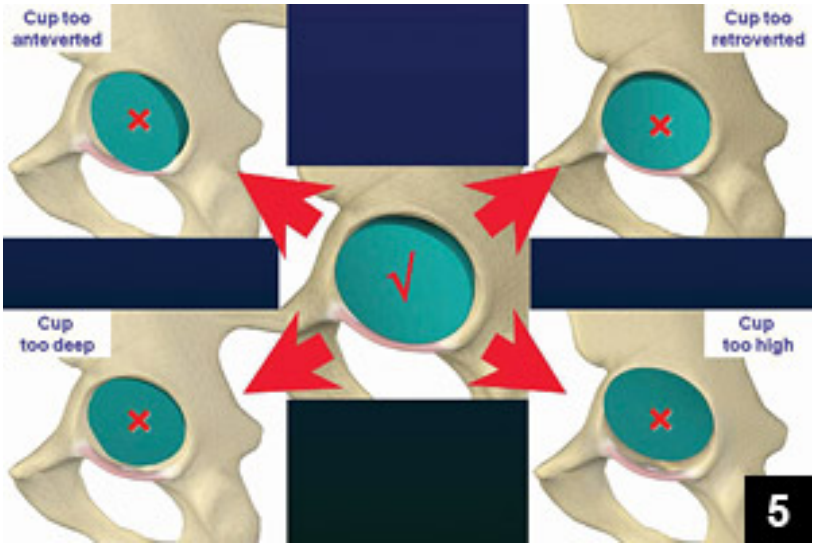
Cup and stem anteversion have opposite effects on impingement. Increasing cup anteversion and decreasing stem anteversion will favour impingement of the posterior aspect of the neck against the posteroinferior part of the acetabulum in extension and external. On converse, decreasing cup anteversion and increasing stem anteversion will favour anterosuperior impingement in flexion and adduction. As such, it is the sum of the cup

and stem anteversion or the “combined anteversion” that affects cup-neck impingement.

To avoid impingement, a cup inclination of 45° to 55° has been recommended, the optimal combined anteversion depending on the acetabular abduction angle.

Impingement, clinically recorded as maximum flexion-extension, abduction –adduction and axial rotation of the femur.

If the patient feels no pain in above movements, the impingement is ruled out.



Clinical test for impingement

Anterior impingement test - [flexion-adduction-internal rotation]

Patient in supine position, put the ipsilateral hip in flexion-adduction-internal rotation. Apply hand over the anterolateral aspect of knee and force the hip into full adduction and internal rotation.

If there is catching type of pain, the test is positive.

Posterior impingement test – [Hyperextension-abduction-external rotation]

Patient in prone position, passively place the ipsilateral hip in the Hyperextension-abduction-external rotation position.

If there is catching type of pain, the test is positive.

According to Yoshimine *et al,*

A cup position avoiding impingement can be estimated with the following formula :

(Cup inclination) + (Cup anteversion) + 0.77× (Stem anteversion)) = 84.4

As such, a cup inclination of 40° and a stem anteversion of 20° will require a cup anteversion of 29°.

Widner *et al*

Recommends 40° to 45° of cup inclination, 20° to 28° of cup anteversion and a stem anteversion between 12° and 24°, according to:

(Stem anteversion) = (37° - Cup anteversion) /0.7.

Histome *et al,*

Suggesting a cup inclination of 45° and a combined anteversion of 42° calculated with the formula:

(Cup anteversion) + 0.7× (Stem anteversion).

Effect of cup orientation on hip stability

Hip dislocation can occur without impingement but impingement is the largest contributing factor. Especially cup-neck impingement seems detrimental as compared to bone-on-bone impingement. The optimal cup position to avoid dislocation should take both into account, avoiding impingement and providing intrinsic stability within the envelope of impingement-free range of motion.

From a clinical point of view, a “safe zone to avoid hip dislocations” has been defined between 40° ± 10° of cup inclination and 15° ± 10° of anteversion.

These clinical recommendations do not take into account the femoral anteversion, the neck/shaft angle, the restoration of hip biomechanics, the surgical approach and the interaction between cup abduction and anteversion in terms of coverage and risk of impingement. Only mathematical models can do this, but such models are theoretical and have not been validated in clinical practice.

Clinically, the ROM is painful at extremes of movements with mechanical block.

In our study, the clinical test for impingement were negative for all patients.

CONCLUSION

CONCLUSION

- In our study, 90% of patients had excellent functional outcome, 5% of patients had good functional outcome and 5% of patients had fair functional outcome.
- In our study, 90% of acetabular cup positions were in acceptable range. Only 10% of acetabular cups were in excessive anteversion,
- The cases with excessive anteversion were not associated with dislocation of joint. But had no internal rotation.
- CT scan based acetabular cup measurement has given good predication of our intra operative free hand assessment of acetabular cup positioning.

