"EFFECT OF SURGICAL APPROACH ON FUNCTIONAL OUTCOME AND COMPONENT POSITIONING IN TOTAL HIP ARTHROPLASTY : A ONE YEAR HOSPITAL BASED PROSPECTIVE STUDY"

BY

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ABBREVIATIONS

ACL	:	Anterior Cruciate Ligament
AP	:	Anteroposterior
CRP	:	C - Reactive Protein
CXR	:	Chest X-ray
DLC	:	Differential Leukocyte Count
DVT	:	Deep Vein Thrombosis
ECG	:	Electrocardiography
ESR	:	Erythrocyte Sedimentation Rate
FBS	:	Fasting Blood Sugar
GT	:	Greater Trochanter
HA	:	Hemiarthroplasty
HHS	:	Harris Hip Score
PA	:	Pulmonary Artery
RBS	:	Random Blood Sugar
SD	:	Standard Deviation
THA	:	Total Hip Arthroplasty
TLC	:	Total Leukocyte Count
VAS	:	Visual Analogue Scale

ABSTRACT

Introduction : The success of total hip arthroplasty (THA) in addressing pain, mobility, and physical function for osteoarthritis' patients has led to the procedure being dubbed the "operation of the century". THA has good 10-year survival rates and 25-year implant survival rates of over 95% and over 80%, respectively. At short and mid-term follow-up, health-related quality of life outcomes following THA have generally ranged from good to excellent. Two of the most often employed surgical techniques for THA are the posterior and direct lateral approaches. In spite of numerous studies assessing the impact of surgical approaches in THA, Jolles and Bogoch's Cochrane review found that they were insufficient to enable a conclusive determination of whether one approach was superior to the other. Of the four prospective cohort studies included in the Cochrane review, only one trial by Barber et al., with a brief follow up of 2 years and a small patient population of only 49, provided functional outcomes using Harris Hip Score (HHS). According to Jolles and Bogoch's Cochrane review, there are no long-term randomised control trials comparing different acetabular component positioning strategies with the approach chosen for THA. Because both of these surgical approaches have their benefits and drawbacks, orthopaedic surgeons are still debating which is ideal for primary THA.

Objective : To evaluate the difference between the direct lateral and posterior approaches with respect to the functional outcome, component positioning, immediate postoperative pain, and patient satisfaction.

Methods : Patients with osteoarthritis of hip joint, avascular necrosis of femoral head or neck of femur fracture, who will undergo primary THA will be evaluated and studied over a period of 1 year at KLEs Dr. Prabhakar Kore Hospital and Medical Research Centre, Belagavi. These patients will be reviewed using clinical examination. Functional assessment will be performed 1 day before surgery, 1 day after surgery & 1 month and 6 monthly follow-up using Harris Hip score (HHS). Component positioning of acetabular cup and femoral stem will be assessed in plain radiographs at the latest follow-up. Immediate post-operative pain will be measured by using VAS pain score. Generic satisfaction questionnaire will be used to measure satisfaction after THA at the latest follow-up.

Results : While comparing the two groups, in the Lateral group, the mean pre-operative HHS, first post-operative day HHS, 1 month post-operative HHS, and the mean 6 month post-operative HHS were 57.95 (poor), 63.6 (poor), 74.7 (fair) and 84.45 (good) respectively, while in Posterior group, they were 56.7 (poor), 64.9 (poor), 73.45 (fair) and 85.3 (good) respectively. In Lateral group, the mean acetabular cup inclination and cup version was 37.9 degrees and 16.14 degrees respectively, while in Posterior group, it was 45.02 degrees and 27.69 degrees respectively. In Lateral group, 80% of the femoral stem tips were in neutral and 20% of them were in valgus position, while in Posterior group, 75% of the femoral tips were in neutral, 20% in valgus and 5% were in varus position. In Lateral group, the mean immediate post-op VAS score was 4.85, while in Posterior group, it was 5.05. In Lateral group, the mean satisfaction score was 22.5, while in Posterior group, it was 23.

Conclusion : From this study, it can be concluded that both Lateral approach and Posterior approach for Total Hip Arthroplasty had no statistically significant difference in the form of functional outcome, immediate post-operative pain, patient satisfaction and femoral stem tip position. However, the mean acetabular cup inclination and version were significantly more in the posterior approach. Clinically, posterior approach also had 2 instances of dislocation in early follow up period.

Keywords: Total hip arthroplasty, Lateral, Posterior, Approach, Pain, Femur, Acetabulum, Follow-up

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES AND PHOTOGRAPHS

INTRODUCTION

Total hip arthroplasty (THA) is regarded as one of the most effective and impactful surgical procedures in modern medical practice, often being referred to as the "operation of the century"[1]. This technique has revolutionized the treatment of advanced hip osteoarthritis by significantly reducing pain, improving mobility, and enhancing overall physical function. With survival rates exceeding 95% at 10 years and more than 80% at 25 years, THA continues to be the preferred intervention for patients suffering from severe hip joint conditions[2]. Advances in surgical techniques, implant design, and perioperative management have further optimized outcomes, allowing patients to regain independence and an improved quality of life.

While THA has demonstrated considerable success in implant longevity and surgical improvements, patient satisfaction does not always align with these achievements. This discrepancy is primarily due to evolving patient expectations, with individuals seeking not only pain relief but also superior functional recovery, the ability to resume daily activities, and even sports participation[3]. As THA is increasingly performed across the globe due to an aging population and rising mobility demands, it is vital to understand the factors influencing its success. Among these, the selection of a surgical approach plays a crucial role in determining postoperative function, complication risks, and implant positioning.

The two most widely used surgical approaches in THA are the posterior and direct lateral techniques[4]. The choice between them depends on various factors, including the surgeon's expertise, patient anatomy, underlying pathology, and the desired postoperative outcome. Each approach has distinct surgical steps, levels of soft tissue preservation, intraoperative visualization, and rehabilitation protocols. Understanding these differences is essential for optimizing patient recovery and reducing complications.

The posterior approach, also known as the Southern or Moore approach, is commonly used due to its excellent visualization of the femoral canal and acetabulum, facilitating component placement[5]. This approach minimizes disruption to the abductor muscles, crucial for hip stability. However, one notable drawback is the increased risk of postoperative dislocation due to the disruption of the posterior capsule and external rotators. To mitigate this risk, surgeons employ posterior capsular repair and advanced soft tissue closure techniques, significantly reducing the likelihood of dislocation.

Conversely, the direct lateral approach, often called the Hardinge method, enhances joint stability by preserving the posterior capsule[6]. This method, which accesses the hip joint via the gluteus medius and minimus muscles, lowers the risk of posterior dislocation. However, it has been associated with abductor muscle weakness, prolonged recovery, and an increased likelihood of Trendelenburg gait in some patients. The advantage of enhanced stability must, therefore, be weighed against potential functional limitations and extended rehabilitation needs.

Despite numerous studies comparing the functional outcomes and component positioning between these approaches, no definitive consensus has emerged regarding the superiority of one technique over the other. A Cochrane review by Jolles and Bogoch found insufficient evidence to favor either approach decisively[7]. Among the reviewed prospective cohort studies, Barber et al. assessed functional outcomes using the Harris Hip Score (HHS) but had limitations due to a small sample size and short follow-up period[8]. Studies examining dislocation rates following primary THA have yielded mixed results. For example, Pellicci et al. observed no posterior dislocations in 395 patients who underwent THA with enhanced posterior soft tissue repair, highlighting the importance of meticulous surgical technique in reducing complications[9].

Beyond dislocation risk and functional recovery, acetabular component positioning is another vital consideration in THA. Proper positioning ensures joint stability, optimal biomechanics, and reduces the risk of impingement and premature wear. However, there is a lack of long-term randomized controlled trials comparing component positioning strategies across surgical approaches. This underscores the need for further high-quality research to determine whether a specific approach consistently yields better results.

Given the advantages and limitations of both techniques, the debate over the optimal surgical approach for primary THA persists. While the posterior approach offers superior visualization and muscle preservation, it necessitates meticulous soft tissue repair to prevent dislocation. In contrast, the direct lateral approach provides greater stability but may compromise abductor muscle function and prolong recovery. Ultimately, the choice of approach should be tailored to each patient, considering factors such as muscular strength, dislocation risk, and functional goals. A deeper understanding of the interplay between surgical technique, functional outcomes, and component positioning will help orthopedic surgeons make informed decisions, thereby enhancing the overall success and longevity of THA procedures.

Need for the Study :

This study aims to evaluate the differences between the direct lateral and posterior approaches in terms of functional outcomes, component positioning, immediate postoperative pain, and patient satisfaction.

AIM AND OBJECTIVES

Aim:

To assess and compare the outcomes of the posterior and lateral approaches in patients undergoing total hip arthroplasty.

Objectives:

1. To evaluate and compare the functional and radiological outcomes of the two approaches.
2. To determine the efficacy of each technique in terms of pain reduction and patient satisfaction.

REVIEW OF LITERATURE

ANATOMY OF HIP JOINT[10]

The hip joint is a ball-and-socket structure, where the femoral head articulates with the acetabulum, a concave cavity. The articular surface of the acetabulum is horseshoe-shaped, with an inferior opening at the acetabular notch. Hyaline cartilage covers the articulating surfaces, ensuring smooth movement. Surrounding the acetabulum is a fibrocartilaginous rim known as the acetabular labrum, which increases the depth of the cavity. The labrum has a triangular cross-section, with its base attached to the acetabular margin and its apex forming a free edge that curls inward, securing the femoral head within the joint.

A fibrous capsule encases the joint, attaching medially to the acetabular labrum and laterally to the intertrochanteric line of the femur. The capsule is thickest in the superior and anterior regions, where the greatest structural support is required, and relatively thinner posteriorly and inferiorly. The key ligaments contributing to joint stability include the iliofemoral, pubofemoral, and ischiofemoral ligaments, as well as the ligamentum teres and the transverse acetabular ligament.

The iliofemoral ligament is a strong Y-shaped band that originates from the anterior inferior iliac spine and extends to the intertrochanteric line, preventing excessive extension while standing. The pubofemoral ligament, with a triangular shape, extends from the superior pubic ramus to the lower intertrochanteric line, limiting extension and abduction. The ischiofemoral ligament, a spiraled structure, extends from the ischium to the acetabular margin, with its fibers inserting into the greater trochanter. This ligament restricts excessive internal rotation.

The transverse acetabular ligament spans the acetabular notch, forming a tunnel for neurovascular structures. The ligament of the femoral head, a flat triangular band, extends from the femoral head to the transverse acetabular ligament and is enclosed in a synovial sheath.

The hip joint is closely related to several muscles that contribute to stability and movement. Anteriorly, it is bordered by the rectus femoris (straight head), iliacus, and psoas major (separated from the capsule by a bursa), as well as the pectineus muscle. Superiorly, the reflected head of the rectus femoris and the insertion of the gluteus minimus closely adhere to the capsule. Inferiorly, the obturator externus and pectineus provide structural support. Posteriorly, the reflected head of the rectus femoris and the insertion of the gluteus minimus remain in close contact with the capsule.

Blood supply to the hip joint is provided by the obturator artery, the medial circumflex femoral artery, and the superior and inferior gluteal arteries. Nerve innervation is derived from the sciatic, obturator, and femoral nerves, along with a branch from the nerve to the quadratus femoris.

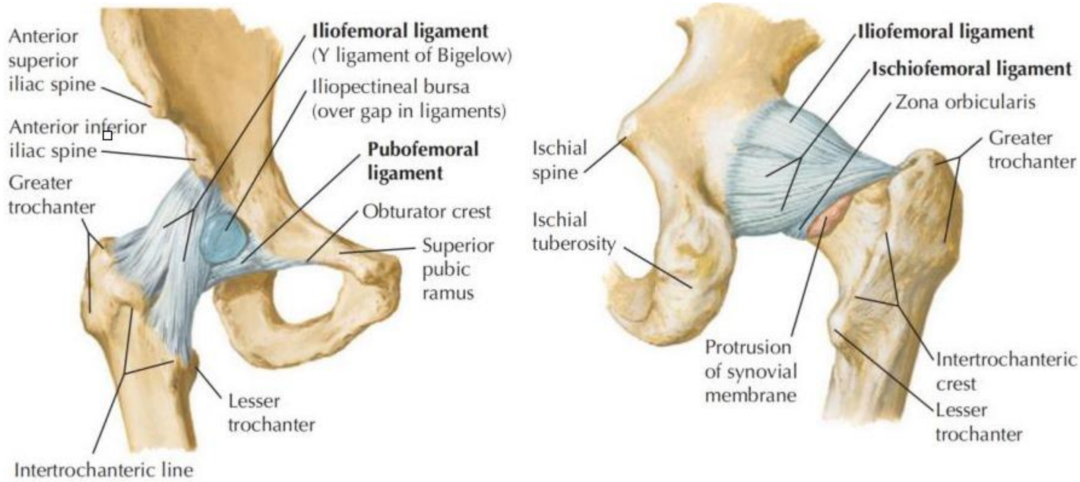

Fig. 1: Hip joint - Anterior and Posterior view

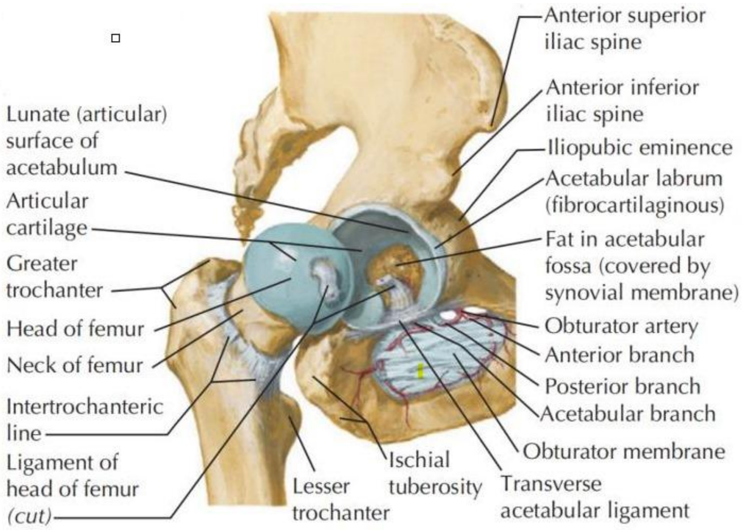

Fig. 2: Hip joint (opened) - Lateral view

The major muscles responsible for hip movements include:

i. Flexion: Psoas major, Psoas minor, Iliacus, Pectineus, Rectus femoris, Sartorius, Adductors
ii. Extension: Gluteus maximus, Biceps femoris, Semitendinosus, Semimembranosus
iii. Abduction: Gluteus medius, Gluteus minimus, Sartorius, Tensor fascia latae
iv. Adduction: Adductor longus, Adductor brevis, Adductor magnus, Pectineus, Gracilis
v. Internal rotation: Gluteus medius (anterior fibers), Gluteus minimus, Tensor fascia latae
vi. External rotation: Piriformis, Obturator muscles, Gemelli, Quadratus femoris, Adductors, Sartorius

Due to the angulation and length of the femoral neck, movements such as flexion, extension, adduction, and abduction partially translate into rotational movements. The femoral head rotates along a transverse axis within the acetabulum when the thigh is flexed or extended. Movements occur through both gliding and rotational actions within the joint. The axis of rotation is defined by a vertical line passing through the femoral head and the intercondylar notch.

In the hip joint, the femoral head is securely enclosed within the acetabulum, with nearly half of its sphere engaged. The acetabular labrum enhances stability by closely surrounding the head of the femur, ensuring it remains secured even when the capsular fibers are compromised. This structure contributes to the overall strength and function of the hip joint, facilitating efficient movement and load distribution.

BLOOD SUPPLY[11]

The vascularization of the hip joint is particularly crucial in cases of intracapsular fractures. The femoral head receives blood from three major sources: capsular vessels, intramedullary vessels, and contributions from the artery of the ligamentum teres. Among these, the capsular vessels are the most significant in adults, with the medial and lateral circumflex femoral arteries serving as the primary contributors. In approximately 79% of cases, these arteries branch from the profunda femoris, while in 20%, one or both arise directly from the femoral artery, with only 1% originating entirely from the femoral artery.

The ascending cervical capsular vessels originate from an extracapsular arterial network, created by the medial and lateral circumflex femoral arteries at the femoral neck base. These vessels enter the anterior capsule near the intertrochanteric line and travel along the posterior neck, beneath the orbicular fibers of the capsule, reaching the joint surface. Referred to as retinacular vessels within the capsule, they are categorized into four main groups: anterior, medial, lateral, and posterior. Of these, the lateral group provides the most significant blood supply to the femoral head. The deep branch of the medial femoral circumflex artery plays a crucial role in nourishing the weight-bearing region of the femoral head, whereas the lateral femoral circumflex artery and metaphyseal vessels contribute to a lesser extent.

A secondary arterial ring, known as the subsynovial intra-articular ring, links the femoral neck to the femoral head. The terminal branches of the medial femoral circumflex artery penetrate the posterosuperior region of the femoral head, approximately 2 to 4 mm proximal to the articular surface. In displaced subcapital fractures, these critical vessels are at risk of injury. When the femoral head is dislocated due to a fracture in this region, its blood supply is significantly compromised, raising the risk of avascular necrosis. Research by Claffey has shown that damage to the primary lateral retinacular arteries greatly increases the likelihood of avascular necrosis.

