"CLINICAL AND RADIOLOGICAL OUTCOME ANALYSIS OF NECK OF FEMUR FRACTURES TREATED WITH BIPOLAR HEMIARTHROPLASTY – AN INSTITUTIONAL STUDY"

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DECLARATION BY THE CANDIDATE

I, hereby declare that this dissertation entitled **"CLINICAL AND RADIOLOGICAL OUTCOME ANALYSIS OF NECK OF FEMUR FRACTURES TREATED WITH BIPOLAR HEMIARTHROPLASTY-AN INSTITUTIONAL STUDY"** is a bonafide and genuine research work carried out by me under the guidance of Prof. Dr. R.BALACHANDRAN. M.S. Ortho, D.Ortho Professor, Department of Orthopaedics, Government Royapettah Hospital, Government Kilpauk Medical College.

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This is to certify that this dissertation entitled "**CLINICAL AND RADIOLOGICAL OUTCOME ANALYSIS OF NECK OF FEMUR FRACTURES TREATED WITH BIPOLAR HEMIARTHROPLASTY- AN INSTITUTIONAL STUDY"** is a bonafide research work done by **Dr. T. KALAIYARASAN** under the guidance of **Prof. Dr. R. BALACHANDRAN.**, M.S. ORTHO., D. Ortho, Professor, Department of Orthopaedics, Government Royapettah Hospital, Kilpauk Medical College.

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TABLE OF CONTENTS

Introduction

INTRODUCTION

The neck of femur fracture is one of the common fractures in elderly. It has been always a challenge to the orthopaedic surgeons to manage these fractures.

The prevalence of neck of femur fractures has increasing with increased incidence of osteoporosis, poor vision in elderly, poor neuro muscular coordination, life style changes, sedentary habits, improvement in life expectancy. The incidence is expected to be double in next twenty years, triple by 2050. The burden of neck of femur fractures and its sequelae continued to be on the rise. The treatment goal for this fractures is restoring of functions without morbidity, still controversy exists in management of neck of femur fractures in elderly. Open reduction and internal fixation in elderly has higher chance of non union & avascular necrosis.

The introduction of unipolar prosthesis by Thompson in 1954 & Austin moore in 1957 to replace the femoral head ushered in the era of hemiarthroplasty and as standard treatment for neck of femur fractures in elderly patients. With higher chance of non union & avascular necrosis in internal fixation, hip arthroplasty has become the best treatment choice in elderly for early mobilisation and reduce morbidity.

Currently the orthopaedic surgeons can choose between unipolar, bipolar and total hip replacement in the treatment of intracapsular fractures in elderly.

The problem with unipolar prosthesis seen were like actebular erosion, stem loosening.

In 1974, bipolar prosthesis was introduced by bateman which had mobile haed element and had additional head surface to alow movement within acetabulum. This reduces the erosion in acetabulum and reduction in pain and incidence of protrusio. The motion occurs between metal head and polyethylene socket (inner bearing) as well as between metallic head and acetabulum (outer bearing).

Modular prosthesis is now introduced in the market which allows for neck adjustment, future conversion to total hip replacement is easier. Because only acetabular component only has to be added.

Unipolar prosthesis is used only in developing countries. It should be reserved for acive elderly and very limited patients. In india, bipolar prosthesis is slowly replacing unipolar prosthesis in elderly patients, because of the advantage of bipolar than unipolar like less post operative pain, good results, good range of movements & cost effectiveness.

Though, Primary total hip replacement is being preferred at many tertiary centres in india. Still its not popular in government hospitals due to high cost and majority of the patient doing well with hemiarthroplasty. Thus bipolar hemiarthroplasty appears to be the best option in active elderly group in our country. Still long term follow up results not available in literatures.

We have taken this study for better understanding of problems and results with bipolar hemiarthroplasty.

Aim of the Study

AIM OF THE STUDY

- To study the functional outcome of intracapsular fracture of femoral neck with bipolar prosthesis in Indian population.
- To study the end results of bipolar prosthesis with respect to pain, mobility and stability.
- To analyse the radiological parameters and bipolar mobility in fluorosocpy
- To study the complications of bipolar hemiarthroplasty.

Review of Literature

REVIEW OF LITERATURE

HISTORICAL REVIEW

Ambroise Pare, a French surgeon and anatomist was the first person to described fracture of proximal femur in 1564[12].

Emil Theodor Kocher suggested two mechanisms of injury in femoral neck fractures[2]. The first was a fall producing a direct blow over the greater trochanter. This mechanism was confirmed by Linten in 1955. The second mechanism is external rotation of the extremity which was confirmed by Protzman et al in 1976[13].

Sir Jacob Astley Cooper in 1882 was the first to distinguished between intra- and extra-capsular fractures[14].

In 1985, Roentgen invented the X-rays and it paved a new way for conservative management of femoral neck fractures.

The concept of traction was introduced in the mid-19th century with the goal of minimizing limb shortening and deformity. Multiple schemes for traction were devised, but high rates of non-union encouraged efforts to achieve reduction and apply forceful impaction as part of the closed treatment algorithm for femoral neck fractures.

Whitman in 1902 initially applied a hip spica in children for immobilization after closed reduction by manipulation[15].

In 1933, Lead better developed another technique of closed reduction maintained in a hip spica with higher rate of union[16]. Speed published the classic article “The unsolved fracture” in 1935 in which he described another technique of closed reduction[17]. Union rates for closed reduction and spica casting from the 1930s was recorded at only 23%[18]. Eric Lexer of Germany in 1908 used autogenous bone graft to facilitate union in case of nonunions[12].