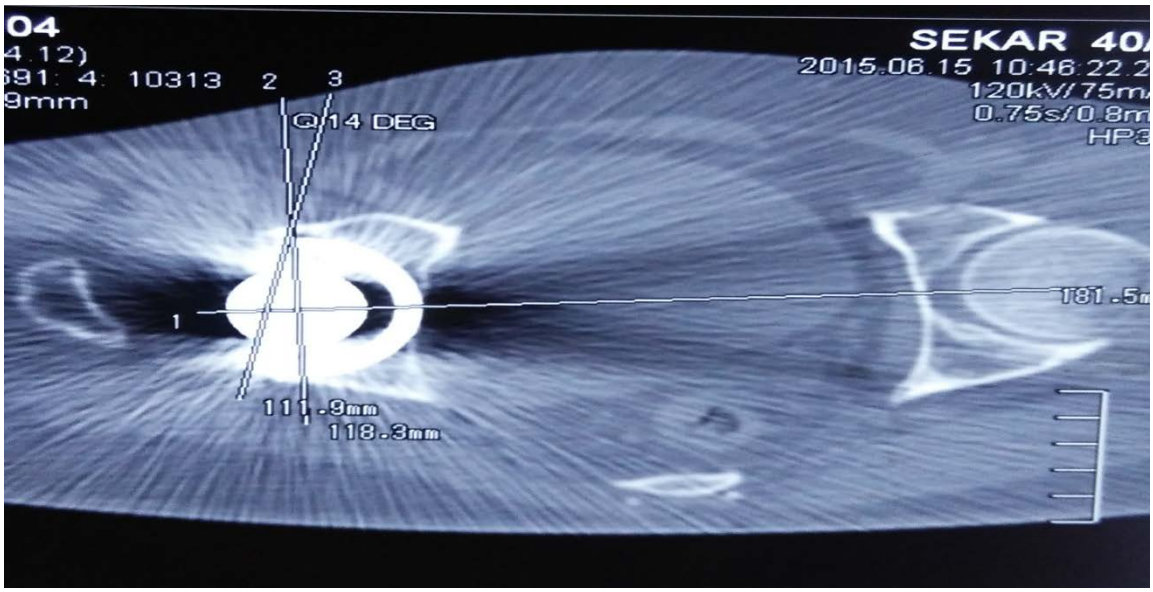
CASE ILLUSTRATION

CASE ILLUSTRATION

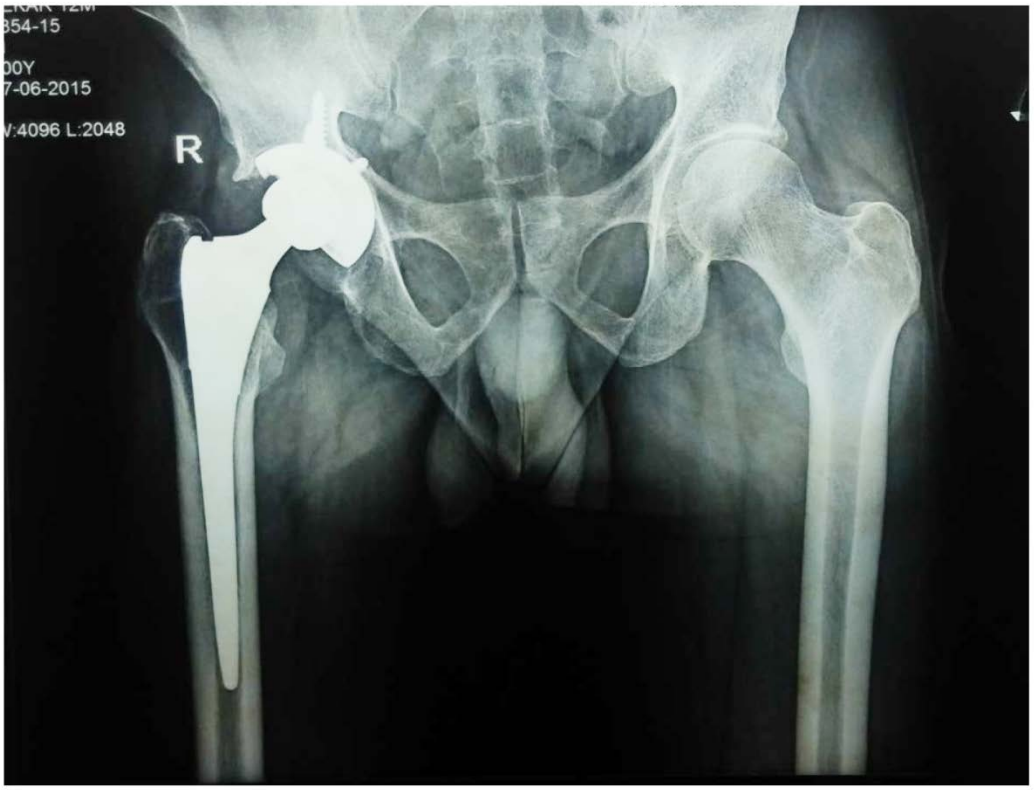
CASE 1

Sekar, 40 year old man had history of RTA 2 year back. He diagnosed fracture non union neck of femur.