The artery of the ligamentum teres, which typically originates from the obturator artery or occasionally the medial femoral circumflex artery, contributes minor vascular supply. Additionally, the medullary circulation within the femoral neck augments blood flow in adults. Similar to the retinacular vessels, these veins are highly susceptible to rupture in cases of displaced fractures. Although the artery of the ligamentum teres assists in supplying the femoral head, it is usually insufficient to maintain full vascular integrity. Following a fracture, revascularization occurs through residual blood supply areas and new vessel formation from the metaphysis. The cambial layer within the fibrous sheath of the femoral neck, located within the hip joint capsule, does not actively participate in callus formation during fracture healing.

Instead, bone healing is entirely dependent on endosteal remodeling, which explains the prolonged healing duration commonly associated with these fractures.

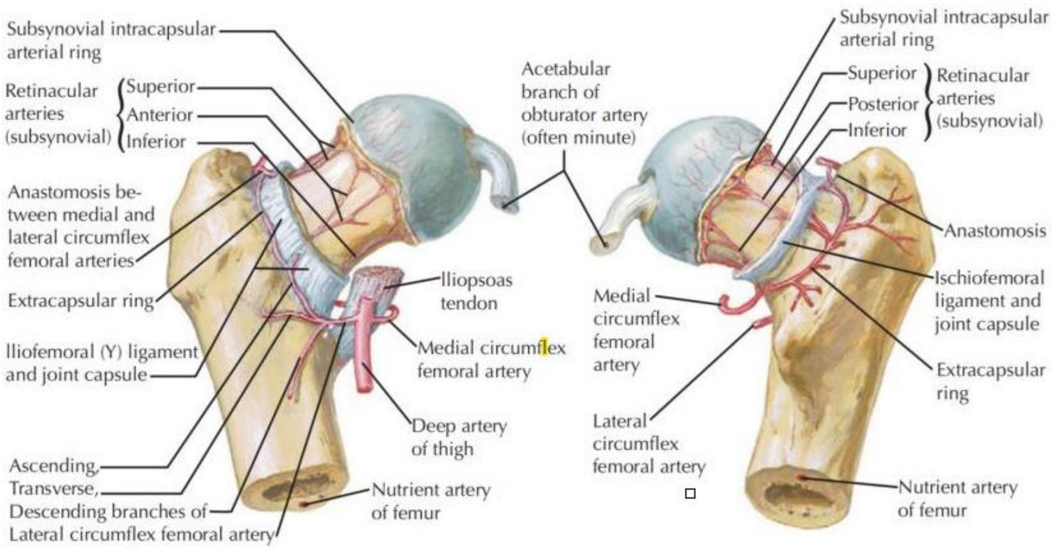

Fig. 3: Blood supply of the hip joint - Anterior and Posterior view

APPLIED BIOMECHANICS[12]

The biomechanics of the hip joint can be understood through the principles of moment forces, which include a fulcrum, a lever arm, and a power arm. The femoral head functions as the fulcrum, with body weight acting on one side and the abductor muscles on the other. The hip joint operates similarly to a first-class lever, where the semi-spherical femoral head articulates within the acetabular cup, ensuring movement and stability.

Forces acting on the hip:

The hip joint withstands significant forces during movement. Body weight acts as a load on a lever arm extending from the body's center of gravity to the femoral head. When standing on one leg, the abductor muscles generate an opposing force to keep the pelvis level. Given that the body's weight lever arm is roughly 2.5 times longer than the abductor muscle's lever arm, these muscles must exert a force approximately 2.5 times the body weight to maintain balance during single-leg stance.

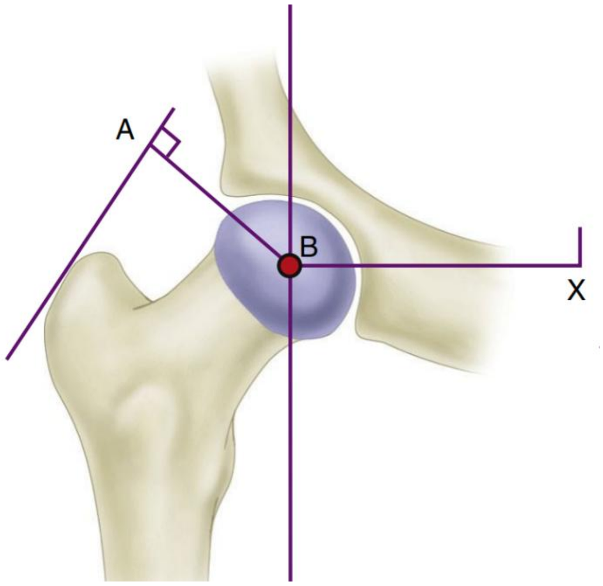

Fig. 4: Lever arms acting on hip joint

The moment created by body weight at the center of gravity (X) on the lever arm (B-X) must be counterbalanced by the force exerted by the abductors (A) on a shorter lever arm (A-B). In cases of hip arthritis, this lever arm may be shortened, leading to biomechanical alterations. The Charnley concept of total hip arthroplasty (THA) sought to address this by deepening the acetabulum to reduce the body weight lever arm while lengthening the abductor lever arm via lateral repositioning of the osteotomized greater trochanter. These modifications reduce the moment force required by the abductor mechanism, ultimately decreasing stress on the hip joint.

During activities like lifting, sprinting, or jumping, forces on the hip can reach up to ten times the body weight. Increased physical activity or excessive body weight can lead to mechanical stress that may contribute to implant loosening, bending, or fracture of the femoral component.

While forces primarily act in the coronal plane, the body's center of gravity, positioned slightly posterior to the joint axis, also exerts a force in the sagittal plane. This leads to posterior bending of the femoral stem. The combined effect of these forces results in torsional stress on the stem, often initiating fractures on the anterolateral side of the femoral component. Expanding the proximal femoral stem to better occupy the metaphysis can improve torsional stability. This can also be achieved by preserving the femoral neck portion during implantation.

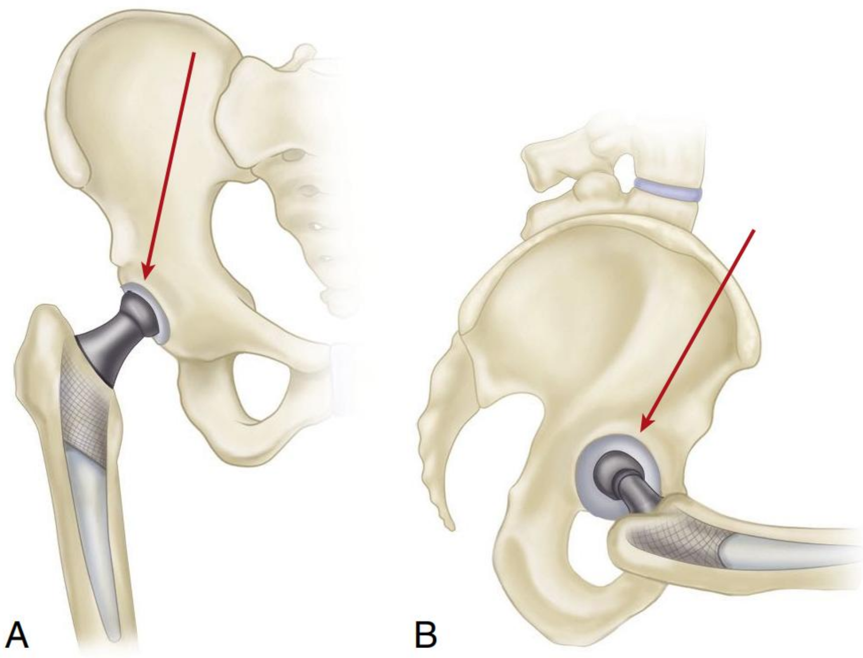

Fig. 5: Forces producing torsion of stem. Forces acting on hip in coronal plane (A) tend to deflect stem medially, and forces acting in sagittal plane (B), especially with hip flexed or when lifting, tend to deflect stem posteriorly. Combined, they produce torsion of stem.

Strategies to Reduce Hip Joint Forces:

- ✓ Shortening the body weight lever arm by deepening the acetabulum.
- ✓ Extending the abductor lever arm by laterally repositioning the greater trochanter.

Reattaching the osteotomized greater trochanter laterally increases the distance between the femoral head and the stem, effectively lengthening the abductor lever arm. However, abductor weakness caused by surgical trauma, infection, nonunion, or proximal trochanteric displacement can destabilize the hip and increase the risk of implant loosening and prosthetic stem failure. Because sufficient exposure can be obtained without trochanteric osteotomy, this procedure is now avoided to prevent associated complications.

The preoperative bone quality is crucial in determining the most suitable implant, fixation method, and long-term success of hip arthroplasty. Dorr et al. classified proximal femurs based on cortical thickness and canal dimensions, correlating these features with implant stability:

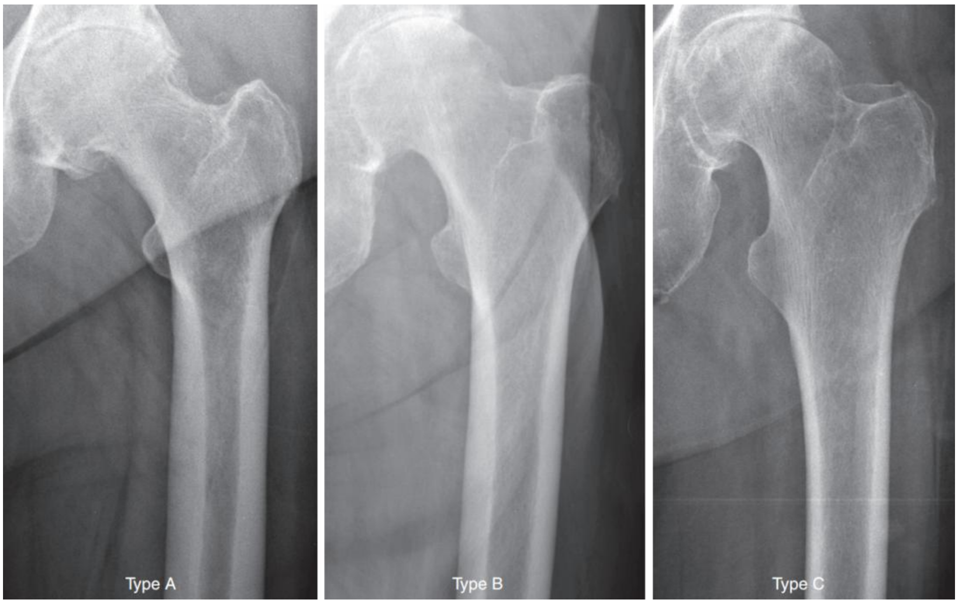

Fig. 6: Dorr radiographic categorization of proximal femurs

Type A Femur: Characterized by thick cortical bone on the anteroposterior view and a prominent posterior cortex on the lateral view. The narrow distal canal gives the proximal femur a "champagne flute" shape. This type is common in men and younger patients and provides excellent fixation for both cemented and cementless implants.

Type B Femur: Shows moderate cortical thinning in the medial and posterior regions, resulting in increased intramedullary canal width. Despite these changes, the femoral shape remains adequate for implant fixation.

Type C Femur: Displays significant cortical bone loss, leading to an expanded intramedullary canal. On lateral radiographs, it appears "stovepipe" shaped. This type is frequently observed in older postmenopausal women and poses challenges for cementless implant fixation, often necessitating alternative stabilization techniques.

SURGICAL APPROACHES[13]

Two commonly used approaches for THA are:

1. Posterior approach
2. Lateral approach

Posterior approach:

Planes:

- Internervous Plane: Not present
- Intermuscular Plane: The gluteus maximus is split, stopping at the first nerve branch to its upper half. The superior gluteal artery supplies the proximal one-third, while the inferior gluteal artery supplies the distal two-thirds. A fat line on the gluteus maximus surface marks the hiatus in the vascular plane.

Anesthesia: General or spinal anesthesia

Positioning: Lateral or supine positioning

Surgical Approach:

Initially popularized by Moore, the posterior or Southern approach positions the patient laterally, with the affected limb elevated. A 10 to 15 cm curved incision is made posterior to the greater trochanter, beginning 6 to 8 cm above it and extending downward along the femoral shaft. The fascia lata is incised to reveal the vastus lateralis, and blunt dissection is performed to separate the gluteus maximus fibers.

Retracting the gluteus maximus exposes the short external rotator muscles, which are placed under tension through internal hip rotation. The piriformis and obturator internus tendons are tagged with sutures before detaching them near their insertion, allowing them to be reflected posteriorly. This exposes the posterior capsule, which is incised longitudinally or in a T-shape. Flexion, internal rotation, and adduction facilitate femoral head dislocation, enabling its removal.

At-Risk Structures:

- Sciatic nerve
- Inferior gluteal artery
- First perforating branch of profunda femoris
- Femoral vessels
- Superior gluteal artery and nerve

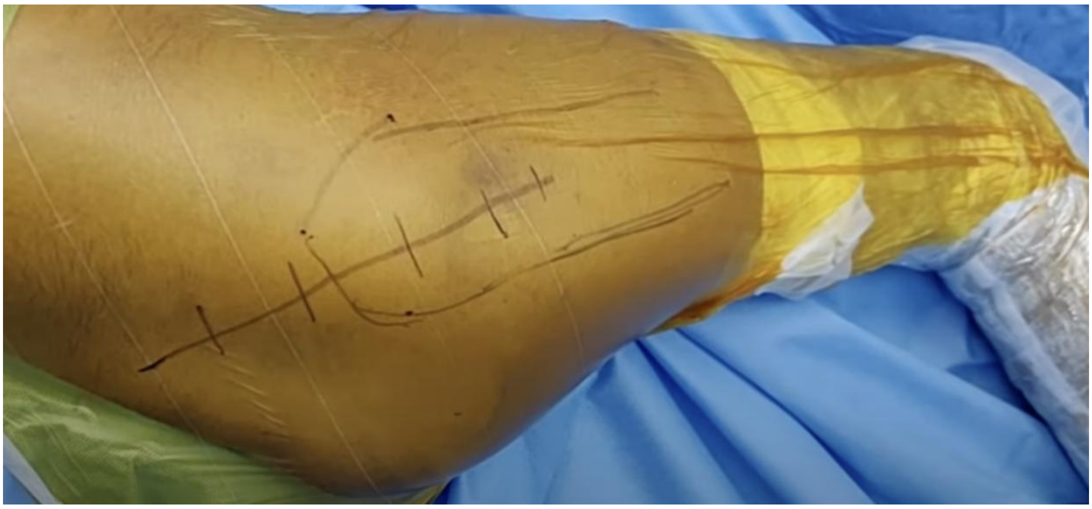

Fig. 7: Skin incision for the posterior approach to the hip joint.

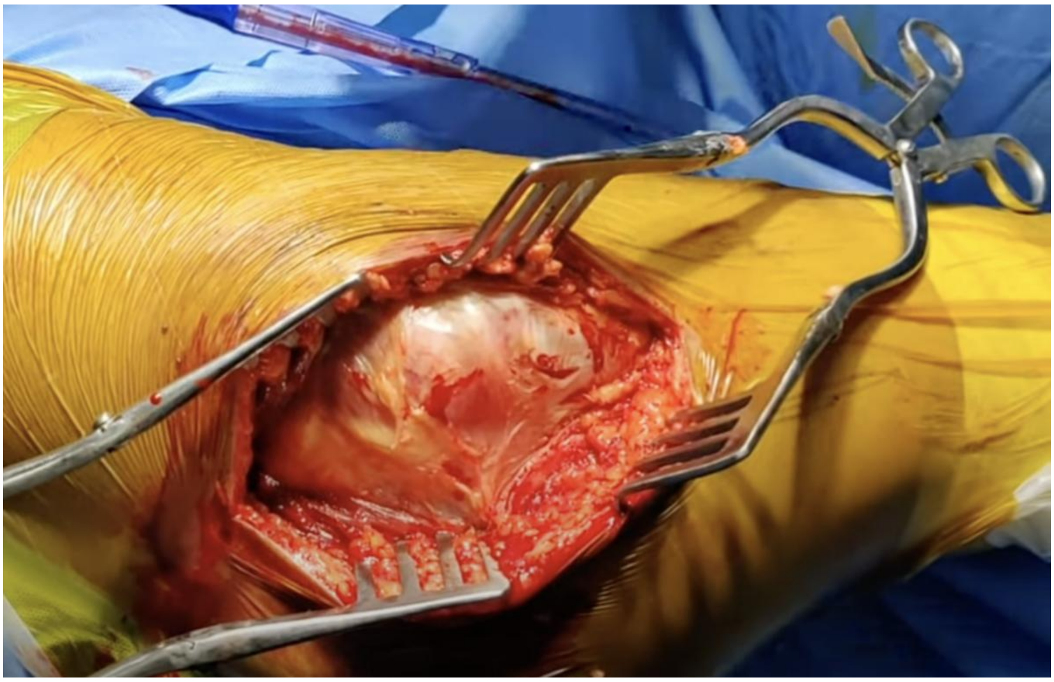

Fig. 8: Incise the fascia lata in line of the skin incision to expose the trochanteric bursa and vastus lateralis.