Attempts at internal fixation date back to isolated cases as early as 1850[12]. Senn made a plea for internal fixation of femoral neck fractures when reporting his results from canine trials in 1877[19], but after his argument was largely rejected by the surgical community, he reverted to advocating closed reduction and impaction. In 1916 Hey Groves initiated use of his quadra-flanged nail the results of which were published in 1926[20]. Despite the publicity this received, the most widely used internal fixation through the early part of the 20th century were “bone pegs”—crude intra- medullary devices of ivory or beef bone used to keep the fracture ends roughly aligned[3].

Smith-Petersen, et al. in 1931 reported a series of open nailings with his tri- flanged nail, a simple internal fixation device designed to achieve maximum purchase of both fragments but allow some impaction along the fracture line[21]. In 1932, Johansson introduced a canulated nail which assisted closed reduction of fracture and then fixing the fracture. It was slightly modified by Westcott in 1934. Thronston devised a side plate to the triflanged nail in 1937 which further paved way for Jewett nail-plate device in 1941[12]. Smith-Petersen's idea evolved further with the introduction of the cannulated Smith-Peterson nail and the technique for low angle insertion, designed to capture low on the calcar and centrally in the femoral head[22].

The same three-point fixation concept introduced at this time is still relevant in the treatment of femoral neck fractures today. Multiple pin constructs, which permitted the open or percutaneous fixation of femoral neck fractures, were introduced by Knowles and Moore and were the precursor of today's cannulated screws[12].

Harmon in 1944 added a side plate for accommodating these pins. It was later modified by Deyerle in 1958 which had a template for multiple pin insertion and sliding. The use of the dynamic hip screw in the treatment of intra-capsular fractures has also been reported[23].

The 1950s saw the advent of the hemiarthroplasty as a means to prophylactically address nonunion and avascular necrosis (AVN), the primary complications following femoral neck fracture fixation. The Judet arthroplasty featured an acrylic head and a stabilizing short intramedullary peg to be placed in the femoral neck[24]. The Austin-Moore [25] and Thompson prostheses [26] were successful metallic implants designed to replace the femoral head and neck, secured with an intramedullary stem in the femoral shaft. The remainder of the 20th century witnessed the evolution and refinement of radiology, implant design, implant materials, and operative technique for the fixation of femoral neck fractures, which built on the ideas and the experience of the first 50 years[12].

Compromising of vascularity of the femoral head was the prime concern in femoral neck fracture fixation. Meyers and associates in 1974 advocated the use of muscle -pedicle bone graft from the quadratus femoris muscle posteriorly. It was postulated that this procedure provided posterior stability along with vascularity to femoral head[27]. Surgeries were performed away from the fracture site in the form of osteotomies e.g. Pauwell's wedging osteotomy (1935), McMurray's displacement osteotomy[28] and Schanz angulation osteotomy[29] but with limited results.

THE EVOLUTION OF HIP ARTHROPLASTY

Although major surgical procedures occasionally were performed in the early 1800s, it was not until the introduction of general anesthesia and antiseptic technique during the latter half of the nineteenth century that the field of surgery in general, and arthroplasty in particular could be developed[30]. Resection arthroplasty of the hip first was reported in Europe in the early 1800s and became well established by the middle of the nineteenth century. However, they were primarily being used in infected hip[30].

Kocher initially advocated excision arthroplasty as a treatment of femoral neck fractures[2]. Interest in interposition arthroplasty was kindled by Murphy who, starting in 1902, began to use muscle and fascia as the interposing materials[31]. Interposition arthroplasties also were reported in the 1920s by Campbell and MacAusland who preferred to use fascia lata. The results were considered to be reasonably good compared with the results of other procedures available at that time[30,32].

Brackett performed one of the first reconstructive procedures for treatment of non-union of the femoral neck. He resected the remaining portion of the femoral neck and placed the viable femoral head on the upper end of the femoral shaft, after transplanting the trochanter distally[33]. In 1921, Whitman resected the femoral head and neck and placed the upper end of the femur into the acetabulum after distal transplantation of the greater trochanter[34]. In 1935, Colonna modified the Whitman procedure by placing the greater trochanter within the acetabulum after resecting the head and neck. A portion of the abductor musculature was left attached to the trochanter in the hope that these tissues might form an articulating surface. The bulk of the abductor muscle mass was reattached distally. This procedure became known as the Colonna trochanteric reconstruction[35]. Reconstructive procedures were also developed later by Luck[36] and Wilson[37] with variable results.

The cup arthroplasty was introduced by Smith-Petersen of Boston[38]. He reported that a pseudomembrane, similar to the synovium of a normal joint, developed around a piece of glass that was lodged in the back of one of his patients. He therefore initially used a cup made of glass as an interpositional arthroplasty between the femoral head and the acetabulum in a patient with degenerative arthritis. These glass cups were too brittle to withstand the forces encountered in the hip and they frequently fractured. Accordingly Smith-Petersen experimented with numerous other materials[38]. In 1937, Venable et al described Vitallium as a biologically inert material that might have numerous in vivo applications[39]. Shortly thereafter Smith-Petersen began using Vitallium cups and performed 500 cup arthroplasties between 1938 and 1948. His work was continued by Aufranc who, in 1957 reported on 1000 cup arthroplasties performed at the Massachusetts General Hospital with 85% of patients having satisfactory to good results[40].

The first reported hemiarthroplasty was by Delbet who used reinforced rubber as a replacement for the femoral head in 1919[30]. Hey-Groves, in England, used ivory for this purpose in 1927[30]. In 1940, Moore and Bohlman replaced the upper end of the femur in a patient with a malignant giant cell tumor using a 12-inch stainless steel prosthesis. The prosthesis functioned well until the patient's death and is credited with being the first of the modern endoprostheses. As reported by Thompson, the Judet brothers developed a short-stemmed endoprosthesis, initially made of acrylic, between 1946 and 1953. In 1950, Thomson developed a short-stemmed metal device that came to be known as the light bulb prosthesis. The prosthesis was made up of vittalium or stainless steel. It is now frequently used with cement because due to its small stem, stability witin the femur can be difficult to achieve.These soon gave way to longer-stemmed intramedullary prostheses.