He underwent THR on 9.1.2013



ACETABULAR CUP VERSION	FLEX [DEG]	EXT [DEG]	ABD [DEG]	ADD [DEG]	I R [DEG]	E R [DEG]
14^{O}	90	10	30	30	20	30

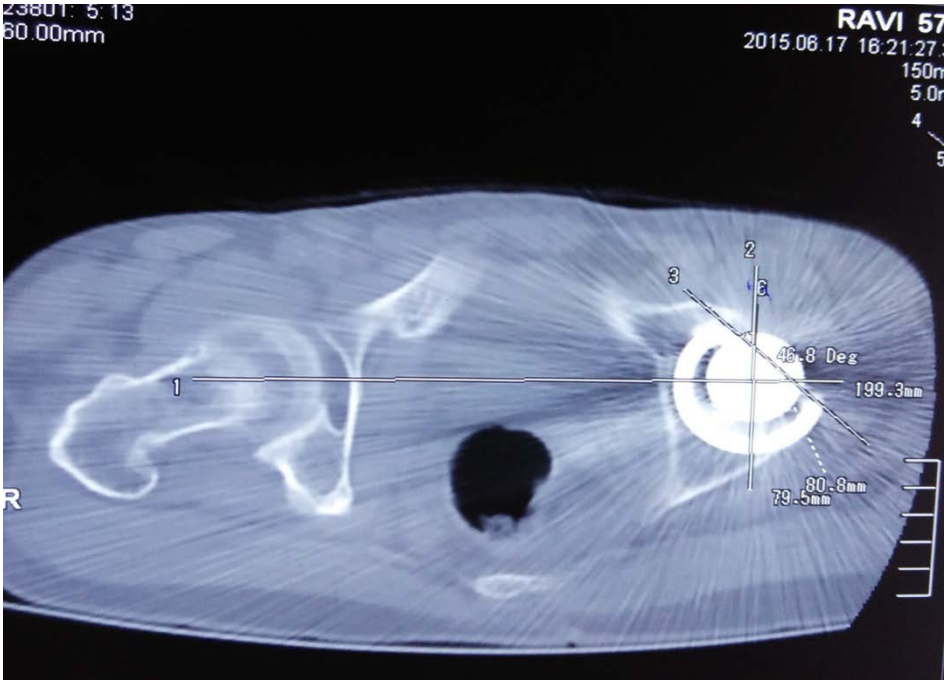

854-15
00Y
7-06-2015
V:4096 L:2048
R

CASE 2

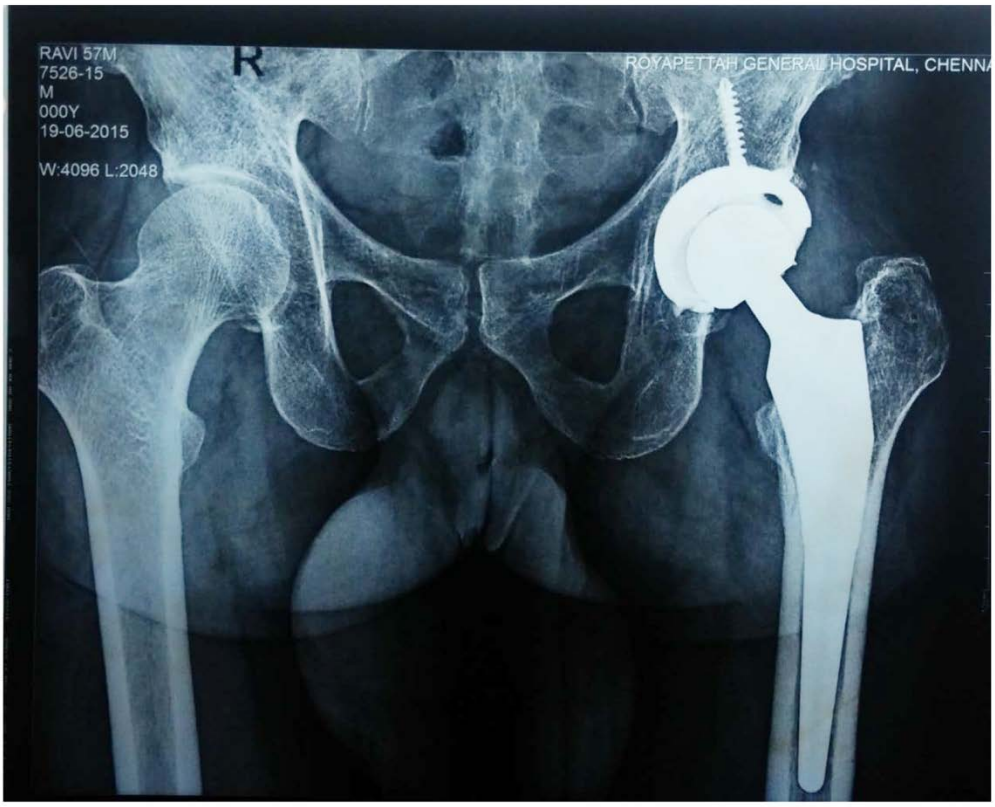
Ravi, 57 YRS male- H/O RTA 2 years back DIAGNOSED:

Fracture non union neck of femur

THR done on 20.8.2013



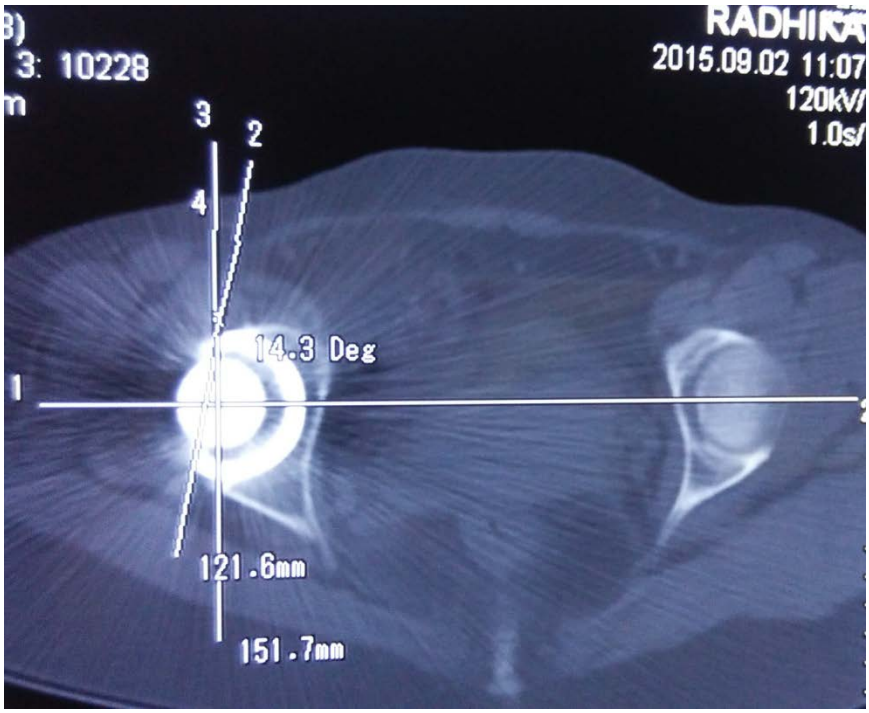
ACETABULAR CUP VERSION	FLEX [DEG]	EXT [DEG]	ABD [DEG]	ADD [DEG]	I R [DEG]	E R [DEG]
46.8^{O}	90	10	30	30	NIL	30