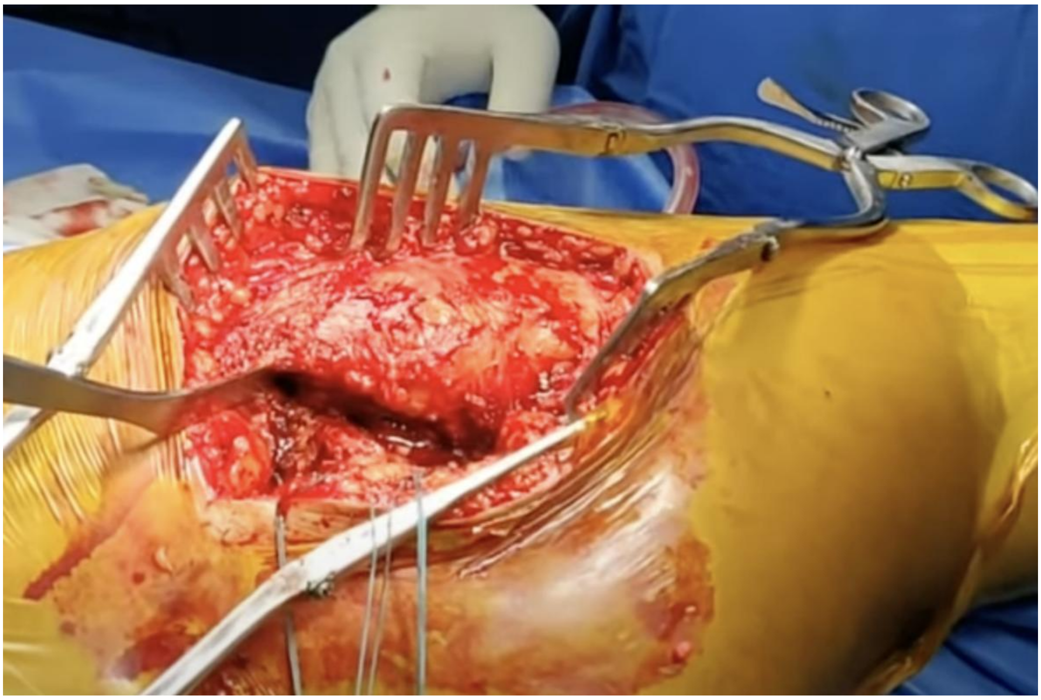

Fig. 9: Insertions of the short external rotators are exposed by internally rotating the femur.

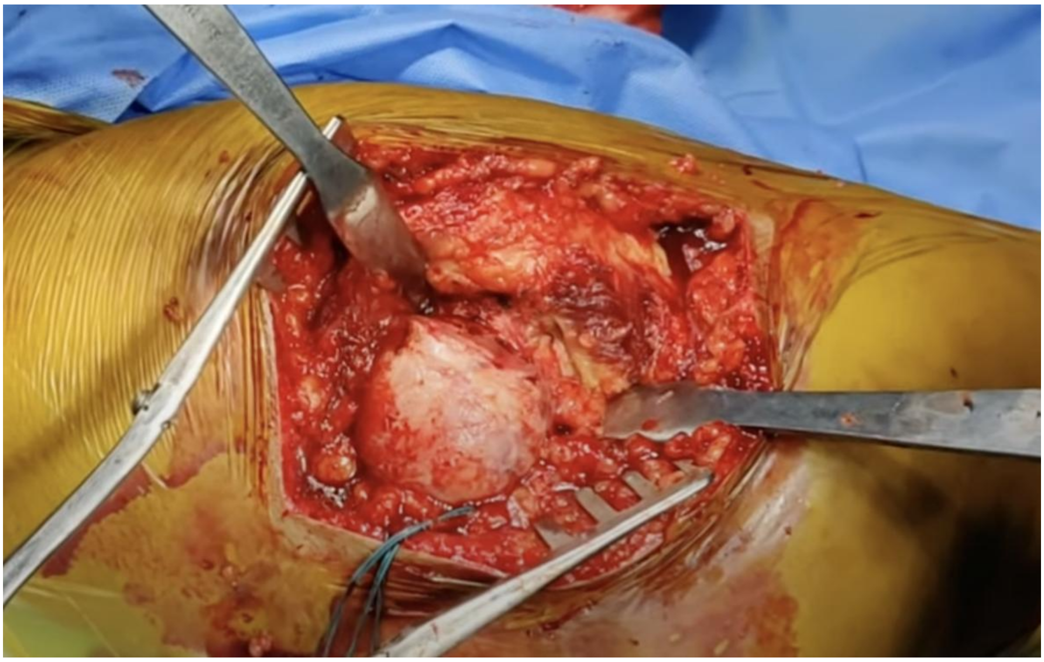

Fig. 10: Detach the short rotator muscles close to their femoral insertion and incise the posterior joint capsule to expose the femoral head and neck.

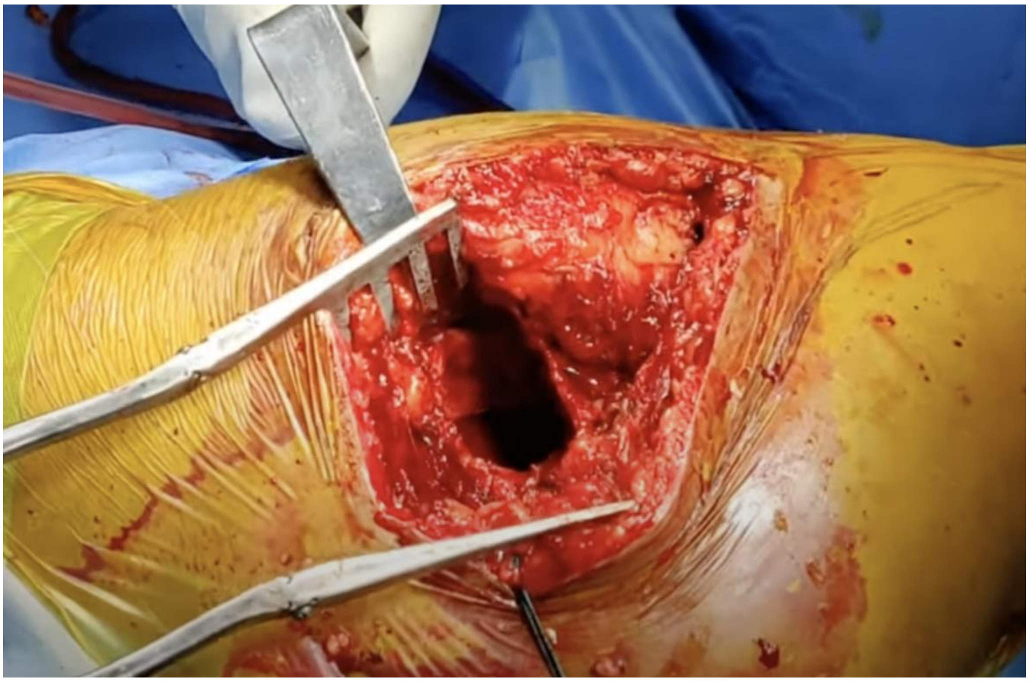

Fig. 11: Extract the femoral head and insert appropriate retractors to reveal the acetabulum.

Lateral Approach:

Planes:

- ❖ Internervous Plane: Not present
- ❖ Intermuscular Plane: Involves splitting the gluteus medius below its innervation (superior gluteal nerve) and dividing the vastus lateralis lateral to its innervation (femoral nerve).

Anesthesia: General or spinal anesthesia

Positioning: Patients were placed in either the lateral or supine position

Surgical Approach:

The direct lateral or transgluteal approach provides enhanced joint exposure while preserving the majority of the gluteus medius, allowing for earlier postoperative mobilization. The patient is positioned laterally, with the affected limb supported above the other. A longitudinal incision is initiated 5 cm above the greater trochanter, extending approximately 8 cm downward along the femoral shaft. The fascia lata is incised along the trochanter's posterior border and extended in line with the skin incision.

Internally rotating the hip assists in identifying the insertion of the gluteus medius. The muscle is split in alignment with its fibers at the junction of its anterior and middle thirds, roughly 4 cm above the posterosuperior tip of the trochanter. The incision continues distally into the vastus lateralis along the anterolateral femoral surface. Using a chisel, the gluteus medius attachment to the trochanter, along with the periosteum and vastus lateralis fascia, is lifted as a single layer and displaced anteriorly.

Subsequently, the gluteus minimus tendon is separated to expose the hip joint capsule. A retractor is placed over the pelvic brim beneath the rectus femoris, and the anterior capsule is dissected off the acetabular margin. A T-shaped capsulotomy is performed, allowing easy anterior dislocation of the femoral head following its removal.

At-Risk Structures:

Superior gluteal nerve: Located 3–5 cm above the greater trochanter between the gluteus medius and minimus. Injury may lead to Trendelenburg gait.

Lateral neurovascular bundle: To prevent iatrogenic damage, retractors should be placed directly on bone without soft tissue entrapment.

Fig. 12: Make a longitudinal incision centered over the tip of the greater trochanter in the line of the femoral shaft.

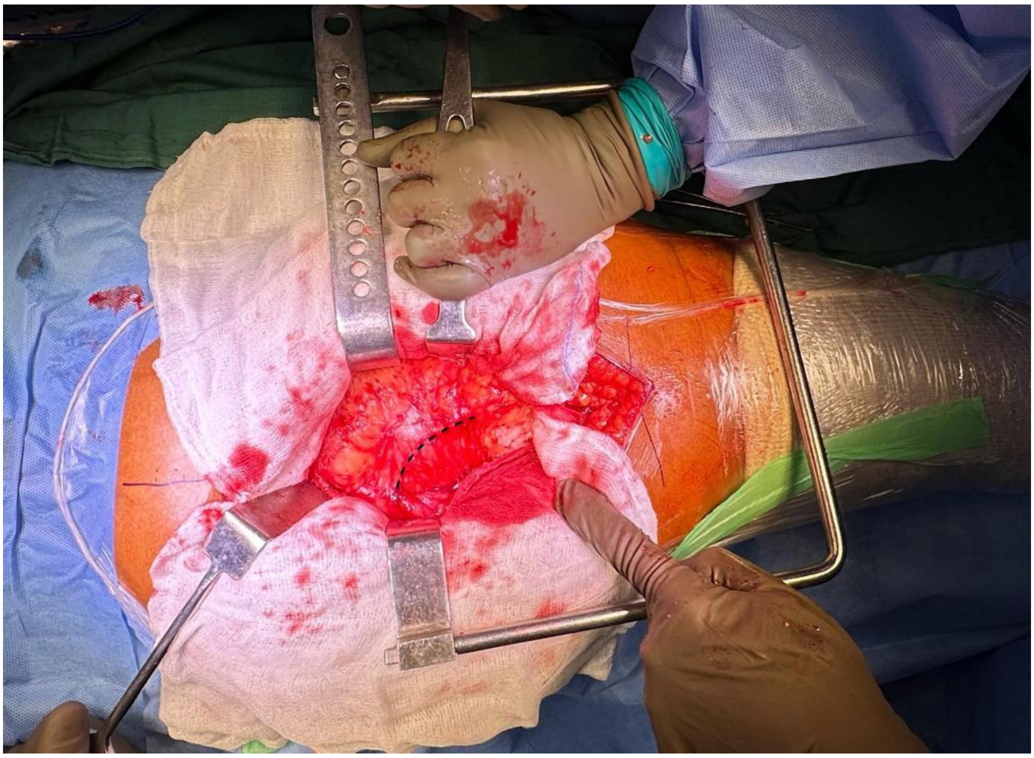

Fig. 13: Incise the fascia lata in the line of the skin incision and divide the tendon of the gluteus minimus muscle to reveal the anterior aspect of the hip joint capsule, which is entered using a longitudinal T-shaped incision to expose the head of femur.

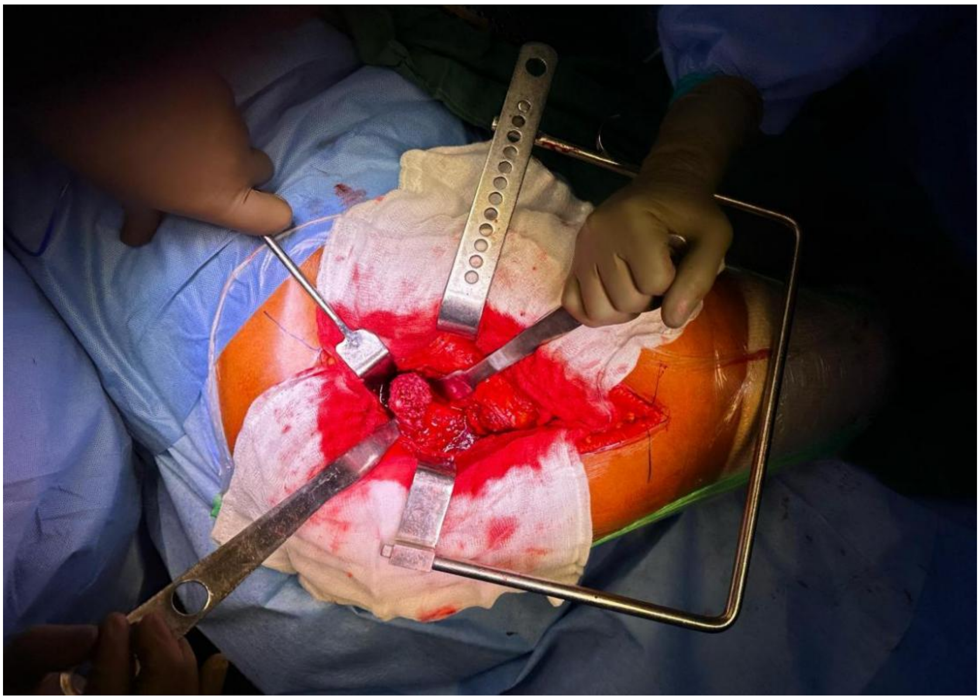

Fig. 14: The exposed head of femur is dislocated. Osteotomize the femoral neck using an oscillating saw.

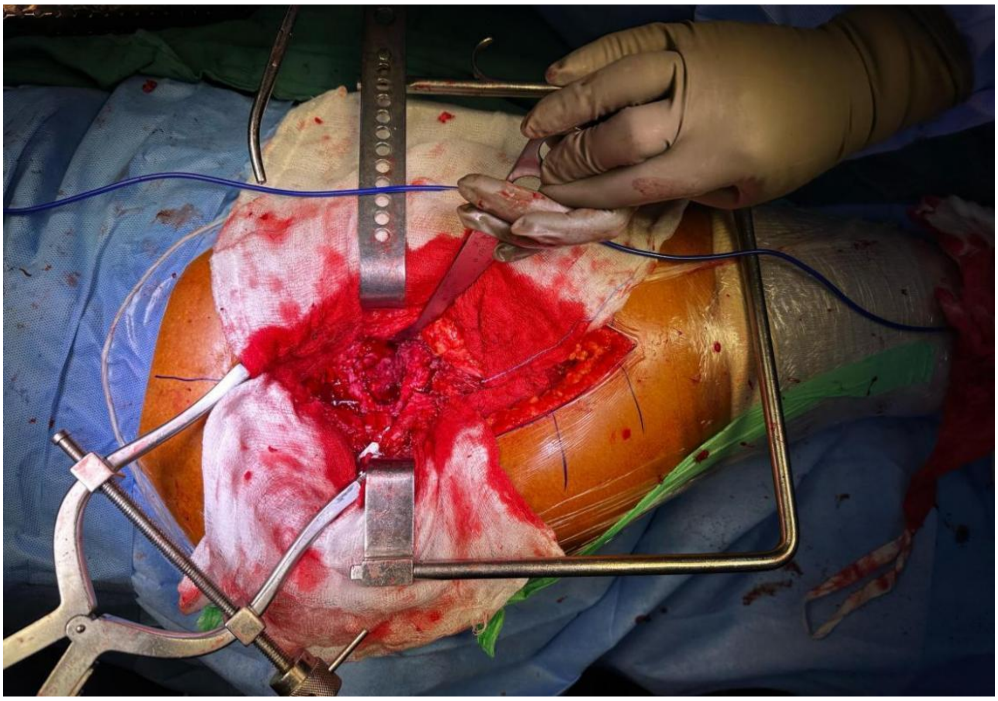

Fig. 15: Extract the femoral head and insert appropriate retractors to reveal the acetabulum.

COMPONENT IMPLANTATION[12]

Implantation of uncemented (cementless) acetabular component :

Begin acetabular preparation using power reamers, starting with a smaller size than the expected final implant. Direct the reamer medially, stopping just before penetrating the medial wall. Frequently assess reaming depth to preserve the integrity of the medial wall, allowing for better lateral component coverage. Continue reaming in the same orientation as the acetabular face, progressively increasing the reamer size in 1–2 mm increments.

Frequent irrigation of the acetabulum is necessary to evaluate reaming adequacy and adjust the reaming direction for uniform circumferential preparation. Reaming should be considered complete when all cartilage has been removed, the bone is exposed at the periphery, and a hemispherical shape is achieved. Remove any residual soft tissue from the acetabular floor and excise excess soft tissue around the periphery.