Figure 1: THE THOMPSON and AUSTIN MOORE PROSTHESIS

At about the same time, the Austin Moore prosthesis was described. This prosthesis had a femoral stem which was fenestrated and also has a shoulder to enable stabilisation within the greater trochanter and so prevent rotation within the femoral canal[25]. It became apparent that the long-stemmed devices generally were superior to the shorter devices, which they soon replaced[26].

In an attempt to improve on the results with traditional unipolar endoprostheses, McKeever and Collison in the early 1950s developed bipolar endoprostheses that used Teflon lined metal cups placed over the metallic femoral endoprosthesis[30].

Beginning in 1973 and working independently, Giliberty and Bateman developed the prototypes of the current bipolar endoprostheses, which used metallic cups lined with high density polyethylene that were locked securely onto the head of the femoral component[44,45]. Bateman wrote, ‘The provision of a completely mobile head element and the addition of another head surface for motion in the acetabulum create a compound system that provides for a greater distribution of bearing forces, thus minimizing wear-and-tear changes both on the implant and the containing tissues[45]. He concluded that this would result in decreased post-operative pain and early mobilization of the patients[45].

Sir John Charnley began the development of various types of total hip replacement arthroplasties between 1958 and 1963 [46].His initial results using Teflon were disastrous; but once he began to use high-density polyethylene for the acetabular component, results improved markedly. His development of the low friction arthroplasty led to dramatic improvements in the function and durability of total hip replacement. It soon was followed by countless other designs that were built on the original principles of Charnley. Charnley is credited as being the father of total hip replacement and he ushered in the era of modern joint replacement surgery[30.]

INTERNAL FIXATION VERSUS ARTHROPLASTY

Carpenter et al in a study of the Functional outcome following femoral neck fractures in elderly reported that the reoperation rate following internal fixation was much higher (28%) than that following hemiarthroplasty (3-5%). The rate of reoperation after unipolar hemiarthroplasty was 5% and following bipolar hemiarthroplasty was 3%.[47]

Lu-Yao, et al in a meta-analysis of one hundred and six published reports of outcomes after displaced fractures of the femoral neck found that union is achieved in 67% of patients within 2 years, and normal blood flow to the femoral head is maintained in 85% of patients. Of patients treated with reduction and internal fixation, however, 35% required secondary procedures: conversion to a total hip arthroplasty or hemiarthroplasty accounted for 2⁄3, removal of the internal fixation device accounted for 1⁄6, and repeat internal fixation accounted for 1⁄6[48]. Elderly patients with displaced femoral neck fractures achieve the best functional results with a well healed femoral neck without osteonecrosis after reduction and internal fixation. Achieving this result may be difficult, and it is not as cost effective as arthroplasty. Hudson et al. reported an 8-year outcome study of 367 femoral neck fractures treated surgically. Their study showed a higher rate of revision in patients older than 80 years treated with internal fixation of a displaced femoral neck fracture compared with patients who were treated with hemiarthroplasty. There was no difference, however, in the revision rates of nondisplaced fractures treated by internal fixation or hemiarthroplasty in this age group. These authors noted a significantly higher mortality rate associated with internal fixation than with hemiarthroplasty for patients in this age group[49].

In Sweden, Rogmark et al. reported a 2-year prospective study of 409 ambulatory patients, 70 years or older with Garden stage III or IV fractures treated with arthroplasty or internal fixation. They found the rate of failure to be higher in patients with internal fixation than in patients with arthroplasty (43% versus 6%) and the rate of complications higher in the arthroplasty group (23% versus 15%). Functionally, 36% of patients with internal fixation had impaired walking and 6% had severe pain compared with 25% and 1.5% for patients with arthroplasty[50].

Bhandari et al., in a meta-analysis of nine trials comparing arthroplasty with internal fixation in 1162 patients, found that arthroplasty significantly reduced the risk of revision surgery. Increased blood loss, longer operative times, and greater infection and mortality rates occurred, however, with arthroplasty[5].

BIPOLAR HEMIARTHROPLASTY VERSUS UNIPOLAR HEMIARTHROPLASTY

Patients treated with unipolar hemiarthroplasty have had 80% implant survivorship 7 years after surgery. After unipolar hemiarthroplasty, 70% of patients regain community ambulatory status at 1 year, and 80% of patients report no pain or mild pain at 1 year[51]. However, unipolar hemiarthroplasty has not been uniformly successful in active elderly patients. The articulation of a large metal head on articular cartilage is associated with acetabular erosion and groin pain in active patients.

Undersizing of the unipolar head is associated with increased acetabular erosion and pain while oversized heads are associated with decreased motion. Active elderly patients with high demand requirements are not completely satisfied with the above suboptimal outcomes[52].

Based on the hypothesis that cementing will negate a few disadvantages of Unipolar hemiarthroplasty, D'Arcy and Devas studied a series of 354 cemented Thompson hemiarthroplasties in patients with a mean age of 81 years. Of the 156 survivors available for review at 3 years, there was an 18.9% failure rate. The most common reason for failure was acetabular erosion (11%)[53]. Kofoed and Kofod followed 71 patients with a mean age of 82.5 years for 2 years who were treated with Austin Moore's Prosthesis. Of active patients, 55% needed total hip arthroplasty.

Acetabular degeneration was the most common reason for failure. They concluded that active patients, regardless of age, should not be treated with an Austin Moore type implant[54].

Unipolar hemiarthroplasty should thus be reserved for patients with debilitating medical problems and little or no ambulatory capability. Bipolar hemiarthroplasty offers little advantage over unipolar hemiarthroplasty in this patient group[55].

Bateman hypothesised that bipolar prosthesis by virtue of its unique articulation with the acetabulum, would function without eroding the acetabulum[44].