RAVI 57M
7526-15
M
000Y
19-06-2015
W:4096 L:2048
R
ROYAPETTAH GENERAL HOSPITAL, CHENNA

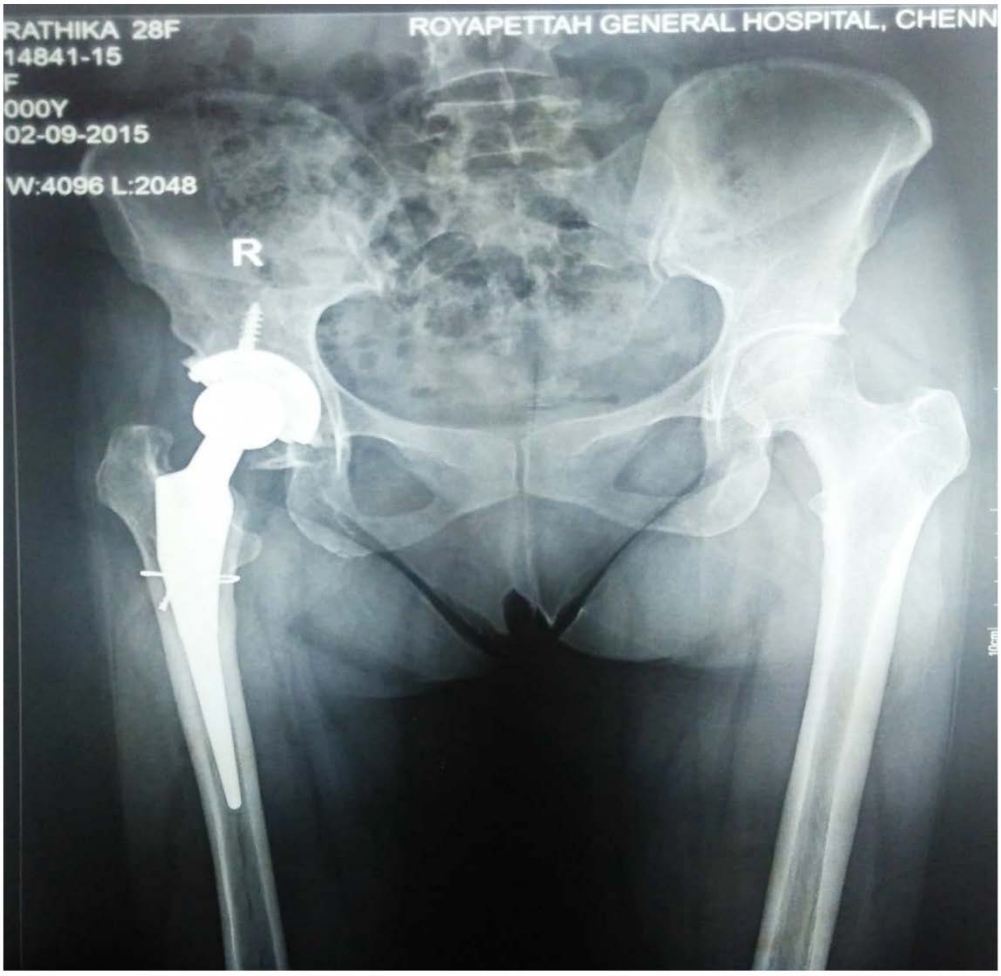
CASE 3

Rathika, 33/yrs female had h/o pain in right hip joint before 3 yrs. She diagnosed secondary osteoarthritis right hip.

THR done on 10.4 2012



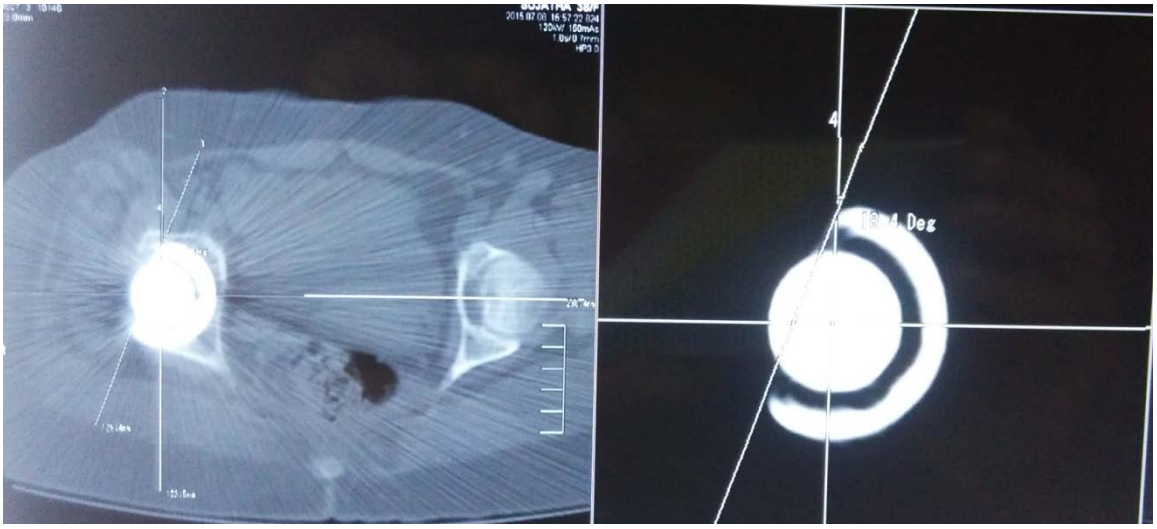
ACETABULAR CUP VERSION	FLEX [DEG]	EXT [DEG]	ABD [DEG]	ADD [DEG]	I R [DEG]	E R [DEG]
14.3^{O}	90	10	40	20	20	40


RATHIKA 28F
14841-15
F
000Y
02-09-2015
W:4096 L:2048
ROYAPETTAH GENERAL HOSPITAL, CHENN
R

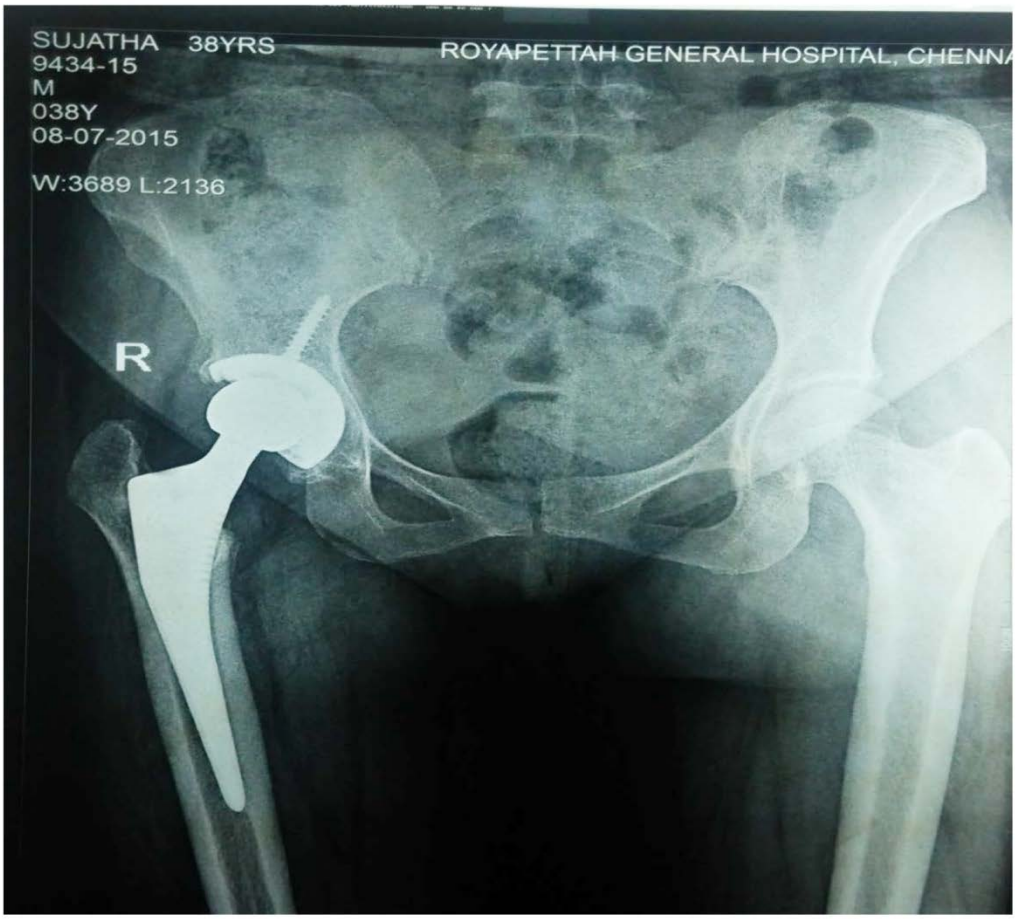
CASE 4

Sujatha 38/female had h/o pain in left hip joint – 1 yr back. She diagnosed avascular neck of femur.