Attach the acetabular component to the positioning device included in the system. Typically, a rod extending from the device aligns either parallel or perpendicular to the floor to establish the correct abduction angle. Another alignment feature helps determine anteversion relative to the patient's trunk axis. The ideal inclination angle is between 40 and 45 degrees, while anteversion should be around 20 degrees. The transverse acetabular ligament is a useful landmark for positioning, with the component placed parallel and just above it. The total anteversion of both femoral and acetabular components should range between 25 and 40 degrees.

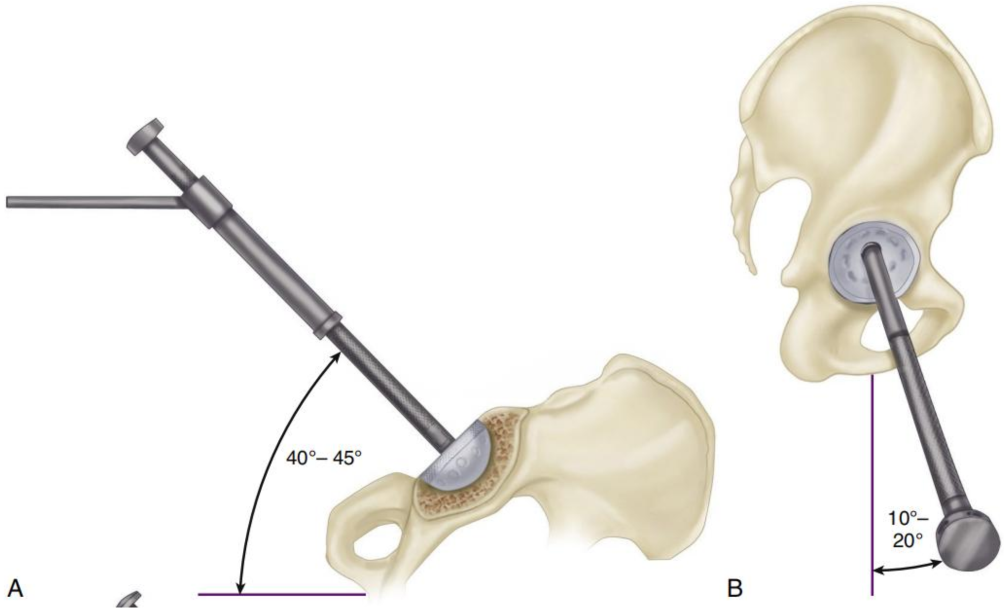

Fig. 16 A: Socket positioning in abduction; B: Anteversion

Before impaction, recheck implant positioning, as adjustments become difficult once the component is seated. Maintain the positioning device alignment while impacting the component into place. A change in pitch indicates that the implant has engaged the subchondral bone. Once positioned satisfactorily, remove the positioning device.

If screws are required for additional fixation, position them in the posterosuperior quadrant. Utilize a flexible drill bit and a universal joint screwdriver to insert the screws within the metal shell. Verify screw length using an angled depth gauge, preferring self-tapping 6.5-mm screws. After placing one or two screws, assess component stability. If any motion is detected between the implant and bone, add more screws as needed.

Use a curved osteotome to remove osteophytes extending beyond the component rim. Flush any debris from the metal shell. When inserting the polyethylene liner, ensure that no soft tissue becomes trapped between the liner and metal backing, as this could interfere with complete engagement of the locking mechanism.

Implantation of uncemented (cementless) femoral component :

Expose the proximal femur by internally rotating it so the tibia is perpendicular to the floor. Allow the knee to drop towards the floor and push the femur proximally. Remove any residual soft tissue from the posterior and lateral aspects of the femoral neck. Use a box osteotome to clear remaining portions of the lateral femoral neck and the medial greater trochanter, ensuring proper access to the femoral canal.

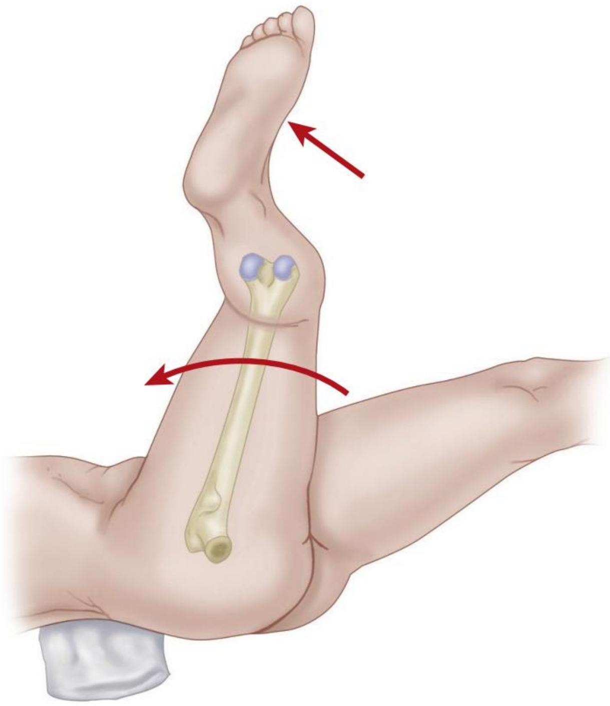

Fig. 17: Positioning of femur for reaming, with patient in lateral position (looking down on patient). Hip is internally rotated, flexed, and adducted until tibia is vertical and axis of knee joint is horizontal. Femoral neck now points downward 15 to 20 degrees, and consequently table is tilted to opposite side for reaming of canal.

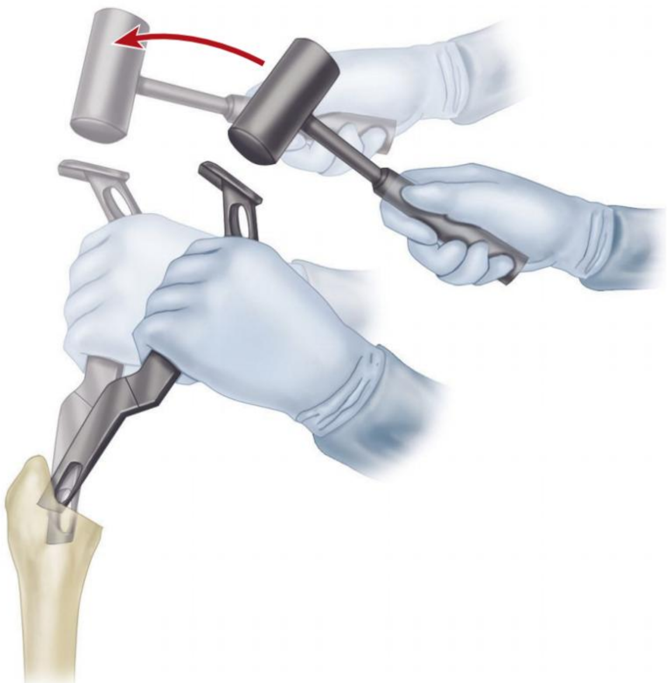

Fig. 18: Removal of remaining lateral edge of femoral neck and medial portion of greater trochanter with box osteotome.

Introduce the smallest reamer at the piriformis fossa, slightly posterior and lateral to the cut surface of the femoral neck. Once the reamer tip is inserted, direct the handle laterally towards the greater trochanter and proceed down the femur towards the medial femoral condyle. Continue with progressively larger reamers until diaphyseal cortical resistance is felt. Assess axial stability before preparing the proximal femur. Remove cancellous bone along the medial neck with precision broaches.

Start broaching with a size at least two steps smaller than the estimated final stem size. Push the broach handle laterally during insertion to prevent varus positioning. Adjust anteversion by rotating the broach, ensuring alignment with the femoral neck axis. Maintain strict anteversion control while gradually impacting the broach down the canal using even mallet blows. The broach should advance with each strike; if it ceases to move, avoid applying excessive force.

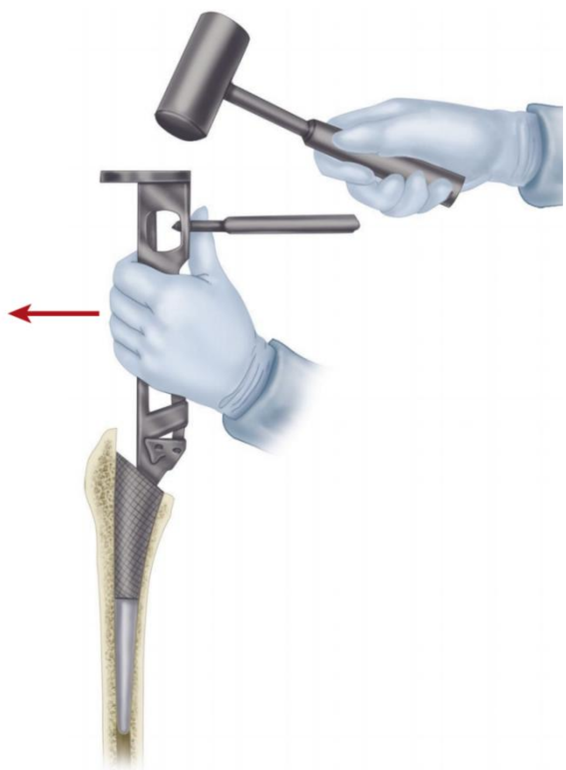

Fig. 19: Femoral broaching. Progressively larger broaches are inserted, lateralizing each one to maintain neutral alignment.

Lateralize further into the greater trochanter using reamers to maintain neutral alignment. Continue broaching until the final broach achieves axial stability without further advancement despite uniform mallet strikes. The cutting teeth should align with or slightly below the initial neck cut. Verify that the broach fits securely within the canal, making close contact with the endosteal cortex, particularly posteriorly and medially. Manually attempt to rotate the broach into retroversion and observe for any movement within the femoral canal. If instability is present, proceed with the next larger stem size. Sequentially increase the stem size while reaming until the broach completely fills the proximal femur and achieves sufficient axial and rotational stability.

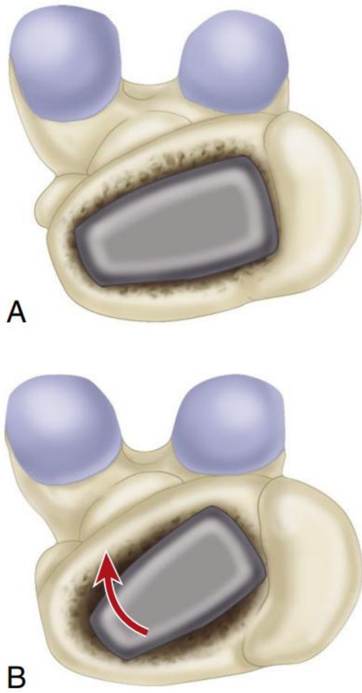

Fig. 20: Femoral component anteversion. A, Stem placed in same axis as femoral neck. Largest possible stem size fills metaphysis well and obtains rotational stability. B, Stem placed in excessive anteversion. Largest possible stem size does not completely fill metaphysis and tends to retrovert when femur is loaded.

Once adequate stability is confirmed, adjust the final neck cut. Most systems allow trial head and neck components to attach to the broach handle. Evaluate femoral head positioning relative to the greater trochanter. If neck length appears appropriate, clear debris from the acetabulum. Apply traction to the leg while maintaining slight hip flexion, and use a plastic-covered pusher to position the femoral head into the acetabular socket. Avoid excessive force or torque on the femur during reduction to prevent fracture. Reassess limb length and evaluate the hip's range of motion. Check for impingement between the femur and pelvis or between prosthetic components in extreme positions.

Stability should be confirmed in the following positions: (i) full extension with 40 degrees of external rotation, (ii) 90 degrees of hip flexion with at least 45 degrees of internal rotation, and (iii) 40 degrees of flexion with adduction and axial loading (the "position of sleep"). If the hip dislocates easily or if the head can be distracted more than a few millimeters (Shuck test), consider using a longer neck length. If excessive limb lengthening would occur with a longer neck, opt for a stem design with greater offset, if available. This modification enhances soft-tissue tension and reduces impingement without significant lengthening. A slight increase in limb length is generally preferable to instability risks.

Remove trial components and the broach. Insert the correctly sized femoral implant by hand until a few centimeters remain unseated. Replicate the precise anteversion achieved with the broach and gently impact the stem down the canal. Apply uniform mallet blows as the component seats. As it nears full seating, progress will slow with each strike. Do not increase force to advance the component, as excessive pressure may cause femoral fracture. Completion is indicated when the implant ceases movement despite consistent mallet strikes, accompanied by a distinct change in sound.

Assess implant stability against rotational and extraction forces. Secure the prosthetic head of the appropriate size and neck length onto the trunnion using a single mallet strike over a head impactor. Clear any debris from the acetabulum and reduce the hip. Perform a final check of hip stability across functional movements.

COMPLICATIONS

Nerve injuries :

The sciatic nerve is the most frequently affected nerve in hip arthroplasty[12]. Improper retraction may lead to either direct trauma or excessive stretching, causing injury. Additionally, sciatic nerve damage can occur if limb lengthening exceeds 4-5 cm or due to postoperative dislocation. Symptoms of subgluteal hematoma include pain, localized swelling, and tenderness. Early recognition, timely surgical decompression, and reversing anticoagulation are essential. Thus, assessing the sciatic nerve before surgery is crucial.

Vascular injuries :

Although rare, vascular injuries can be severe, sometimes leading to limb amputation[12]. Therefore, preventive measures must be taken intraoperatively. Sharp retractors should not be placed arbitrarily. When using them near the acetabulum, they should be firmly positioned against the bone. Careful surgical techniques help prevent direct vascular damage due to osteotomies.

Thromboembolism :

Among the serious complications following total hip arthroplasty, thromboembolism is the most prevalent and may be fatal within the first three months[12]. It often develops in the deep veins of the thigh or calf within three weeks post-surgery. Clinical signs include calf pain, tenderness, unilateral leg swelling, erythema, low-grade fever, and a rapid pulse. Pulmonary embolism may be diagnosed through chest pain (particularly pleuritic), imaging (CXR, ECG), and arterial blood gas analysis. Diagnostic tools for deep vein thrombosis (DVT) include venography, ultrasound, impedance plethysmography, and fibrinogen scans.

DVT Prophylaxis: Non-pharmacological strategies include early ambulation and compression stockings. Pharmacological prophylaxis involves medications like aspirin, low-dose or adjusted-dose heparin, dextran, and warfarin.

Dislocation :

Dislocation rates vary among studies. Although different surgical approaches have advantages and drawbacks, research suggests that posterior approaches pose a greater risk of dislocation than lateral techniques.

Classification of Dislocation:

Based on Cause:-

- **Spontaneous (True) Dislocation:** Occurs due to routine movements like standing from a low seat or exiting a vehicle.
- **Traumatic Dislocation:** Results from a high-impact force to the hip. Long-term studies usually report traumatic dislocations unless specifically excluded.

Based on Timing (Daly & Morrey Classification[14]):

- **Early Dislocation (within 3 months):** Most common, often due to improper implant placement combined with postoperative soft tissue relaxation. Accounts for 75% of cases. Managed with closed reduction and immobilization unless severe component malposition is detected.
- **Secondary Dislocation (4-5 years post-surgery):** Usually due to stem malalignment or abductor dysfunction. Around 10% of cases require identifying and correcting implant malposition to prevent recurrence.
- **Late Dislocation (after 5 years):** Rates vary significantly across studies. Often due to progressive stretching of the pseudo-capsule, exacerbated by inflammation from wear debris.

<u>Treatment:</u> Early dislocations can often be managed with closed reduction and short-term immobilization. Recurrent dislocations, usually caused by severe implant misalignment, require surgical correction, which may involve adjusting the acetabular cup position or tightening the gluteal muscles. It is important to note that surgical reduction is used primarily for recurrent cases, making statistical comparisons with closed reduction difficult.

Limb length discrepancy :

Achieving equal limb lengths is ideal but not always feasible. Priority is given for joint stability. Radiographic evaluation by Muller suggests that the femoral head center should align with the superior border of the greater trochanter.

Heterotopic ossification :

Patients with ankylosing spondylitis, fused hips, hypertrophic osteoarthritis, or post-traumatic arthritis are at higher risk due to extensive bone removal and soft tissue disruption. It shares histological similarities with myositis ossificans and often leads to restricted mobility.

Brooker et al. Classification[15]:

- **Grade 1:** Small bone islands within soft tissue.
- **Grade 2:** Bone spurs from the proximal femur, leaving more than 1 cm between opposing surfaces.
- **Grade 3:** Bone projections with less than 1 cm spacing between surfaces.
- **Grade 4:** Radiographic evidence of hip ankylosis.

Preventive Measures:

- Low-dose radiation therapy (600-700 cGy within three days post-surgery).
- Medications: Indomethacin (75 mg daily for six weeks) or bisphosphonates.

Osteolysis :

A condition characterized by bone degradation around the implant, primarily due to microscopic polyethylene wear debris triggering an inflammatory response. This can lead to implant loosening and associated pain.

Stem failure :

Stem failure, caused by cyclic loading, typically manifests several years after arthroplasty. Common risk factors include:

- High body weight, especially in males with degenerative arthritis.
- Increased activity levels.
- Varus positioning of the stem.
- Long-neck or high-offset femoral components.
- Inadequate bone support for the proximal stem.