Bipolar prosthesis was designed to allow movement to occur not only between the acetabulum and the prosthesis but also at the joint within the prosthesis itself. The internal joint may be of the trunion type, which allows axial movement between the head and neck of the prosthesis, or of the ball and socket type, which allows universal movement at the inner joint[44].

In 1988 Bochner, et al presented their results of a consecutive series of 120 bipolar replacements of the femoral head that had been done for the treatment of a fracture of the femoral neck with a minimum follow-up of two years. Roentgenograms were made with the patient bearing weight in order to determine the relative motion at the two sites of articulation of the bipolar prosthesis. The roentgenograms demonstrated the presence and maintenance of motion at both bearing surfaces. They concluded that Bipolar hemiarthroplasty is an effective treatment for fracture of femoral neck and the rate of complications are acceptable and comparable with that of unipolar hemiarthroplasty with motion maintained at both bearing surfaces after 2 years, although there was greater motion at the outer bearing–cartilage interface[47].

Lu-Yao, et al in a meta-analysis of one hundred and six published reports of outcomes after displaced fractures of the femoral neck found that the rate of reoperation for patients with unipolar prosthesis was double that of patients who had bipolar prosthesis[48].

Bipolar replacement has higher percentage of satisfactory results, less post-operative pain, greater range of movement, more rapid return to unassisted activity, fewer unsatisfactory results and no acetabular erosion. The device functioned as bipolar in all cases studied for inner bearing motion.

Maricevic et al in 1998 in a study conducted to know the effectiveness of treatment with bipolar prosthesis in elderly patients with femoral neck fractures reported that there were no poor results. Hence the authors concluded that bipolar hemiarthroplasty is the treatment preferred in elderly patients with femoral neck fracture[56].

Bednar, et al in 1988 presented their study correlating component movement with clinical outcome. It was seen that greater motion at the inner bearing correlated with better clinical results[57].

Dixon, et al found that the results of bipolar hemiarthroplasty is significantly better than would be expected with conventional hemiarthroplasty in patients who are independently mobile outside their homes at the time of displaced intracapsular fracture neck of femur, the results being comparable with that of total hip replacement but without the risk of dislocation[58]. They also suggested that the ability to walk one mile at a stretch should define the mobile active elderly patient.

Bipolar prosthesis can more appropriately be used in patients who are community ambulators and whose likelihood of success with internal fixation is low. Bipolar hemiarthroplasty is also attractive in patients with neurologic impairment and instability risks, such as patients who have had a stroke and patients with Parkinson's disease or dementia.

Cost-effectiveness analysis shows that arthroplasty is the most cost-effective treatment when complication rate, mortality, reoperation rate, and function are evaluated during a 2-year postoperative period[4].

Haidukewych, et al in 2002 reviewed the results and survivorship of 212 bipolar hemiarthroplasties done in 205 patients for acute femoral neck fractures between 1976 and 1985. The data showed that cemented bipolar hemiarthroplasty done for a diagnosis of femoral neck fracture was associated with excellent component survivorship. Ten-year survivorship free of reoperation for any reason was 93.6% and free of revision surgery for acetabular cartilage wear was 99.4%[59].

Anatomy

GROSS ANATOMY OF THE HIP JOINT[60]

The hip joint is an enarthrodial or ball-and-socket joint, formed by the reception of the head of the femur into the 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. Within the lunate surface there is a circular depression devoid of cartilage, occupied in the fresh state by a mass of fat and covered by synovial membrane.

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 is attached, in front, to the intertrochanteric line and the base of the neck anteriorly and posteriorly to the neck, about 1.25 cm above the intertrochanteric crest. From its femoral attachment some of the fibers are reflected upward along the neck as longitudinal bands, termed retinacula. The capsule is much thicker at the superior and anterior part of the joint where the greatest amount of resistance is required. 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.

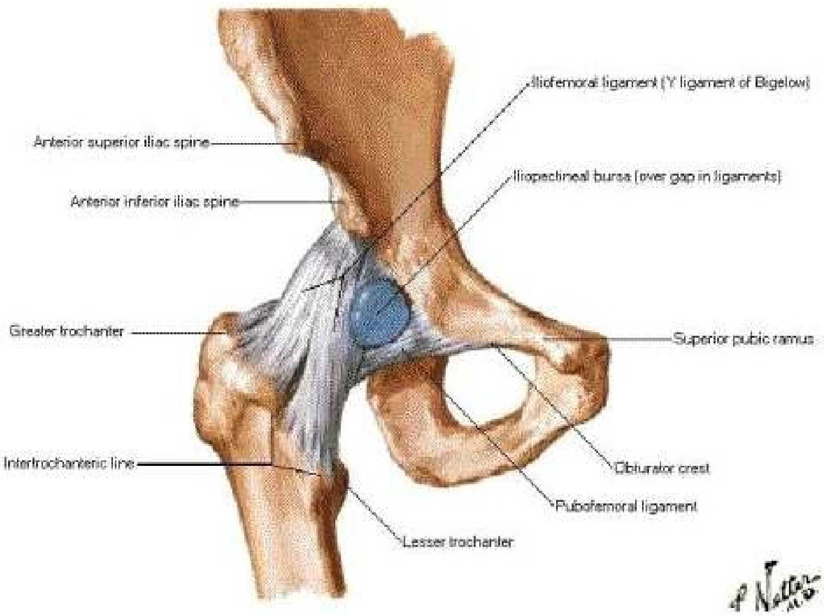


Fig 4: HIP JOINT – ANTERIOR VIEW

The ilio-femoral ligament/ Y-shaped ligament of Bigelow is the strongest ligament in the body and lies in front of the joint. It is intimately connected with the capsule, and serves to strengthen it in this situation. 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 and is attached to the upper part of the same line. In some cases there is no division, and the ligament spreads out into a flat triangular band which is attached to the whole length of the intertrochanteric line.

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.