THR done on 4.7.2014

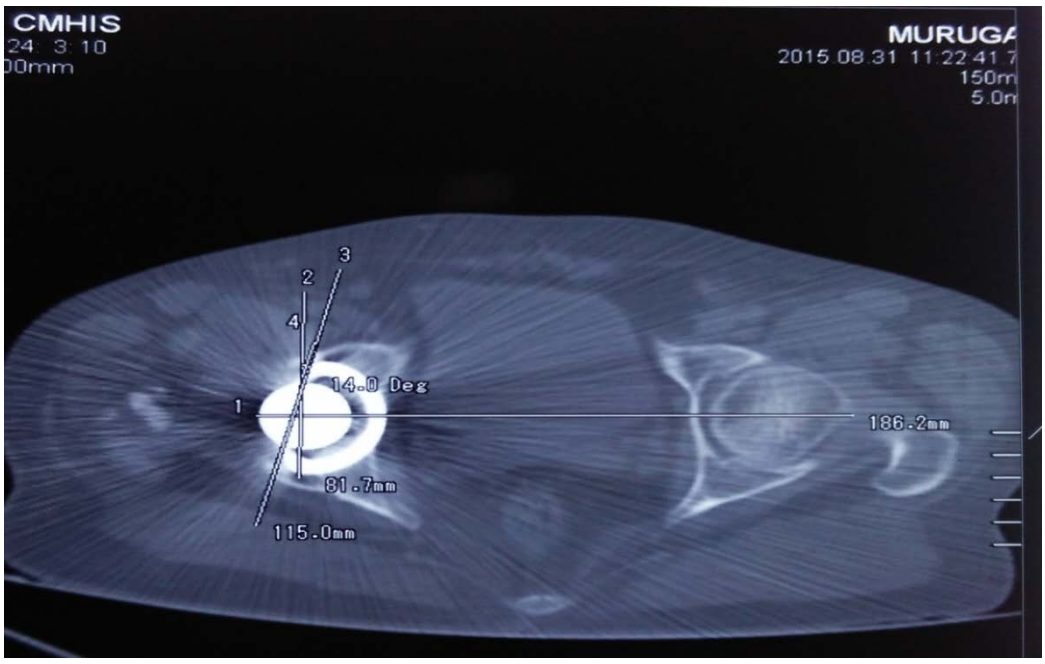


ACETABULAR CUP VERSION	FLEX [DEG]	EXT [DEG]	ABD [DEG]	ADD [DEG]	I R [DEG]	E R [DEG]
18.4^{O}	100	10	30	30	10	30

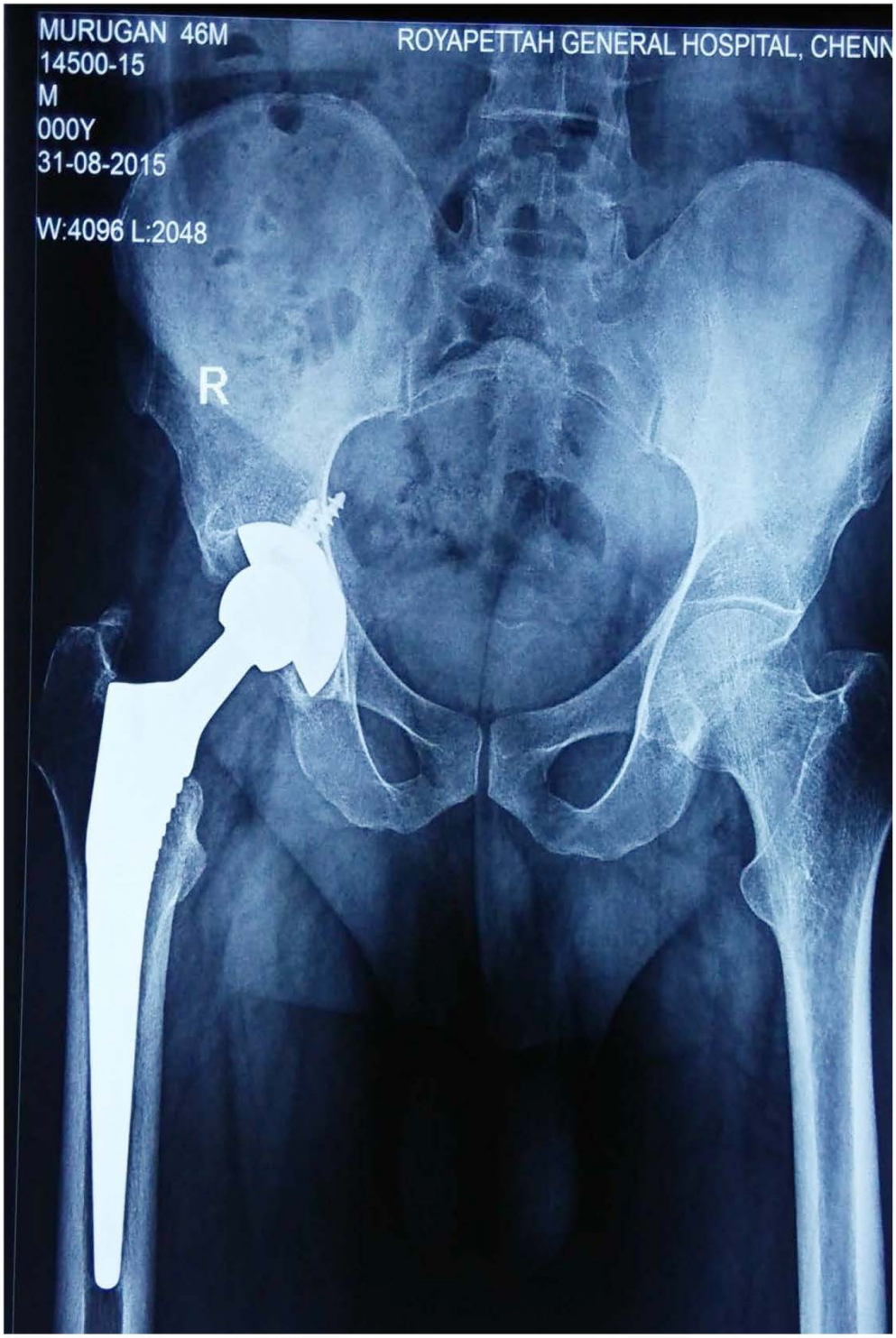

SUJATHA 38YRS
9434-15
M
038Y
08-07-2015
W:3689 L:2136
ROYAPETTAH GENERAL HOSPITAL, CHENNA
R

CASE 5:

Murugan 44/Male had H/O pain in left hip joint -1 year. He diagnosed AVASCULAR NECK OF FEMUR LEFT HIP. He underwent THR on 20.8.2014.



ACETABULAR CUP VERSION	FLEX [DEG]	EXT [DEG]	ABD [DEG]	ADD [DEG]	I R [DEG]	E R [DEG]
14^{O}	100	10	40	20	10	30


MURUGAN 46M
14500-15
M
000Y
31-08-2015
W:4096 L:2048
ROYAPETTAH GENERAL HOSPITAL, CHENN
R

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BIBLIOGRAPHY

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PROFORMA

“ANALYSIS OF ACETABULAR CUP POSITIONG AND IT’S IMPACT ON FUNCTIONAL OUTCOME IN TOTAL HIP REPLACEMENT”

Patient’s Name:

Age and sex:

Occupation:

Address:

Contact no:

I.P. No:

Date and mode of injury:

Date of admission:

History of previous treatment:

Plain X-ray AP view of hips:

CT SCAN:

Diagnosis:

Treatment:

Date of surgery:

Other co morbid conditions:

Implants use:

Post operative complications:

Follow up: evaluated with CT scan of affected hip:

Functional assessment: graded as excellent, good, fair and poor.

PATIENT CONSENT FORM

“ANALYSIS OF ACETABULAR CUP POSITIONG AND IT’S IMPACT ON FUNCTIONAL OUTCOME IN TOTAL HIP REPLACEMENT”

Study Detail: Retrospective design

Study Centre: Govt. Royapettah Hospital, Chennai

Patient’s name, age, sex:

Date & place:

Identification number:

I confirm that I have understood the purpose and procedure of the above study. I have the opportunity to ask questions and all my questions and doubts have been answered to my complete satisfaction.

I understand that my participation in the study is voluntary and that I am free to withdraw at any time without giving reason, without my legal rights being affected.