Periprosthetic fractures :

Intraoperative: Factors increasing risk include preoperative bone loss, low cortical-to-canal ratio, excessive force during dislocation and reduction, aggressive cortical reaming, and oversized implants.

Postoperative: Caused by trauma or increased activity, leading to stress fractures.

Infections :

Postoperative infections following total hip arthroplasty (THA) are serious and may necessitate implant removal. They are associated with high morbidity and mortality. Gristina suggested that biofilm formation on implant surfaces complicates infection eradication.

Treatment Options:

- Antibiotics for early-stage infections.
- Surgical debridement and modified Girdlestone excision arthroplasty.
- Hip arthrodesis (suitable for young, unilateral cases but difficult with poor bone stock).
- Hip disarticulation as a last-resort life-saving measure.

Acute infections are usually superficial and managed with antibiotics, incision, and drainage. In deep, delayed infections, joint aspiration and radiographic evaluation are crucial. If component loosening is evident, removal is recommended, followed by a modified Girdlestone procedure. The wound should be left open rather than sutured. Intravenous antibiotics are administered for 4-6 weeks, followed by oral therapy for another 4-6 months. Late hematogenous infections follow the same treatment protocol.

RADIOLOGICAL EVALUATION:

Postoperative anteroposterior (AP) pelvic radiographs assess key parameters:

- Acetabular cup version angle
- Acetabular cup inclination angle
- Femoral stem tip position

Femoral Stem Tip Positioning:

On AP X-rays, the stem's midpoints at one, three, and five cm proximal to the tip are analyzed to determine alignment relative to the femoral shaft. Reference lines drawn between these points help measure any varus or valgus angulation.

Stem tip was noted as :

- Neutral
- Valgus
- Varus

LITERATURE REVIEW

Gibson A., in his research titled "Posterior exposure of the hip joint," found that the posterior approach for total hip arthroplasty (THA) is a quick and nearly bloodless procedure that does not compromise the strength of the gluteal muscles[5].

Hardinge K., in the study "The direct lateral approach to the hip," concluded that the direct lateral approach provides optimal conditions for implant alignment and correction of limb length discrepancy in THA[6].

Jolles BM et al. conducted a systematic review in 2004, which revealed no significant difference between the posterior and direct lateral approaches to THA, with a relative risk (RR) of 0.35 (95% confidence interval (CI): 0.04–3.22). However, nerve injury risk was notably higher in the direct lateral approach, with an RR of 0.16 (95% CI: 0.03–0.83)[7].

Barber TC, Roger DJ, Goodman SB, and Schurman DJ, in their study "Early outcome of total hip arthroplasty using the direct lateral vs. the posterior surgical approach," concluded that both approaches yielded comparable clinical and radiographic outcomes[8].

Santic V, Legovic D, Sestan B, et al. examined the postoperative improvement in THA patients using the SF-36 Health Survey and found a substantial enhancement in health-related quality of life following the procedure[16].

Harris WH, in "A new lateral approach to the hip joint," described how this approach allows for both anterior and posterior dislocation of the hip, facilitates complete capsulectomy under direct vision while preserving the femoral head and neck, and offers an unobstructed view of the entire acetabulum[17].

Graves SC et al., in a 2016 study, observed that the mean surgical blood loss (403 mL vs. 293 mL) and in-hospital transfusion rates (20% vs. 10%) were higher in patients undergoing the direct anterior approach compared to those who had the posterior approach. However, no significant differences in adverse events were found between the two groups, suggesting that the posterior approach is a better surgical option for THA[18].

Pincus D et al., in a 2020 study involving 30,098 THA patients (mean age: 67 years), reported that 10% underwent the anterior approach, 70% the lateral approach, and 20% the posterior approach. The study found that patients undergoing the anterior approach had a significantly higher risk of major surgical complications (2% vs. 1%)[19].

Putananon C et al., in a 2018 meta-analysis, found that the anterior and lateral approaches ranked first and second, respectively, for postoperative Harris Hip Score (HHS) and Visual Analog Scale (VAS) pain scores. Meanwhile, the posterior and lateral approaches ranked highest for postoperative complications. The study recommended the lateral approach as a preferred surgical method for THA due to its balance of acceptable pain levels, function, and complication rates. Among the approaches, the posterior approach had the lowest risk, with RR values of 0.39 (95% CI: 0.19–0.81), 0.57 (95% CI: 0.21–1.57), and 1.74 (95% CI: 0.36–8.33) when compared to the anterior, lateral, and posterior-2 approaches, respectively[20].

Fullam et al., in 2017, analyzed 13 studies, including 12 observational and one randomized trial. The majority were single-site studies, with multi-site and national registry data emerging more recently. Reporting inconsistencies were observed in surgical techniques and outcomes. A trend toward higher dislocation rates was noted with the posterior approach, leading eight studies to recommend the direct lateral approach over the posterior approach[21].

Torbjorn B. Kristensen et al., in 2016, conducted a study utilizing data from the Norwegian Hip Fracture Register (2005–2014) on femoral neck fractures in individuals aged 60 and older. A total of 18,918 procedures used the direct lateral approach, while 1,990 used the posterior approach. PROM (Patient-Reported Outcome Measures) data, including satisfaction, pain, quality of life (EQ-5D), and walking ability, were recorded at 4, 12, and 36 months postoperatively. Statistically significant differences were noted, with patients in the posterior approach group reporting better satisfaction, less pain, and improved quality of life. However, the risk of reoperation was comparable between the two approaches[22].

P.D. Vaughan et al., in their 2007 study on femoral stem tip orientation in THA, noted that achieving a neutral stem tip position was more challenging with the anterolateral approach than with the posterior approach. In the anterolateral approach, 12 subjects had neutral alignment, 12 had valgus positioning, and 26 had a varus alignment. In contrast, in the posterior approach group, 26 had neutral alignment, 7 had valgus positioning, and 17 had a varus alignment[23].

Gore DR, Murray MP, Sepic SB, and Gardner GM, in their study "Anterolateral compared to posterior approach in total hip arthroplasty: Differences in component positioning, hip strength, and hip motion," observed that patients undergoing the posterior approach had less anteversion of the prosthetic component and longer neck lengths, leading to a more lateral and distal position of the greater trochanter compared to those who underwent the anterolateral approach. The posterior approach group demonstrated better hip abductor muscle strength and greater internal rotation on the operated side, whereas the anterolateral approach group exhibited more external rotation[24].

MATERIALS AND METHODS

Source of Data:

Data was gathered from patients presenting with hip joint pain at KLEH Casualty or the Outpatient Department (OPD) who subsequently underwent Total Hip Arthroplasty (THA) at Dr. Prabhakar Kore Hospital & Medical Research Centre, Belagavi, over a one-year period from June 1, 2023, to May 31, 2024.

Study Design: A prospective observational study

Study Duration: One year

Sample Size:

The minimum sample size was determined using the formula:

$$n = \frac{(z_a + z_b)^2 \, (s_1^2 + s_2^2)}{(X_1 - X_2)}$$

where:

- z_a represents the significance level (1.96 for 5%).
- z_b corresponds to the test power (0.84 for 80%).
- X_1 is the mean acetabular cup inclination angle for the Lateral Approach Group (35.9).
- X_2 is the mean for the Posterior Approach Group (46.02).
- s_1 and s_2 are the standard deviations for the Lateral (12.8) and Posterior (9.65) Approach Groups, respectively.

Using these parameters, the required sample size was calculated to be 20. Each study group comprised at least 20 patients.

Sampling Technique:

This study involved a comparative analysis of two groups. Mean and standard deviation were computed for continuous quantitative variables. Unpaired Student’s T-test was used for inter-group comparisons, while Paired Student's T-test was applied for intra-group comparisons. Categorical data was presented as rates, ratios, and percentages. Chi-square or Fisher's Exact test assessed associations between outcomes and clinical/demographic characteristics. Additionally, statistical tools such as ANOVA, correlation, and regression were used when necessary. Nonparametric tests were applied for discrete variables, and appropriate graphs illustrated comparisons. A p-value < 0.05 was considered statistically significant.

Inclusion Criteria:

- Patients aged 20–80 years.
- Patients with unilateral or bilateral hip pain.
- All patients undergoing THR.

Exclusion Criteria:

- Patients who declined to provide consent.
- Patients with significant head injuries displaying abnormalities on a CT Brain scan.
- Patients requiring revision surgeries or who had prior osteotomies.
- Cases of developmental hip dysplasia.
- Patients diagnosed with inflammatory arthritis.
- Patients with modular neck-stem implants.

Study Protocol:

Patients presenting with hip pain at KLEH Casualty or OPD who met the inclusion criteria and underwent THA at Dr. Prabhakar Kore Hospital & Medical Research Centre were evaluated. They were assigned to one of the two approaches and followed up with clinical and radiological assessments postoperatively.

Data Collection Procedure:

Patients diagnosed with hip osteoarthritis or avascular necrosis of the femoral head who underwent THA at KLE's Dr. Prabhakar Kore Hospital over a one-year period were assessed. Clinical evaluations were conducted preoperatively (one day before surgery), immediately postoperatively (one day after surgery), and at subsequent follow-ups (one month and six months). Functional outcomes were assessed using the Harris Hip Score (HHS). Acetabular cup and femoral stem positioning were analyzed using pelvic anteroposterior (AP) radiographs at the latest follow-up. Pain levels were recorded using the Visual Analog Scale (VAS), and patient satisfaction was measured with a generic satisfaction questionnaire.

Data Processing and Statistical Analysis:

Data entry was performed in Microsoft Excel and analyzed using SPSS software (version 27). Descriptive statistics were presented as percentages, and chi-square or nonparametric tests were used to assess associations.

Ethical Considerations:

1. Institutional ethical approval was obtained before commencing the study.
2. Informed consent was secured from all study participants.
3. Standard medical care was provided throughout the study and follow-up period.

Investigations:

All patients underwent the following:

1. Routine Blood Tests: Hb, TLC, DLC, ESR, Platelet Count, Blood Grouping, CRP, RBS, and Coagulation profile.
2. Radiographs: X-Ray of the pelvis and both hip joints - AP view
3. Urine Analysis: Albumin, sugar, and microscopy.
4. Additional Tests: Any required investigations for anesthesia fitness.

RESULTS

Table 1 : Age distribution comparision between two groups

		Group			
		Lateral		Posterior	
		Count	%	Count	%
Age	20 - 40 years	9	45	7	35
	41 - 60 years	5	25	8	40
	61 - 80 years	6	30	5	25
	Total	20	100	20	100
	Mean Age	49.8 ± 16.26 years		48.1 ± 15.4 years	

In Lateral group, mean age of patients was 49.8 ± 16.26 years and in Posterior group, mean age of patients was 48.1 ± 15.4 years. There was no significant difference in age distribution between two groups (p value = 0.744).

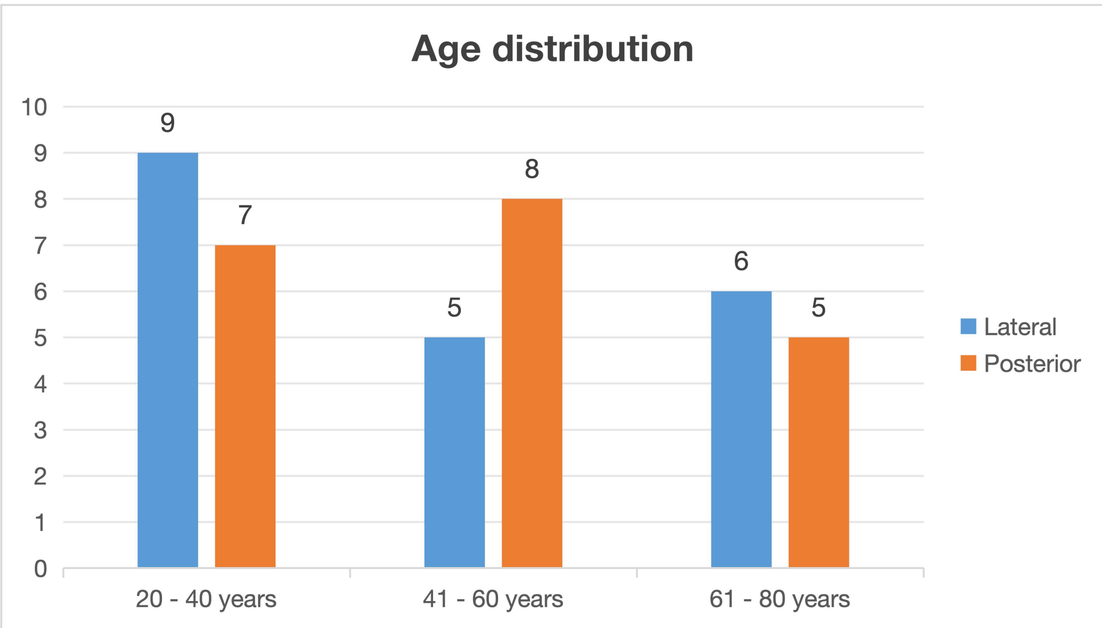

Fig. 21 : Bar diagram showing age distribution comparision between two groups

Table 2: Gender distribution comparison between two groups

		Group			
		Lateral		Posterior	
		Count	%	Count	%
Gender	Female	6	30	4	20
	Male	14	70	16	80
	Total	20	100	20	100

In Lateral group, 70 % were males and 30 % were females and in Posterior group, 80 % were males and 20 % females.

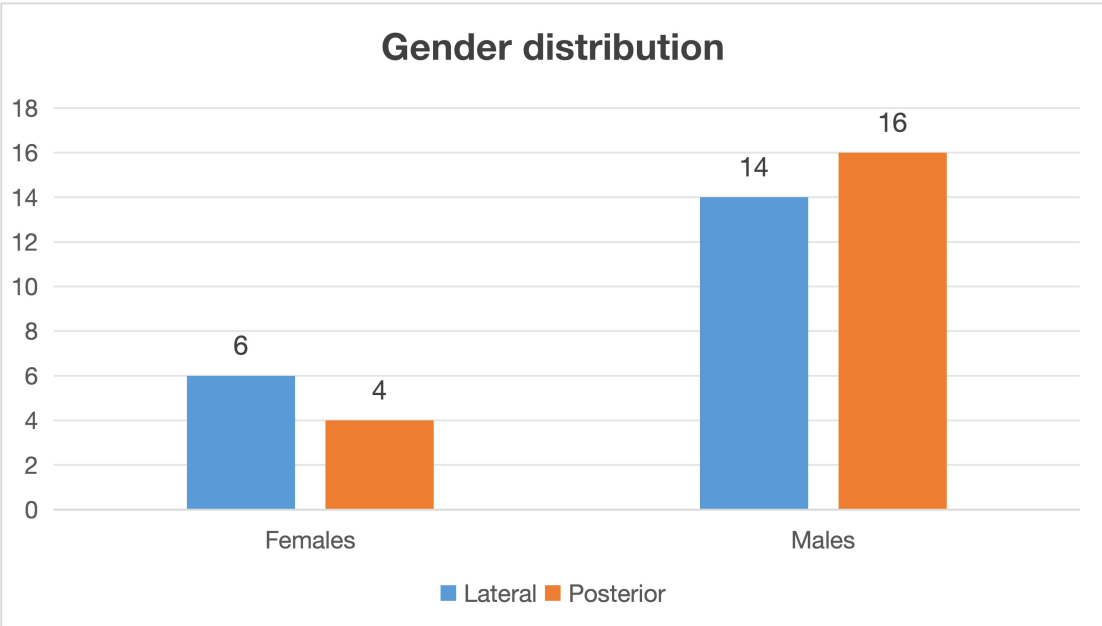

Fig. 22 : Bar diagram showing gender distribution comparison between two groups

Table 3 : Functional Outcome Assessment, 1 day pre-operatively

		Group			
		Lateral		Posterior	
		Count	%	Count	%
Harris Hip Score (HHS)	<70	20	100	20	100
	70 - 79	0	0	0	0
	80 - 89	0	0	0	0
	90 - 100	0	0	0	0
	Total	20	100	20	100
	Mean score	57.95 ± 7.01		56.7 ± 6.67	

In the Lateral group, the mean pre-operative HHS was 57.95 ± 7.01 (poor), while in Posterior group, the HHS was 56.7 ± 6.67 (poor) and hence, there was no significant difference between the two groups (p value = 0.567).