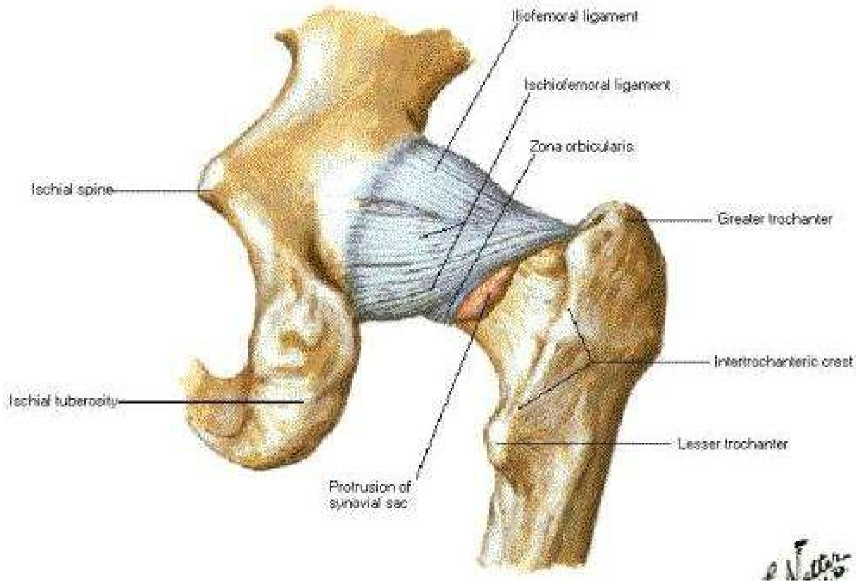


Fig 5: HIP JOINT – POSTERIOR VIEW

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 also protects the edge of the bone, and fills up the inequalities of its surface. It bridges over the notch as the transverse ligament, and thus forms a complete circle, which closely surrounds the head of the femur and assists in holding it in its place. 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.[60]

MUSCLES AROUND THE HIP[60]

A. MUSCLES IN FRONT OF THE THIGH

1. Psoas major
2. Ilaicus
3. Tensor fascia latae
4. Sartorius
5. Quadriceps femoris

B. Muscles of the gluteal region

1. Gluteus maximus
2. Gluteus medius
3. Gludeus minimus
4. Obturator internus
5. Superior and inferior gemelli
6. Quadratus femoris

C. Muscles posterior to the hip :

1. Semi tendinosus
2. Semimembranosus
3. Biceps femoris

D. Medial muscles of hip :

1. Pectineus
2. Adductor longus

3. Adductor brevis
4. Adductor magnus

MOVEMENTS OF THE HIP[61]

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 – PosteriorlY, 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 [61].

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°.[61]

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 in the gluteus medius and minimus limits the adduction. Normal range 25^{0} – 35^{0}.[61]

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°.[61]

EXTERNAL ROTATION

This is carried out by flexing the hip and knee to 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.[61]

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.[61]

BLOOD SUPPLY OF HEAD AND NECK OF THE FEMUR

Avascular necrosis of femoral head is one of the most serious complication following femoral neck fractures, which have all the problems associated with healing of intracapsular fractures elsewhere in the body. Hip joint capsule is strong fibrous structure which encloses femoral head and most of its neck. That portion of neck which is intracapsular has no cambium layer to participate in peripheral callus formation. Thus femoral neck area is dependent on endosteal union alone.

Arterial supply of proximal end of femur has been studied extensively. Crock described arteries of proximal end of femur into 3 groups and provided a definitive anatomical nomenclature to these vessels thus avoiding ambiguity.[62]

1) The extra-capsular arterial ring located 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 large 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 arise from the extra-capsular arterial ring. Anteriorly they penetrate the hip joint capsule at the intertrochanteric line and 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 that demarcates femoral head from its neck. These arteries are called retinacular arteries described initially by Weitbrecht.[2,63] This close proximity of retinacular arteries puts them at risk of injury in any fracture neck of femur. As the ascending cervical arteries traverse superficial surface of the neck of the femur they send small branches into the metaphysis of femoral neck.[2]

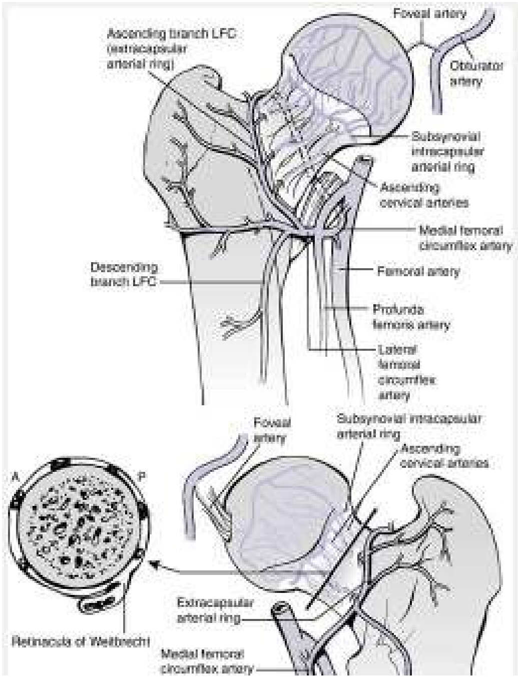
As the ascending cervical arteries traverse the superficial surface of the femoral neck, they send many small branches into the metaphysis of the femoral neck. Additional blood supply to the metaphysis arises from the extracapsular arterial ring and may include anastomoses with intramedullary branches of the superior nutrient artery system, branches of the ascending cervical arteries, and the subsynovial intra- articular ring. In the adult, there is communication through the epiphyseal scar between the metaphyseal and epiphyseal vessels when the femoral neck is intact.[2,63]