I understand that the ethical committee and the regulatory authorities will not need my permission to look at my health records, both in respect of the current study and any further research that may be conducted in relation to it, even if I withdraw from the study I agree to this access. However I understand that my identity would not be revealed in any information released to third parties or published, unless as required under the law. I agree not to restrict the use of any data or results that arise from this study.

I hereby consent to participate in this study.

I have been clearly explained about the atls protocol and damage control orthopaedics which may be applied as required.

I hereby give permission to undergo complete clinical examination and diagnostic tests including haematological, radiological tests and to undergo the surgical procedure which is individualised based on the fracture pattern.

Patient’s name with signature/lt thumb impression

ANNEXURE – 3

நோயாளிஒப்புதல்படிவம்

ஆராய்ச்சியின்விவரம் :

ஆராய்ச்சிமையம் :

நோயாளியின்பெயர் : நோயாளியின்வயது :

பதிவுஎண் :

நோயாளிகீழ்கண்டவற்றுள்கட்டங்களை (✔) செய்யவும்

1. மேற்குறிப்பிட்டுள்ளஆராய்ச்சியின்நோக்கத்தையும்பயனையும்முழுவதுமாகபுரிந்துகொண்டேன் மேலும்எனதுஅனைத்துசந்தேகங்களையும்கேட்டுஅதற்கானவிளக்கங்களையும்தெளிவுபடுத்திக் கொண்டேன். ☐

2. மேலும்இந்தஆராய்ச்சிக்குஎனதுசொந்தவிருப்பத்தின்பேரில்பங்கேற்கிறேன்என்றும், மேலும்எந்தநேரத்திலும்எவ்விதமுன்னறிவிப்புமின்றிஇந்தஆராய்ச்சியிலிருந்துவிலகமுழுமை யானஉரிமைஉள்ளதையும், இதற்குஎவ்விதசட்டபிணைப்பும்இல்லைஎன்பதையும்அறிவேன். ☐

3. ஆராய்ச்சியாளரோ, ஆராய்ச்சிஉதவியாளரோ, ஆராய்ச்சிஉபயத்தாரோ, ஆராய்ச்சிபேராசிரியரோ, ஒழுங்குநெறிசெயற்குழுஉறுப்பினர்களோஎப்போதுவேண்டுமானாலும்எனதுஅனுமதியின்றிஎன துஉள்நோயாளிபதிவுகளைஇந்தஆராய்ச்சிக்காகவோஅல்லதுஎதிர்காலபிறஆராய்ச்சிகளுக்காக வோபயன்படுத்திக்கொள்ளலாம்என்றும்,மேலும்இந்தநிபந்தனைநான்இவ்வாரய்ச்சியிலிருந்துவி லகினாலும்தகும்என்றும்ஒப்புக்கொள்கிறேன்.ஆயினும்எனதுஅடையாளம்சம்பந்தப்பட்டஎந்தபதி வுகளும்சட்டபூர்வமானதேவைகள்தவிர)
   வெளியிடப்படமாட்டாதுஎன்றஉறுதிமொழியின்பெயரில்இந்தஆராய்ச்சியிலிருந்துகிடைக்கப் பெறும்முடிவுகளைவெளியிடமறுப்புதெறிவிக்கமாட்டேன்என்றுஉறுதியளிக்கின்றேன். ☐

4. இந்தஆராய்ச்சிக்குநான்முழுமனதுடன்சம்மதிக்கின்றேன்என்றும்மேலும்ஆராய்ச்சிக்குழுவினர்எ னக்குஅளிக்கும்அறிவுரைகளைதவறாதுபின்பற்றுவேன்என்றும்இந்தஆராய்ச்சிகாலம்முழுவதும் ☐

எனதுஉடல்நிலையில்ஏதேனும்மாற்றமோஅல்லதுஎதிர்பாராதபாதகமானவிளைவோஎற்படுமாயி
ன்உடனடியாகஆராய்ச்சிகுழுவினரைஅணுகுவேன்என்றும்உறுதியளிக்கின்றேன்.