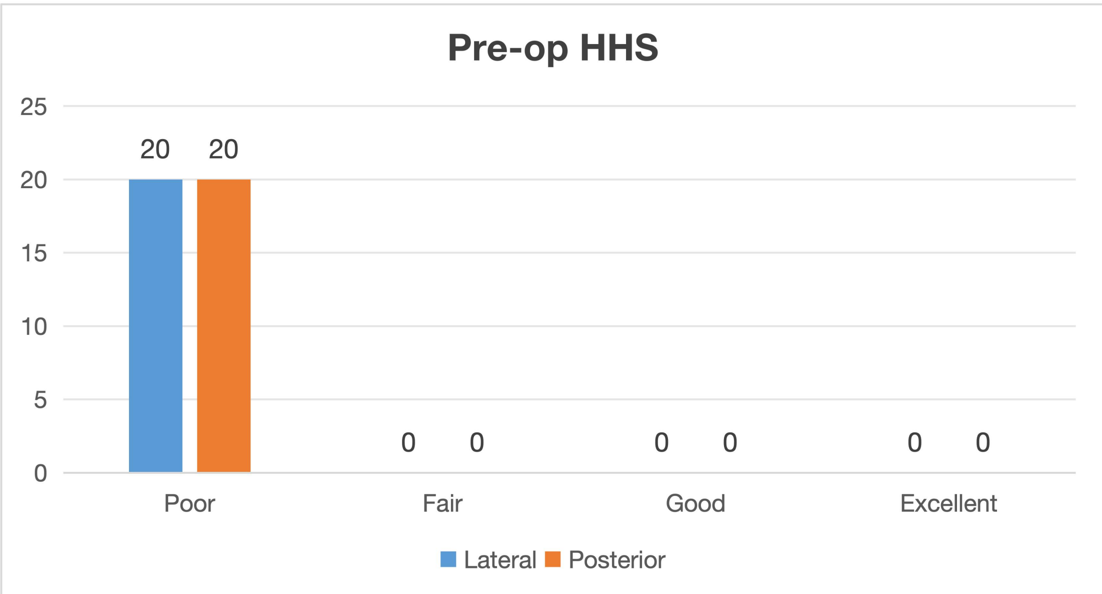

Fig. 23 : Bar diagram showing pre-operative HHS comparison between two groups

Table 4 : Functional Outcome Assessment, 1 day post-operatively

		Group			
		Lateral		Posterior	
		Count	%	Count	%
Harris Hip Score	<70	17	85	16	80
	70 - 79	3	15	4	20
	80 -89	0	0	0	0
	90 - 100	0	0	0	0
	Total	20	100	20	100
	Mean score	63.6 ± 6.16		64.9 ± 5.34	

In the Lateral group, the mean first post-operative day HHS was 63.6 ± 6.16 (poor), while in Posterior group, the HHS was 64.9 ± 5.34 (poor) and hence, there was no significant difference between the two groups (p value = 0.48).

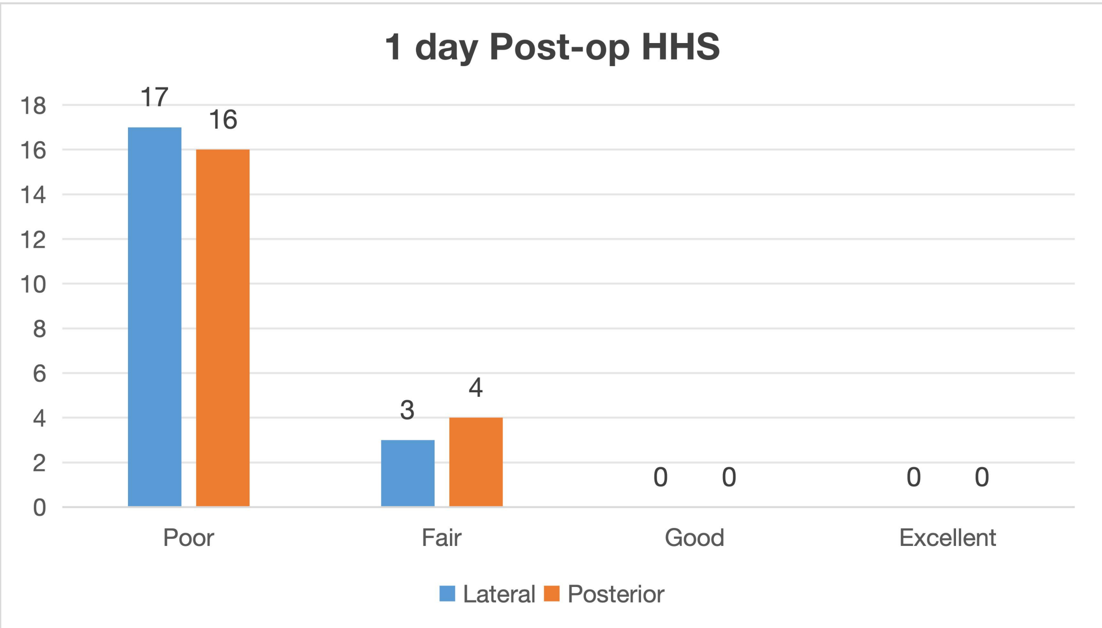

Fig. 24 : Bar diagram showing first post-operative day HHS comparison between two groups

Table 5 : Functional Outcome Assessment, 1 month post-operatively

		Group			
		Lateral		Posterior	
		Count	%	Count	%
Harris Hip Score	<70	4	20	5	25
	70 - 79	12	60	13	65
	80 - 89	4	20	2	10
	90 - 100	0	0	0	0
	Total	20	100	20	100
	Mean score	74.7 ± 5.41		73.45 ± 5.18	

In the Lateral group, the mean 1 month post-operative HHS was 74.7 ± 5.41 (fair), while in Posterior group, the HHS was 73.45 ± 5.18 (fair) and hence, there was no significant difference between the two groups (p value = 0.46).

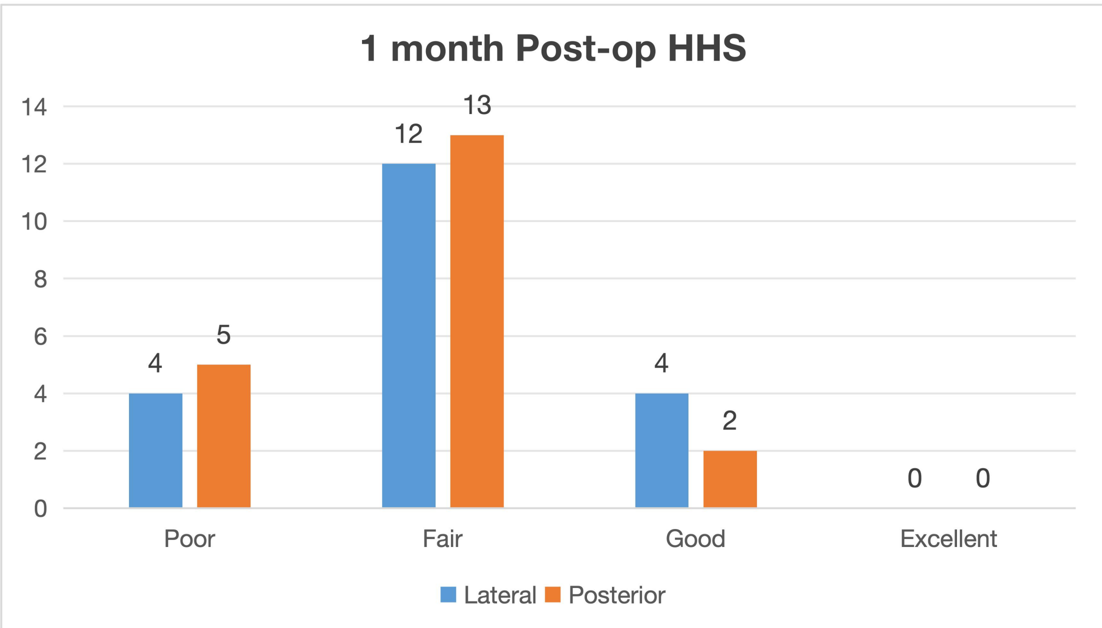

Fig. 25 : Bar diagram showing 1 month post-operative HHS comparison between two groups

Table 6 : Functional Outcome Assessment, 6 months post-operatively

		Group			
		Lateral		Posterior	
		Count	%	Count	%
Harris Hip Score	<70	0	0	0	0
	70 - 79	3	0	2	0
	80 - 89	13	0	14	0
	90 - 100	4	10	4	10
	Total	20	100	20	100
	Mean score	84.45 ± 4.97		85.3 ± 4.14	

In the Lateral group, the mean 6 month post-operative HHS was 84.45 ± 4.97 (good), while in Posterior group, the HHS was 85.3 ± 4.14 (good) and hence, there was no significant difference between the two groups (p value = 0.56).

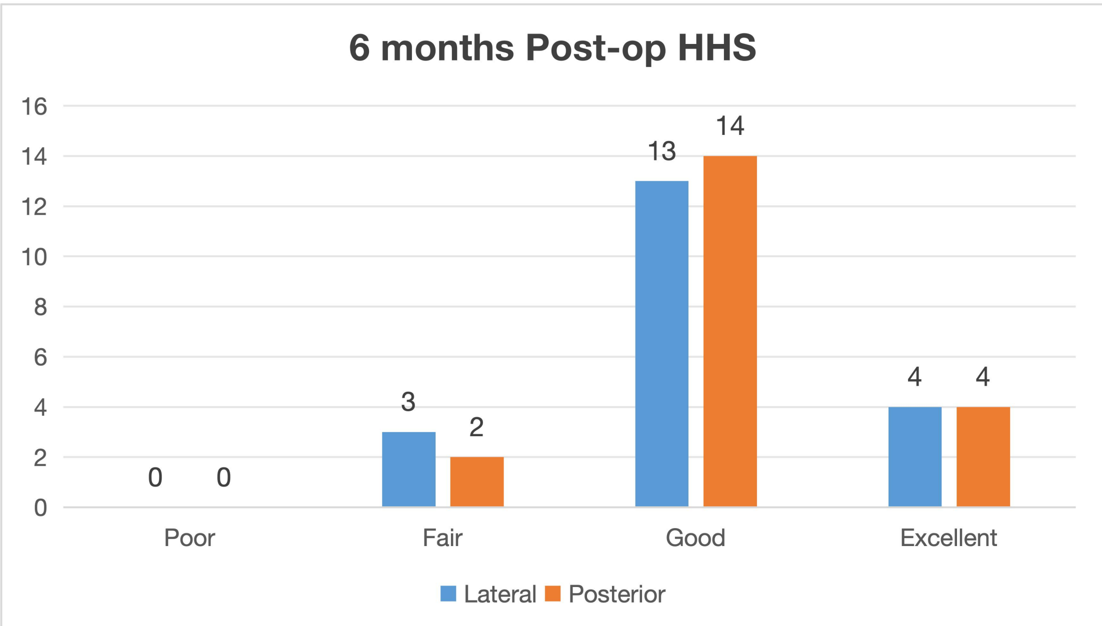

Fig. 26 : Bar diagram showing 6 months post-operative HHS comparison between two groups

Table 7 : Assessment of Component Positioning

		Group			
		Lateral		Posterior	
		Count	%	Count	%
Acetabular Cup Inclination	< 30 degrees	0	0	2	10
	30 - 40 degrees	14	70	5	25
	41 - 50 degrees	6	30	7	35
	> 50 degrees	0	0	6	30
	Total	20	100	20	100
	Mean Inclination	38.8 ± 4.37 degrees		44.62 ± 10.61 degrees	

In Lateral group, the mean acetabular cup inclination was 38.8 ± 4.37 degrees, while in Posterior group, it was 44.62 ± 10.61 degrees. There was a significant difference between the two groups (p value = 0.029).

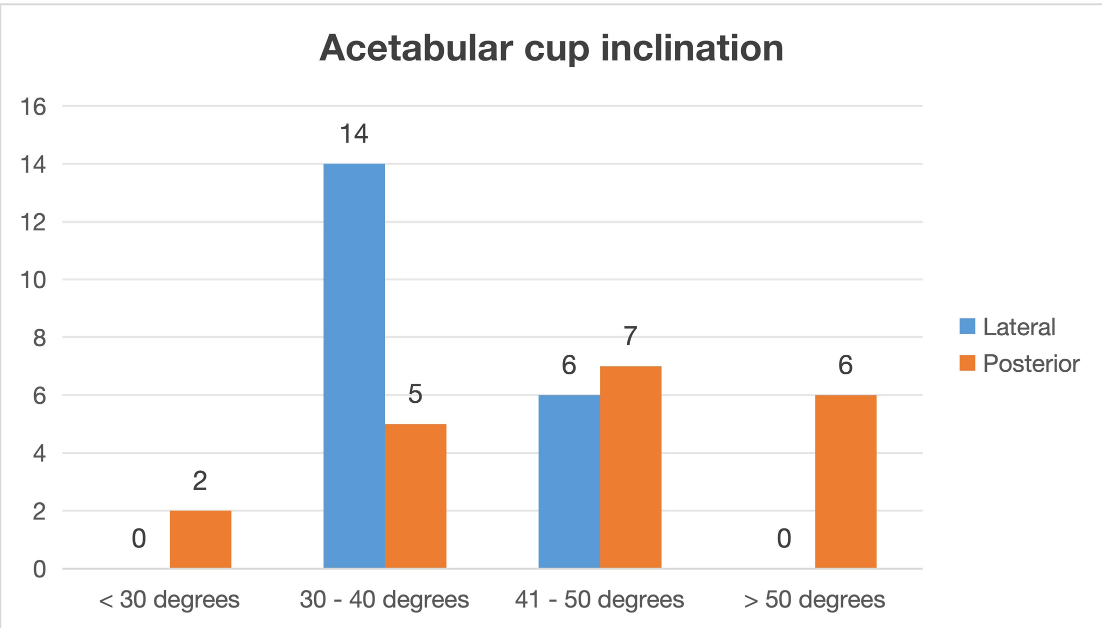

Fig. 27 : Bar diagram showing acetabular cup inclination comparison between the two groups

Table 8 : Assessment of Component Positioning

		Group			
		Lateral		Posterior	
		Count	%	Count	%
Acetabular Cup Version	< 5 degrees	1	5	0	0
	5 - 20 degrees	15	75	7	35
	21 - 35 degrees	4	20	7	35
	36 - 50 degrees	0	0	6	30
	Total	20	100	20	100
	Mean Version	15.54 ± 6.9 degrees		27.18 ± 1.48 degrees	

In Lateral group, the mean acetabular cup version was 15.54 ± 6.9 degrees, while in Posterior group, it was 27.18 ± 1.48 degrees. There was a significant difference between the two groups (p value = 0.001).

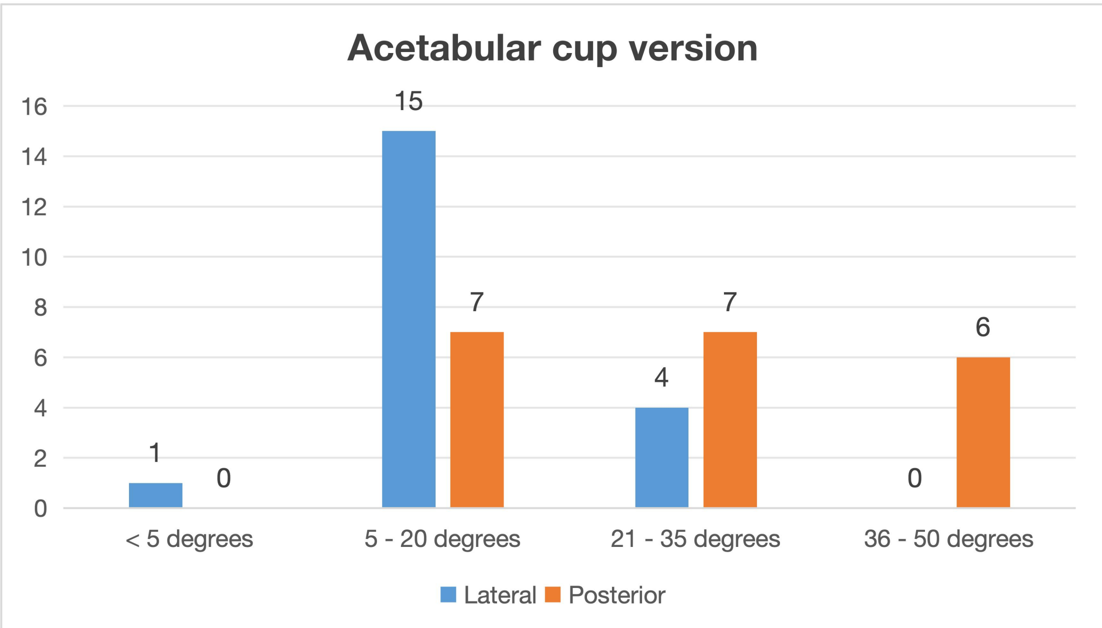

Fig. 28 : Bar diagram showing acetabular cup version comparison between the two groups

Table 9 : Assessment of Component Positioning

		Group			
		Lateral		Posterior	
		Count	%	Count	%
Femoral Stem Tip Position	Neutral	16	80	15	75
	Valgus	4	20	4	20
	Varus	0	0	1	5
	Total	20	100	20	100
	Mean Tip Position	Neutral		Neutral	

In Lateral group, 80% of the femoral stem tips were in neutral position and 20% of them were in valgus position, while in Posterior group, 75% of the femoral tips were in neutral, 20% in valgus and 5% were in varus position. There was no significant difference between the two groups.