This excellent 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 providing most of the supply to femoral head and neck. At the margin of articular cartilage on the surface of the neck of femur, these vessels form a second ring – the subsynovial intra-articular ring described by Chung, which can be complete or incomplete, the complete rings being more common in male specimens.[64] At the subsynovial intra - articular ring - epiphyseal arterial branches arise that enter head of the femur. Disruption of this arterial ring in high intra-articular fractures, leads to aseptic necrosis. Once the arteries from subsynovial arterial ring penetrate femoral head they are termed as epiphyseal arteries. Claffey demonstrated that in all femoral neck fractures that communicated with the point of entry of the lateral epiphyseal vessels, aseptic necrosis occurred.[65]

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. Howe, et al found that although the vessels of the ligamentum teres did supply vascularity to the femoral head, they were often inadequate to assume the major nourishment of the femoral head after a displaced femoral neck fracture.[66]

Claffey also reported that simple patency of the vessels of the ligamentum teres did not make them capable of keeping the femoral head alive if all other sources of blood supply were interrupted.[65]



Blood Supply to the Head and Neck of Femur

CLINICAL SIGNIFICANCE OF VASCULAR ANATOMY

Femoral head circulation arises, therefore, from three sources: (a) intra- osseous cervical vessels that cross the marrow spaces from below; (b) the artery of the ligamentum teres (medial epiphyseal vessels); and (c) the retinacular vessels, branches of the extracapsular arterial ring, which run along the femoral neck beneath the synovium.

When a femoral neck fracture occurs, the intraosseous cervical vessels are disrupted; femoral head nutrition is then dependent on remaining retinacular vessels and those functioning vessels in the ligamentum teres.[67] The amount of the femoral head supplied by the medial epiphyseal vessels varies from a small area just beneath

the fovea to the entire head.[56] Sevitt and Thompson reported that the anastomoses between the subfoveal vessels and other vessels in the femoral head may be insufficient to support viability.[68,69] Therefore, every attempt should be made to protect the remaining vascular supply to the femoral head after fracture.

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.

These function will be disturbed , when there is a fracture in the neck of femur & disturbances of supporting structures. The treatement is aimed at providing support, restoring the function, anatomical realignment.

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 articular 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 provides the 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 by rydell, in terms of magnification factor to body weight.

Standing on one leg = 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

Mechanism of injury:

Fracture neck of femur is common in elderly women due to osteoporosis. It is uncommon in young patients and few races like black people.

Most of the fractures is due to trivial fall and minor trauma. Ethil theodor kocher suggested 2 mechanism of injury in neck of femur fractures.

1. Direct blow over greater trochanter which was confirmed by linten in 1955.

2. External rotation of the extremity which was confirmed by protzman in 1978. In this mechanism while there is external rotation, the head is fixed firmly by anterior capsule & ileofemoral ligament. The posterior cortex of the neck impinges on the acetabulum and buckling happens.

   The third mechanism is a cyclical loading which produces micro and macro fractures.

In osteoporotic bone forces within physiological limits will produce fractures.

Mechanism of bone failure:

In the hip joint , overloading occurs due to number of independent but often inter related factors. The important factors are

1. Influence of fall
2. Impairment of energy absorbing mechanism
3. Osteoporosis

Influence of fall:

In standing position , body possess considerable amount of potential energy while falling potential energy converted to kinetic energy which should be absorbed by body structures, if not fractures occurs. In an human, average amount of energy absorbed by the body on fall would be approximately 4000 kg/cm, but in the proximal femur its only about 500 kg/cm.

Impairment of energy absorbing mechanism:

The dissipation of energy is done by active contraction of muscle. The dissipation requires reacting time. In high velocity injury, no sufficient period for the muscles to contract to absorb energy to avoid overloading. In the elderly patient, there will be slower neuromuscular coordination, thus there will be impairment of energy absorbing mechanism

Bone weakness:

In osteoporosis, the bone strength reduces to approximately 3/4th of the normal healthy bone with low energy absorbing capacity leading to failure. Aitkin et al in 1984, demonstrated the presence of osteoporosis (mild to severe) in 84 percent of patients with neck of femur fractures. Dorne and lander described a group of patient who sustained neck of femur fracture spontaneous without apparent trauma. They used the term insufficiency fractures to describe the neck of femur fractures in elderly with osteoporosis. Griffin et al showed fatigue fracture can occur in elderly if neck of femur on cyclical loading within physiological limits. Freeman et al demonstrated subcapital fractures in osteoporosis due to fatigue , preceded by isolated trabecular fatigue fractures.

Patterns of farcture:

It is influenced by the resultant force which is applied at the moment prior to the fracture. In a normal physiological conditions, the resultant line force can be seen , one perpendicular to femoral neck axis, other in the line of axis of femur neck axis. If the resultant line of force alters at the moment before fracture. Then relative size of two components will be altered.

In 1950, frankel has shown experimentally a transverse fracture occurs if the ratio of bending component to compression component increases 1:6, if the ratio si 1:7, a subcapital fracture with spike occurs.

Classification of fracture neck of femur:

1. Anatomical
2. Gardens
3. Pauwels
4. Ao classification

Anatomical Classification:

It was first designed by sir astley cooper in 1823

It is based on the fracture line involves which part of neck

1. Subcapital fracture
2. Transcervical fracture
3. Basicervical fracture

Classification

Garden classification:[86, 87]

Garden proposed this classification based on the displacement of fracture in the antero posterior view. Classified into 4 types

Type 1 : incomplete fracture or impacted fracture. In this type of fracture, inferior neck trabeculae are intact. This group includes abduction impacted fracture.

Type II : It's a complete fracture without displacement. The trabeculae in the neck is disrupted

Type III is complete fracture with partial dis[placement, the trabecular pattern doesn't not line with tarbeculae pattern of acetabulum. There wil be braekage of trabeculae of the neck.

Type IV is ac complete and fully displaced fracture. The tarbecular pattern of head is in alignment with the acetabular tarbecular pattern.