5. இந்தஆராய்ச்சிக்குத்தேவைப்படும்அனைத்துமருத்துவப்பரிசோதனைகளுக்கும்ஒத்துழைப்புதரு
வேன்என்றுஉறுதியளிக்கின்றேன். ☐

6. இந்தஆராய்ச்சிக்குயாருடையவற்புருத்தலுமின்றிஎனதுசொந்தவிருப்பத்தின்பேரிலும்சுயஅறிவுட
னும்முழுமனதுடனும்சம்மத்திக்கின்றேன்என்றுஇதன்மூலம்ஒப்புக்கொள்கிறேன். ☐

நோயாளியின்கையொப்பம் / பெருவிரல்கைரேகை ஆராய்ச்சியாளரின்கையொப்பம்

இடம்: தேதி:

ANNEXURE – 4

ETHICAL COMMITTEE CERTIFICATE

INSTITUTIONAL ETHICAL COMMITTEE
GOVT. KILPAUK MEDICAL COLLEGE,
CHENNAI-10
Protocol ID. No.09/04/2015 Meeting held on 09/04/2015
CERTIFICATE OF APPROVAL

The Institutional Ethical Committee of Govt. Kilpauk Medical College, Chennai reviewed and discussed the application for approval "A study of acetabular cup positiong and it's impact on functional outcome in total hip replacement".– For Dissertation Purpose submitted by Dr.T.Selvakumar, Post Graduate in MS (Ortho), Govt. Kilpauk Medical College / GRH, Chennai.

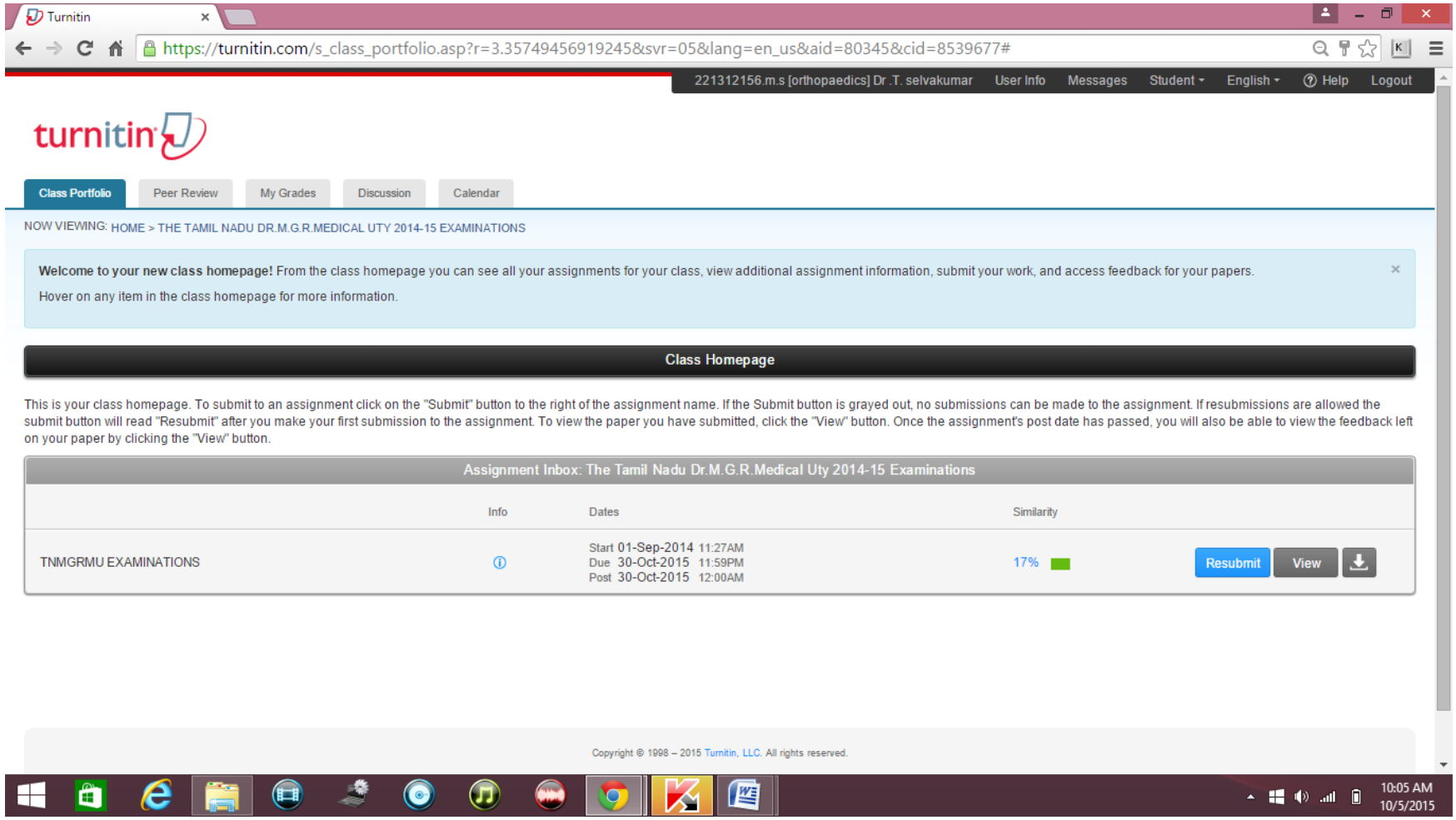
The Proposal is APPROVED.

The Institutional Ethical Committee expects to be informed about the progress of the study any Adverse Drug Reaction Occurring in the Course of the study any change in the protocol and patient information /informed consent and asks to be provided a copy of the final report.