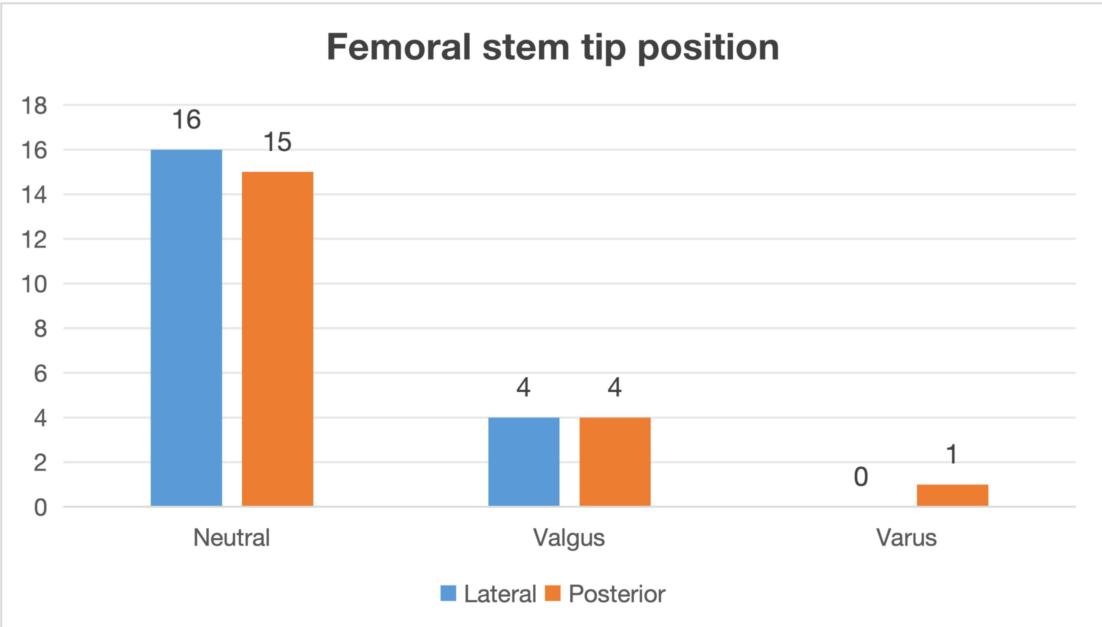

Fig. 29 : Bar diagram showing femoral stem tip position comparison between the two groups

Table 10 : Assessment of Immediate post-op pain

		Group			
		Lateral		Posterior	
		Count	%	Count	%
VAS Score	0 - 3	2	10	1	5
	4 - 7	18	85	19	95
	8 - 10	1	5	0	0
	Total	20	100	20	100
	Mean score	4.85 ± 1.27		5.05 ± 1.05	

In Lateral group, the mean immediate post-op VAS score was 4.85 ± 1.27, while in Posterior group, it was 5.05 ± 1.05. There was no significant difference between the two groups (p value = 0.59).

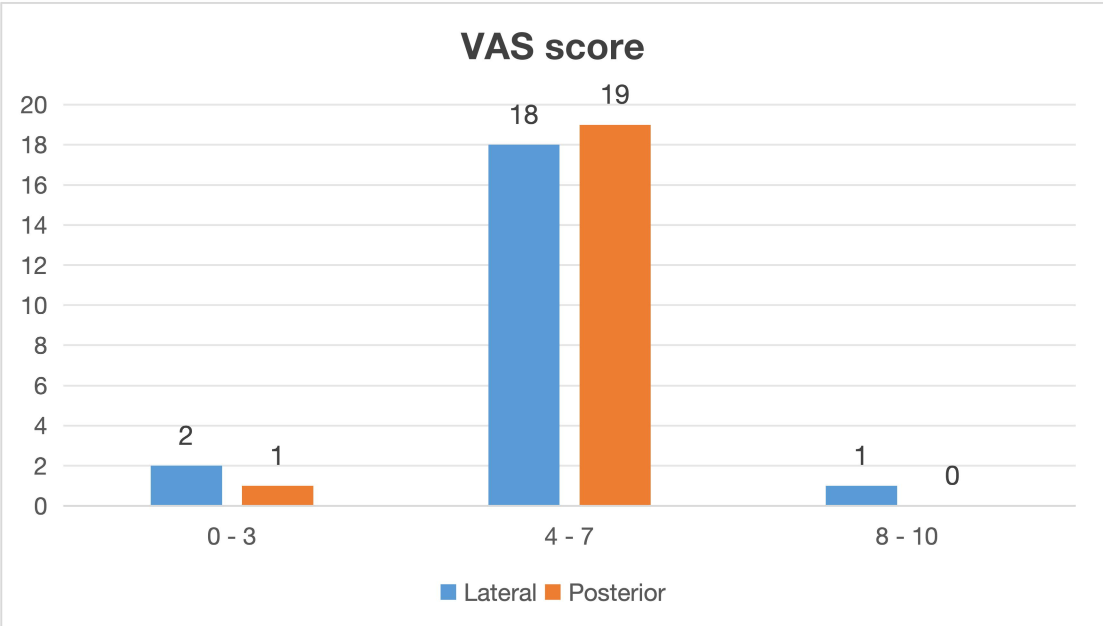

Fig. 30 : Bar diagram showing immediate post-op VAS score comparison between the two groups

Table 11 : Assessment of patient satisfaction

		Group			
		Lateral		Posterior	
		Count	%	Count	%
Generic questionnaire remarks	<= 15	0	0	0	0
	16 - 20	1	5	0	0
	21 - 25	19	95	20	100
	Total	20	100	20	100
	Mean score	22.5 ± 1.46		23 ± 1.05	

In Lateral group, the mean satisfaction score was 22.5 ± 1.46, while in Posterior group, it was 23 ± 1.05. There was no significant difference between the two groups (p value = 0.179).

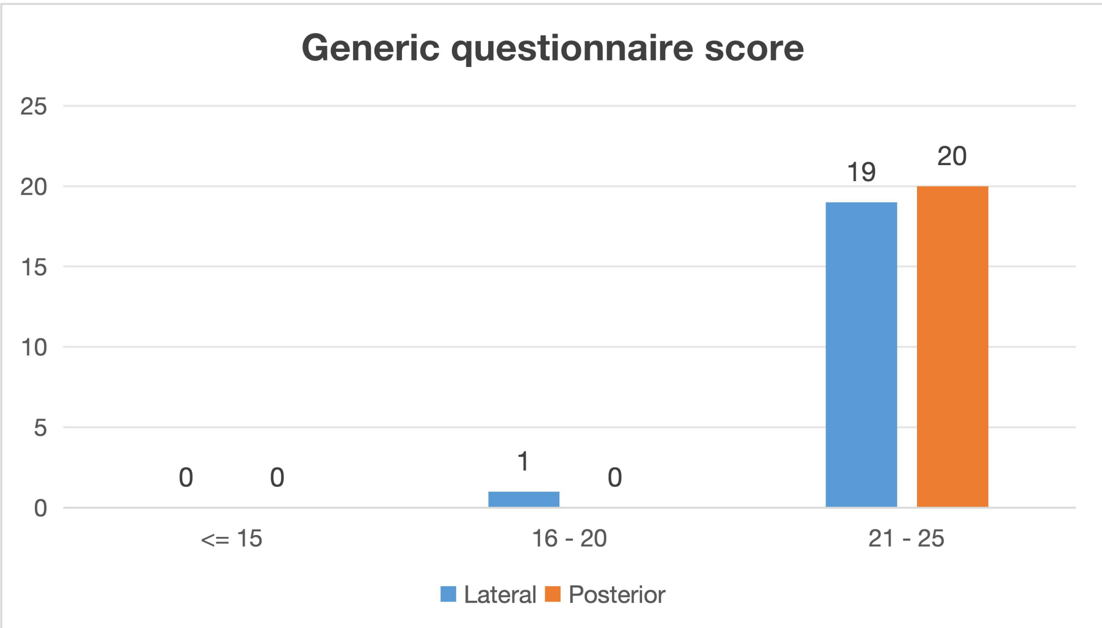

Fig. 31 : Bar diagram showing comparison of patient satisfaction at the latest follow-up between the two groups

Table 12 : Assessment of Intra-operative &/or Post-operative complications

		Group			
		Lateral		Posterior	
		Count	%	Count	%
Complications	Nerve injury	0	0	1	5
	Dislocation	0	0	2	10
	Infection	0	0	0	0

In Lateral group, there were no cases of injury to the nerve, while in Posterior group, 1 patient had injury to sciatic nerve. In Lateral group, there were no cases of post-op hip dislocation, while in Posterior group, 2 of the hips dislocated in the early post-op period. There were no cases with post-op infection in either groups.

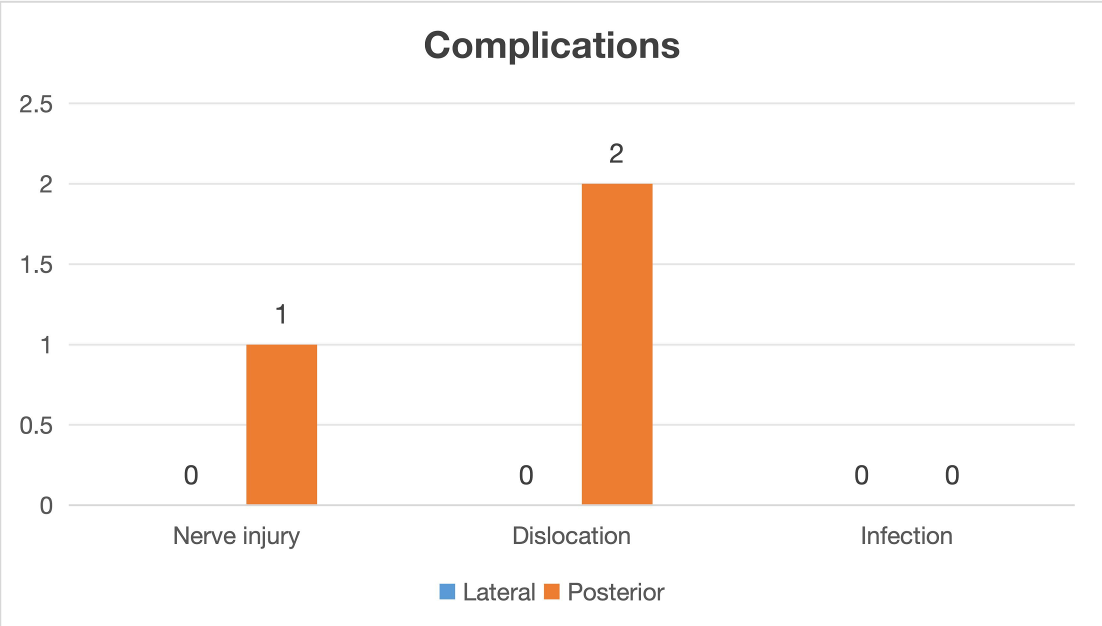

Fig. 32 : Bar diagram showing comparison of complications between the two groups

DISCUSSION

A hospital based, prospective observational study was conducted among 40 patients undergoing Total Hip Arthroplasty in Department of Orthopaedics at KLE's Dr. Prabhakar Kore Hospital and Medical Research Centre, Belagavi for a period of one year, from 01/06/2023 to 31/05/2024. These patients were evaluated, and observed for the either approach (direct lateral or posterior) and were advised to undergo post-treatment clinical examination and appropriate radiological investigations. Functional outcomes and component positioning were then compared between the two groups.

Functional Outcomes

The assessment of functional outcomes following Total Hip Arthroplasty (THA) is critical in determining the effectiveness of different surgical approaches. Our study found no statistically significant differences in short and mid-term functional outcomes between the direct lateral approach and the posterior approach when evaluated using the Harris Hip Score (HHS), VAS pain scale and generic satisfaction questionnaire.

One of the primary advantages of the direct lateral approach is its superior stability[25]. Patients who undergo THA using the direct lateral approach experience significantly lower rates of dislocation. This benefit can be attributed to the preservation of the posterior soft tissue structures, which play a crucial role in maintaining hip stability. However, this approach involves splitting the gluteus medius and minimus muscles, which are essential for hip abduction and overall stability during ambulation. As a result, patients exhibit delayed functional recovery, requiring a more prolonged rehabilitation period to regain muscle strength and coordination[26].

In contrast, the posterior approach allows for preservation of the abductor muscle mechanism, leading to a more rapid early recovery of mobility[25]. Patients undergoing the posterior approach reported lower levels of postoperative pain, greater ease in achieving independent ambulation, and a quicker return to routine activities, particularly within the first six weeks following surgery. This early recovery advantage can be particularly beneficial for younger, more active patients who seek a faster return to daily activities. However, despite this advantage, the posterior approach carries a well-documented risk of posterior dislocation, especially if adequate soft tissue repair is not performed[27]. Dislocations were more frequently observed in patients who underwent the posterior approach, highlighting the importance of meticulous capsular repair and adherence to postoperative movement precautions.

Component Positioning

Optimal component positioning is a fundamental determinant of THA success, influencing both implant longevity and overall patient outcomes. In our study, radiographic analysis demonstrated distinct differences in acetabular cup and femoral component placement between the two approaches. The direct lateral approach provided more consistent acetabular component positioning within the recommended safe zone defined by Lewinnek's criteria[6]. This consistency is likely due to the improved surgical exposure of the acetabulum afforded by the lateral approach, allowing for greater precision in cup placement and inclination.

Conversely, the posterior approach exhibited greater variability in acetabular cup positioning, which can be attributed to the more limited exposure of the acetabulum and femur during surgery. This variability has significant clinical implications, as malpositioning of the acetabular component can increase the risk of impingement, accelerated wear of the prosthesis, and postoperative instability[28]. Improper placement of the acetabular cup in the posterior approach group is associated with a higher incidence of posterior impingement, which can lead to increased stress on the joint and potential implant failure over time. Furthermore, malpositioning in the posterior approach group correlated with a greater risk of dislocation, reinforcing the need for precise intraoperative assessment and corrective measures[29].

These findings highlight the importance of technological advancements in improving component positioning. Navigation systems and robotic-assisted surgery have been shown to enhance accuracy in THA by providing real-time feedback on component placement[30]. Incorporating these technologies, particularly in cases where the posterior approach is preferred, may help mitigate the variability in positioning and improve long-term outcomes. Additionally, the use of intraoperative fluoroscopy and surgeon experience play a crucial role in achieving optimal implant alignment and reducing postoperative complications[30].

Complications

The incidence of complications vary between the two approaches. The most notable advantage of the direct lateral approach is the lower incidence of postoperative dislocations. This finding aligns with previous studies suggesting that the preservation of anterior soft tissues in the direct lateral approach contributes to enhanced joint stability[6,25,26]. However, this advantage offsets by the higher risk of abductor muscle weakness and Trendelenburg gait, which can significantly impact patient mobility and quality of life. The disruption of the gluteus medius and minimus muscles during the direct lateral approach, although necessary for surgical access, poses a challenge in terms of postoperative rehabilitation and functional restoration.

In contrast, the posterior approach is associated with a higher rate of posterior dislocations, particularly in the absence of rigorous soft tissue repair[26]. The posterior capsule and external rotator muscles, which provide stability to the hip joint, are disrupted during this approach, predisposing patients to dislocations if not adequately repaired. Our findings emphasized the critical role of meticulous capsular closure in reducing the risk of dislocation in posterior approach patients. Surgeons employing this approach must adopt robust soft tissue repair techniques and educate patients on movement restrictions to minimize the likelihood of postoperative instability.

Additional complications that can be observed in both groups include deep vein thrombosis (DVT), infection, and heterotopic ossification (HO). The incidence of DVT is comparable between the two approaches, underscoring the importance of standardized thromboprophylaxis measures[31]. The risk of infection can be significantly decreased with adherence to strict aseptic surgical protocols and the routine use of prophylactic antibiotics. HO, characterized by abnormal bone formation around the hip joint, is slightly more prevalent in the direct lateral approach group, possibly due to increased muscle trauma during surgery. Patients exhibiting early signs of HO can be managed with prophylactic nonsteroidal anti-inflammatory drugs (NSAIDs) and, in some cases, low-dose radiation therapy to prevent excessive bone formation and joint stiffness.

Clinical Implications

The selection of surgical approaches for THA is based on patient-specific factors. The direct lateral approach, with its advantage of enhanced joint stability, may be preferred in patients at high risk of dislocation, such as elderly individuals, those with neuromuscular conditions, or those with poor compliance to postoperative movement restrictions. However, surgeons must be mindful of the potential for abductor muscle weakness and the need for targeted rehabilitation strategies to address gait disturbances.

The posterior approach, offers a faster early recovery and minimal impact on abductor muscle function and hence, remains a viable choice for younger, active patients seeking rapid postoperative mobility. To mitigate the risk of dislocations, particular emphasis should be placed on meticulous soft tissue repair and patient education regarding movement precautions. The use of dual-mobility implants or constrained liners may be considered in select cases to enhance stability in high-risk patients undergoing the posterior approach[32].

Limitations and Future Directions

Despite the strengths of this study, certain limitations must be acknowledged. The relatively small sample size may restrict the generalizability of the findings, necessitating further research with larger population. Additionally, the study was conducted at a single institution, and variations in surgical expertise and postoperative rehabilitation protocols could influence outcomes. Longer follow-up periods are needed to assess implant longevity, the progression of functional recovery, and the incidence of late complications such as aseptic loosening and periprosthetic fractures.