Eliasson – eiskjaer and ostgard and recently kreder demonstrated that there is no big difference in outcome and management , when classified based on fracture and displacement.

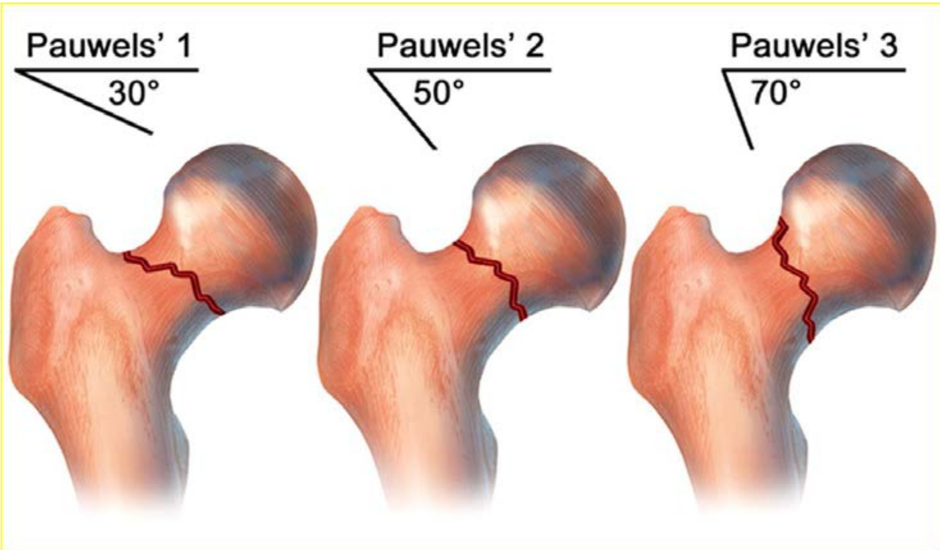
2. Pauwels classification based on fracture angle

Pauwels divided femoral neck fractures based on the direction of fracture line across the femoral neck into three types.

- Type - I is a fracture 30° from the horizontal

- Type - II is a fracture 50° from the horizontal
- Type-III is a fracture 70° from the horizontal.

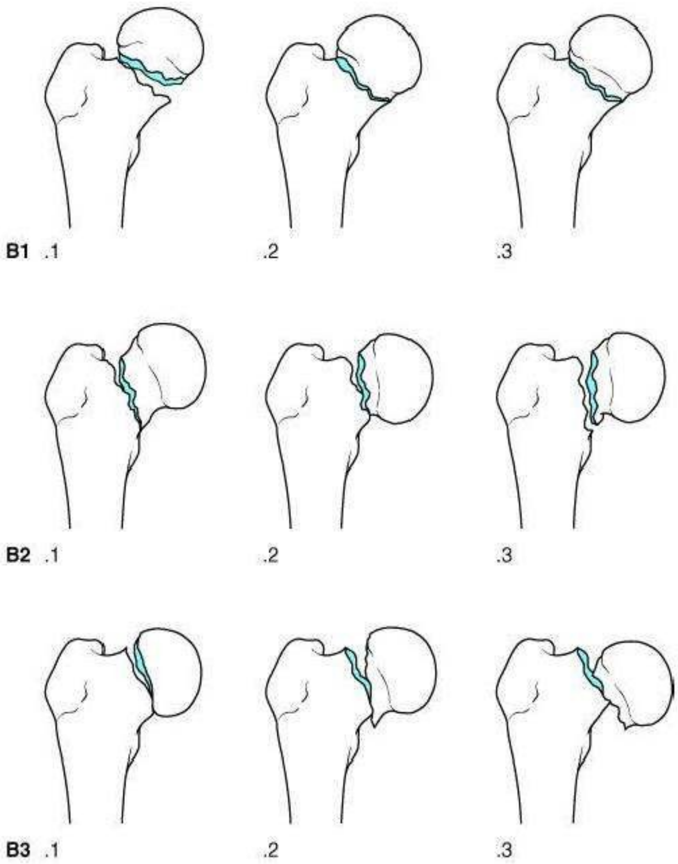
Type I fractures are much more horizontal than type III fractures, which are almost vertical. Pauwels attributed nonunion in type III to the increased shearing force of this vertical fracture.



AO classification: [91]

It is universal classification. For femur tha alphanumeric is 31B, in which 3 stands for femur, 1 for proximal femur, B for neck fractures, further classified on the anatomical site and fracture patterns.

- 31-B1- subcapital fracture
  - ✓ 31 -B1.1 – impacted in valgus > 15 degrees
  - ✓ 31-B1.2- impacted in valgus < 15 degrees
  - ✓ 31- B1.3- non impacted fracture.
- 31- B2- transcervical fracture
  - ✓ 31-B2.1 – basicervical fracture
  - ✓ 31-B2.2- midcervical adduction
  - ✓ 31- B2.3- midcervical shear
- 31- B3 – displaced, non impacted subcapital fractures.
  - ✓ 31-B3.1- moderate displacement in varus and external rotation
  - ✓ 31-B3.2- moderate displacement with vertical translation and external rotation
  - ✓ 31-B3.3- marked displacement in varus with translation


B1 .1
.2
.3
B2 .1
.2
.3
B3 .1
.2
.3

Clinical features of fracture neck of femur: [2,23]