GOVT. KILPAUK MEDICAL COLLEGE ★ Kilpauk, Chennai-10. ★
12 JUN 2015

CHAIRMAN,
Ethical Committee
Govt. Kilpauk Medical College, Chennai

12/6/15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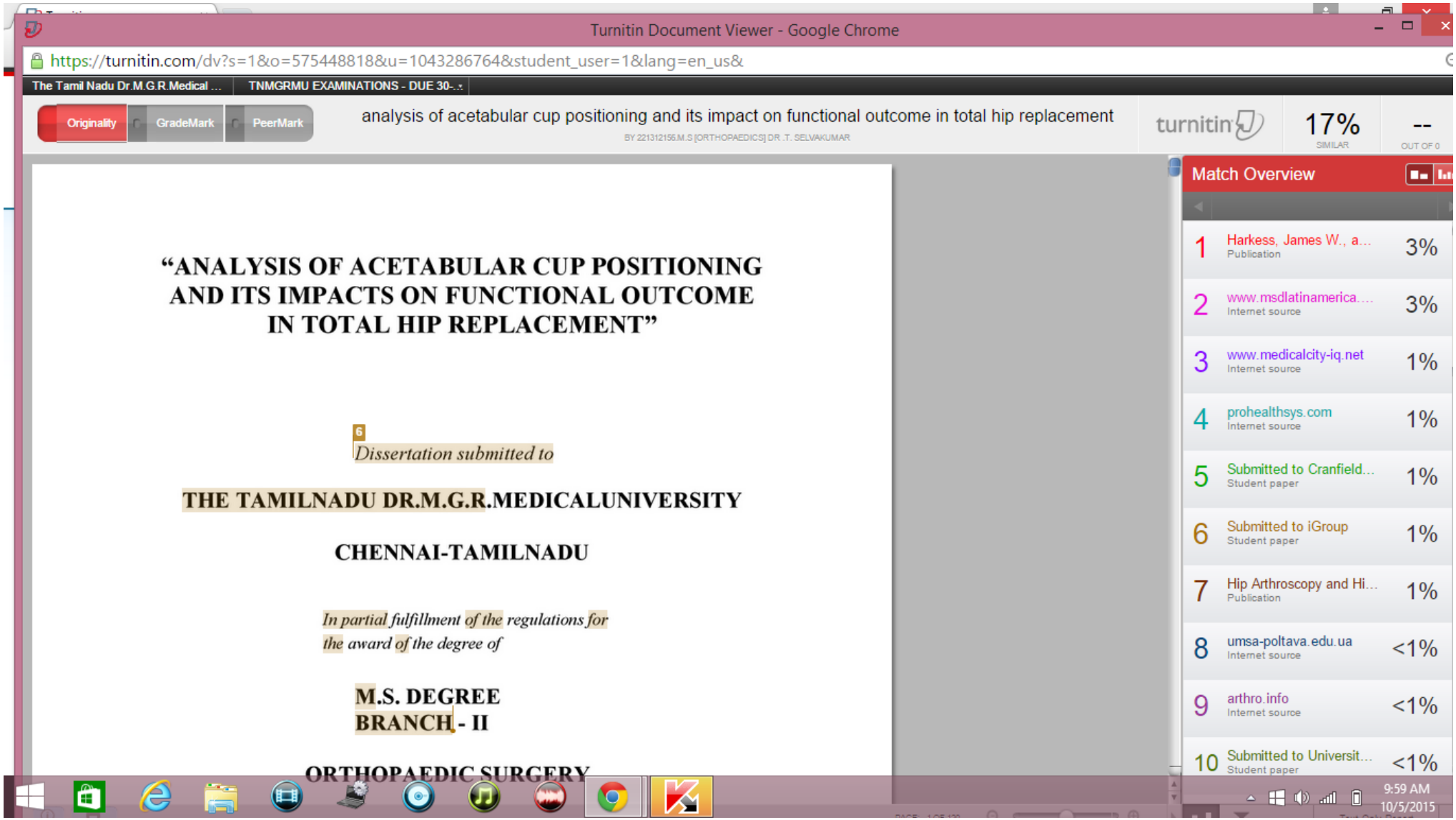
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No.	Name	Cup Version [DEG]	FLEX [DEG]	EXT [DEG]	ABD [DEG]	ADD [DEG]	IR [DEG]	ER [DEG]	LLD [CM]	SLRT	Hip Score
1.	Sekar	14^0	90^0	10^0	30^0	30^0	20^0	30^0	-	80^0	98
2.	Murugan	14^0	100^0	10^0	40^0	20^0	10^0	30^0	0.5cm	90^0	98
3.	Rajendran	25^0	100^0	10^0	30^0	20^0	10^0	30^0	1cm	90^0	98
4.	Athikesava	22.4^0	90^0	20^0	40^0	30^0	20^0	40^0	-	90^0	100
5.	Radhika	14.3^0	90^0	10^0	40^0	20^0	20^0	40^0	0.5cm	90^0	100
6.	Mudupandi	30.5^0	100^0	10^0	30^0	20^0	Nil	30^0	4cm	80^0	88
7.	Karthikeya	6.9^0	90^0	10^0	30^0	20^0	10^0	30^0	1cm	80^0	98
8.	Deenadhayan	16.4^0	100^0	10^0	30^0	20^0	20^0	30^0	-	90^0	98
9.	Sujatha	18.4^0	100^0	10^0	30^0	30^0	10^0	30^0	-	90^0	98

10.	Ravi	46.8^0	90^0	10^0	30^0	30^0	Nil	30^0	0.5cm	90^0	98
11.	Gopal	16.4^0	110^0	10^0	20^0	20^0	10^0	10^0	-	90^0	76
12.	Jayaganthi	12.1^0	100^0	20^0	40^0	20^0	20^0	40^0	-	90^0	100
13.	Balamurgan	14.8^0	110^0	20^0	40^0	30^0	10^0	40^0	-	90^0	100
14.	Megala	16.3^0	110^0	20^0	40^0	-	10^0	40^0	-	90^0	100
15.	Selvadurai	14.7^0	100^0	10^0	30^0	40^0	10^0	20^0	-	90^0	98
16.	Ravidaran	18.1^0	100^0	10^0	40^0	40^0	10^0	30^0	-	80^0	100
17.	Rajan	16^0	100^0	10^0	30^0	40^0	20^0	30^0	-	90^0	100
18.	Sampath	14.5^0	100^0	10^0	40^0	40^0	20^0	30^0	-	90^0	100
19.	Dharman	15^0	110^0	10^0	40^0	30^0	20^0	30^0	-	90^0	100
20.	Babu	16.4^0	100^0	10^0	40^0	40^0	20^0	30^0	-	90^0	100