Future research should focus on multicenter trials to validate these findings across diverse patient populations and surgical settings. The integration of advanced surgical technologies, including robotic-assisted THA and intraoperative navigation, holds promise in optimizing component positioning and improving functional outcomes. Additionally, studies exploring the impact of individualized rehabilitation programs tailored to the specific challenges posed by each surgical approach could further enhance patient recovery and long-term satisfaction.

In conclusion, the choice of surgical approach in THA should be guided by a careful evaluation of patient-specific factors, surgeon expertise, and the desired balance between early recovery and long-term joint stability. While both the direct lateral approach and posterior approach offer distinct advantages and challenges, continued advancements in surgical techniques and rehabilitation strategies will play a pivotal role in further refining THA outcomes for future patients.

CONCLUSION

From this study, it can be concluded that both Direct Lateral approach and Posterior approach for Total Hip Arthroplasty had no statistically significant difference in the form of functional outcome, immediate post-operative pain, patient satisfaction and femoral stem tip position.

However, the mean acetabular cup inclination and cup version were significantly more in the posterior approach. Clinically, posterior approach also had 2 instances of dislocation in early follow up period.

Operating surgeon, based on his expertise, can choose either of the methods for Total Hip Arthroplasty.

SUMMARY

A hospital based prospective observational study was conducted among 40 patients undergoing Total Hip Arthroplasty in Department of Orthopaedics at the KLE's Dr. Prabhakar Kore Hospital and Medical Research Centre, Belagavi for a period of one year [01/06/2023 to 31/05/2024]. The patients were divided in two groups by randomization. One group underwent lateral approach (20 patients) and the other group underwent posterior approach (20 patients). Functional outcomes and component positioning were compared between the two groups.

The following observations were made in the study:

- In Lateral group, mean age of patients was 49.8 ± 16.26 years and in Posterior group, mean age of patients was 48.1 ± 15.4 years (p value = 0.744).

- In Lateral group, 70 % were males and 30 % were females and in Posterior group, 80 % were males and 20 % females.

- In the Lateral group, the mean pre-operative HHS was 57.95 ± 7.01 (poor), while in Posterior group, the HHS was 56.7 ± 6.67 (poor) (p value = 0.567).

- In the Lateral group, the mean first post-operative day HHS was 63.6 ± 6.16 (poor), while in Posterior group, the HHS was 64.9 ± 5.34 (poor) (p value = 0.48).

- In the Lateral group, the mean 1 month post-operative HHS was 74.7 ± 5.41(fair), while in Posterior group, the HHS was 73.45 ± 5.18 (fair) (p value = 0.46).

- In the Lateral group, the mean 6 month post-operative HHS was 84.45 ± 4.97 (good), while in Posterior group, the HHS was 85.3 ± 4.14 (good) (p value = 0.56).

- In Lateral group, the mean acetabular cup inclination was 38.8 ± 4.37 degrees, while in Posterior group, it was 44.62 ± 10.61 degrees (p value = 0.029).

- In Lateral group, the mean acetabular cup version was 15.54 ± 6.9 degrees, while in Posterior group, it was 27.18 ± 1.48 degrees (p value = 0.001).

- In Lateral group, 80% of the femoral stem tips were in neutral position and 20% of them were in valgus position, while in Posterior group, 75% of the femoral tips were in neutral, 20% in valgus and 5% were in varus position.

- In Lateral group, the mean immediate post-op VAS score was 4.85 ± 1.27, while in Posterior group, it was 5.05 ± 1.05 (p value = 0.59).

- In Lateral group, the mean satisfaction score was 22.5 ± 1.46, while in Posterior group, it was 23 ± 1.05 (p value = 0.179).

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ANNEXURE 1 : INFORMED CONSENT

"EFFECT OF SURGICAL APPROACH ON FUNCTIONAL OUTCOME AND COMPONENT POSITIONING IN TOTAL HIP ARTHROPLASTY : A ONE YEAR HOSPITAL BASED PROSPECTIVE STUDY"

This Informed Consent Form is for men and women who come to Dr. Prabhakar Kore Hospital and Medical Research Centre, Belagavi and who are willing to participate in the prospective study on the abovementioned title.

Objective: To prospectively study the difference between the lateral and posterior approaches of THA with respect to the functional outcome, component positioning, immediate postoperative pain, and patient satisfaction.

Introduction: I, BL0122001, P.G. Resident, JNMC Belagavi, am conducting a prospective study on the effect of surgical approach on functional outcome and component positioning in Total Hip Arthroplasty. I am going to give you information and invite you to be a part of this research. There may be some words that you may not understand. Please contact me for more information as needed.
Total Hip Arthroplasty (THA) has good 10-year survival rates and 25-year implant survival rates of over 95% and over 80%, respectively. At short and mid-term follow-up, health-related quality of life outcomes following THA have generally ranged from good to excellent. Two of the most often employed surgical techniques for THA are the posterior and direct lateral approaches. Because both of these surgical approaches have their benefits and drawbacks, orthopaedic surgeons are still debating which is ideal for primary THA. The purpose of this study is to examine the difference between the lateral and posterior approaches with respect to the functional outcome, component positioning, immediate postoperative pain, and patient satisfaction rates.

Explanation of procedure: In a THA, the damaged bone and cartilage is removed and replaced with prosthetic components. The damaged femoral head is removed and replaced with a metal stem that is placed into the hollow center of the femur. A metal or ceramic ball is placed on the upper part of the stem. This ball replaces the damaged femoral head that was removed. The damaged cartilage surface of the acetabulum is removed and replaced with a metal socket. Screws or cement are sometimes used to hold the socket in place. A plastic, ceramic, or metal spacer is inserted between the new ball and the socket to allow for a smooth gliding surface. Post operatively, functional outcome will be performed on subsequent follow-ups till 6 months.

Withdrawal from participation in the study: Participation in this study in voluntary. You will be free to decide whether to participate in this study or continue participation once enrolled. In case you decide to withdraw your participation, you are free to do so. However, please convey the decision to the principal investigator.

Possible benefits from participating in the study: You will not get any benefits by participating in this study. The data gathered will help population at large.

Possible risks from participating in the study: There are no risks involved in participating in this study.

Privacy and confidentiality: The information collected from you will be coded, to prevent any person to identify you. Your identity will never be revealed. The data collected from you will be kept confidential and only processed or aggregated data will be used for publication.

Financial incentives: You will not receive any payment for participating in this study.

Authorization for publication of aggregated data: Results obtained after processing of the aggregated data will be published for scientific purpose and or presented to scientific groups. However, your identity will never be revealed.

Legal rights: By signing this consent form, we are not waving any of your legal rights

ANNEXURE 2 : PROFORMA

"EFFECT OF SURGICAL APPROACH ON FUNCTIONAL OUTCOME AND COMPONENT POSITIONING IN TOTAL HIP ARTHROPLASTY : A ONE YEAR HOSPITAL BASED PROSPECTIVE STUDY"

IP No. - Mob. No. -

Name - Age / Sex -

Occupation - Address -

DOA - DOS - DOD -

Assessment :

	-1D	+1D	+1M	+6M
1) Functional assessment (Harris Hip Score)				

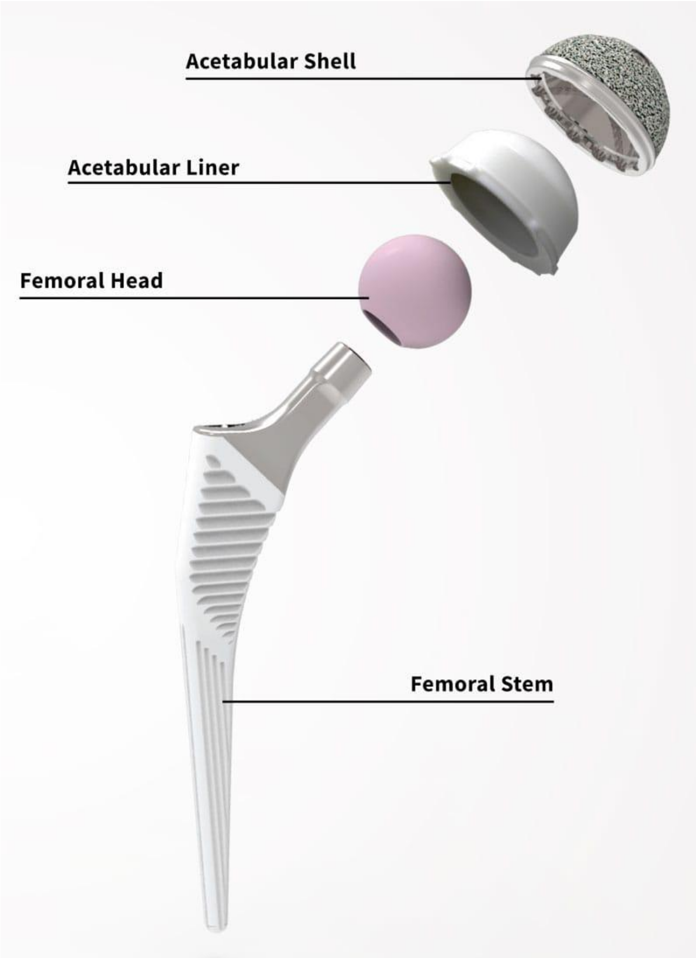
	Cup inclination	Cup version	Femoral stem tip position
2) Component positioning (On Plain AP Radioghaph)			

3) Immediate post-op pain
(VAS Score)

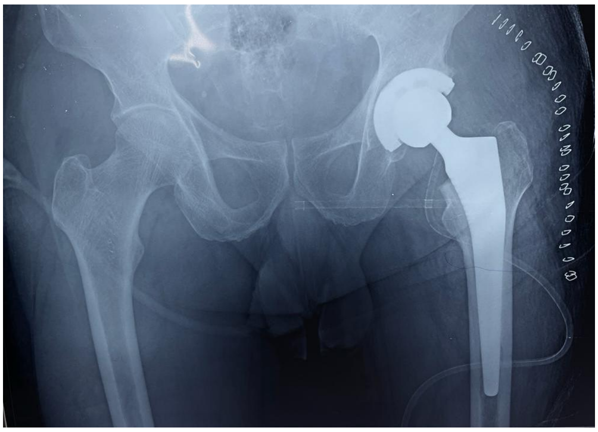
4) **Patient Satisfaction**

ANNEXURE 3 : PHOTOGRAPHS

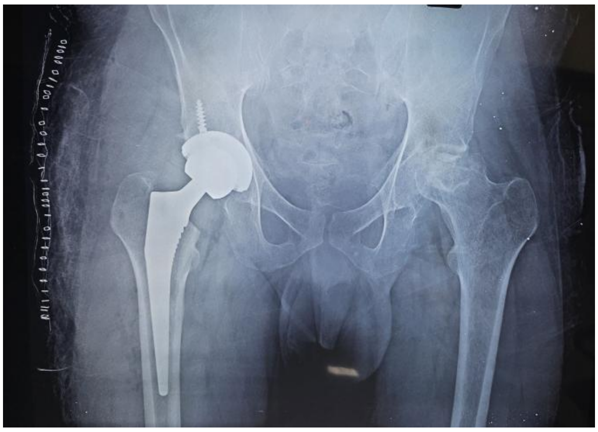
Implants and Instruments :



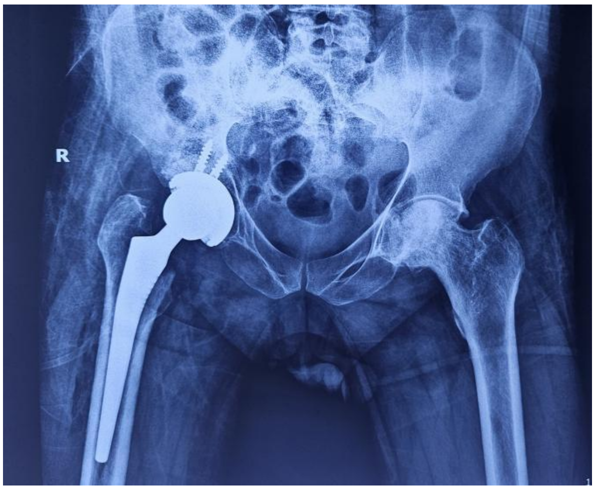
Femoral Stem Tip Position :



Neutral



Valgus



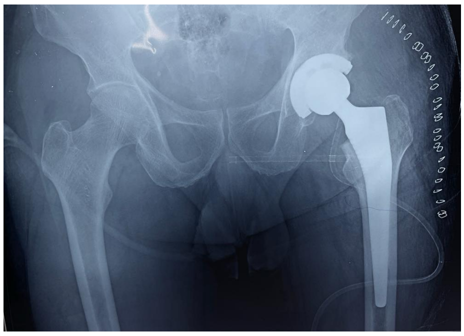
Varus

Pre-operative X-Ray | **Post-operative X-Ray**

CASE 1

CASE 2

CASE 3



CASE 4 (WITH DISLOCATION ON FOLLOW-UP XRAY)

ANNEXURE 4 : MASTERCHART

Key to masterchart :

S.no. - Serial number

IP no. - In Patient number

Age (in years)

Gender : M - Male
F - Female

Approach : L - Direct Lateral
P - Posterior

HHS (Harris Hip Score) : -1D - Pre-operatively
1D - 1 day post-operatively
1M - 1 month post-operatively
6M - 6 month post-operatively

CI - Acetabular Cup Inclination

CV - Acetabular Cup Version

FSTP - Femoral Stem Tip Position

VAS - Visual Analogue Scale

SS - Satisfaction Score

S.no.	IP no.	Age	Gender	Side	Approach	HHS (-1D)	HHS (1D)	HHS (1M)	HHS (6M)	CI	CV	FSTP	VAS	SS
1	10010263	79	M	Right	L	56	62	74	85	38	18	N	4	23
2	10014176	29	M	Right	L	59	64	74	82	44	25.6	N	5	24
3	10014176	29	M	Left	L	62	68	82	91	32	14.3	N	4	21
4	10017153	64	M	Left	L	67	69	77	86	37.5	12.7	N	6	22
5	10018174	48	F	Right	L	52	58	69	81	33	10.5	N	6	20
6	10014137	36	M	Right	L	48	54	66	76	40.5	22.1	N	8	25
7	10017987	38	F	Right	L	56	62	73	84	42	16.4	N	5	23
8	10017987	38	F	Left	L	53	60	72	83	39.5	11.8	N	5	24
9	10017734	78	F	Left	L	67	72	81	90	34	8.9	Val	4	22
10	10024684	68	M	Right	L	69	75	84	92	32.5	19.7	N	3	21
11	10024684	68	M	Left	L	66	69	78	88	41	20	N	4	25
12	10026429	58	M	Left	L	61	67	77	83	35.5	15.1	N	4	23
13	10010983	36	M	Right	L	60	64	75	87	45	13.5	N	4	24
14	10026167	38	M	Right	L	52	59	72	80	38.5	6.4	Val	5	22
15	10018956	47	M	Right	L	57	64	76	84	36	28.2	N	4	21
16	10018715	30	M	Right	L	56	61	73	82	40	4	Val	5	24
17	10017984	55	M	Right	L	47	56	67	75	43	26.9	N	7	23
18	10020554	39	M	Left	L	49	55	68	89	48.5	7.5	Val	6	25
19	10087746	52	F	Right	L	69	74	85	92	39	9.8	N	3	22
20	10090638	65	F	Left	L	53	59	71	79	37	19.4	N	5	23

S.no.	IP no.	Age	Gender	Side	Approach	HHS (-1D)	HHS (1D)	HHS (1M)	HHS (6M)	CI	CV	FSTP	VAS	SS
21	10011829	59	M	Right	P	68	73	83	91	48.2	33.1	N	4	24
22	10012759	52	M	Right	P	61	69	75	87	34.7	22.4	N	3	22
23	10014967	22	F	Right	P	51	59	68	83	58	29.8	N	6	25
24	10018612	58	M	Right	P	52	61	73	84	42.5	15.2	N	5	23
25	10019035	26	M	Right	P	57	68	78	91	50.1	41.6	N	5	23
26	10033164	42	M	Right	P	53	62	71	84	39.3	27.3	N	6	24
27	10047460	38	M	Left	P	45	58	67	78	23	10.9	Val	7	25
28	10058369	32	F	Left	P	69	76	84	92	54.4	36.4	N	4	23
29	10059651	56	F	Right	P	51	60	68	81	46.6	18.5	N	6	22
30	10021841	68	M	Left	P	57	65	73	85	37.9	25.1	N	5	24
31	10020707	59	M	Right	P	53	59	66	78	62	48	Var	5	23
32	10021968	44	M	Left	P	57	61	72	84	45.5	38.7	N	5	23
33	10020850	39	F	Left	P	55	60	69	83	49	30.2	N	5	22
34	10017058	62	M	Right	P	66	72	79	90	28.7	9.6	Val	4	24
35	10017058	62	M	Left	P	62	68	71	85	41.3	20.8	N	4	22
36	10044079	65	M	Left	P	52	63	72	84	43.9	31.7	N	6	25
37	10089174	45	M	Right	P	65	72	78	89	30.6	6	Val	4	23
38	10086034	24	M	Right	P	59	65	76	87	55.8	39.7	N	5	23
39	10090376	73	M	Left	P	49	62	69	81	40	12.5	Val	7	25
40	10059956	36	M	Left	P	52	65	77	89	59.9	45.9	N	5	23