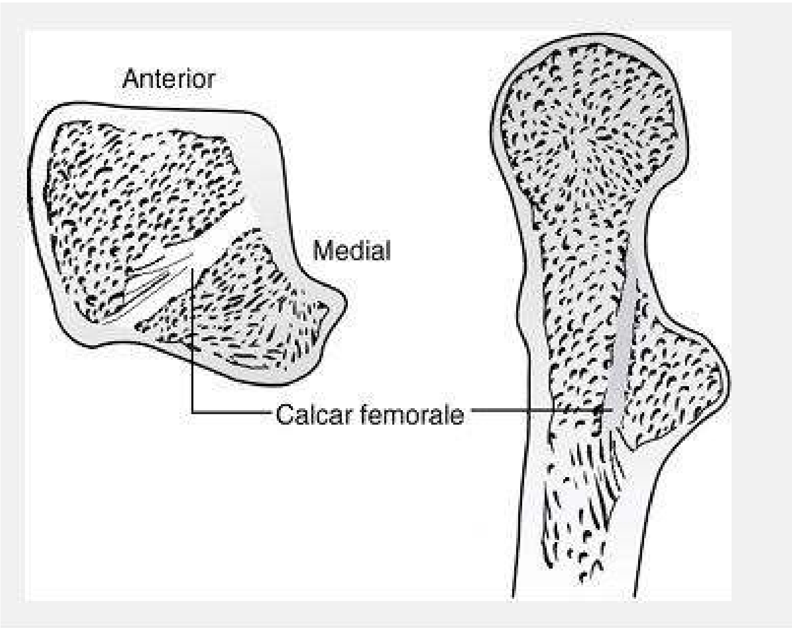
The classical picture wil be pain in the groin often referred to inner thigh and knee. Movements of the hip and whole wil be painful and severely restricted with spasms. Greater trochanter wil be migrated upwards with crepitus on movements. The injured limb will present with shortening and external rotation. In impacted fracture sometimes patient can move his limb or even walk with pain and limp. Quite often there will be external rotation deformity

Roentgenography of the hip region :

The routine x ray evaluation which includes anteroposterior view of pelvis, true anteropsoterior view with traction and maximum internal rotation and cross table lateral view. The hip joint is usually radiographed with heel slightly separated and toe symmetrically directed forwards and medially. In this position femur is rotated medially, the femoral neck is parallel to the film. The shadow of the upper end of femur and acetabular region is clearly seen. A curved white line of cortical bone delinates the superior and medial edge of acetabulum and the cortex of head also appears as white line. The joint space is measured by the gap between the white line of head of femur and acetabulum. Normal space is in adults about 4-7mm. the appearance of neck, greater trochanter, lesser trochanter are altered by the rotation of thigh. When foot directed slightly medially, neck lies in transverse plan, when foot is directed anteriorly, greater trochanter lies in posterior to head of femur, if foot directed outwards, greater trochanter still moves posterior , neck shortened. The angle between neck and shaft is best seen when x ray taken on limb with internal rotation of about 15 -20 degrees. The angle is usually 120- 140 degrees.

Calcar femorale :

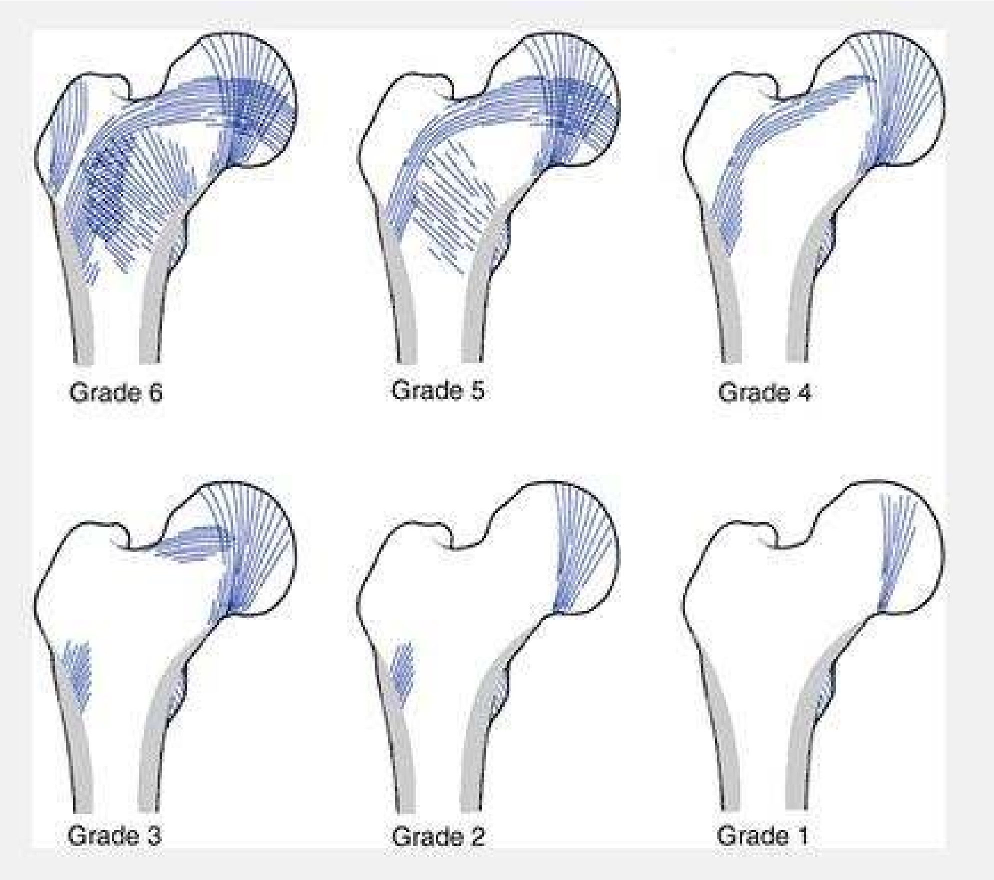
According to Harty [94] and Griffin[95], the calcar femorale is a dense vertical plate of bone extending from the postero-medial portion of the femoral shaft under the lesser trochanter and radiating lateral to the greater trochanter, reinforcing the femoral neck posteroinferiorly. The calcar femorale is thicker medially and gradually thins as it passes laterally The presence and adequacy of Calcar femorale can be best appreciated by an AP view of the hip taken in 15^0 internal rotation.



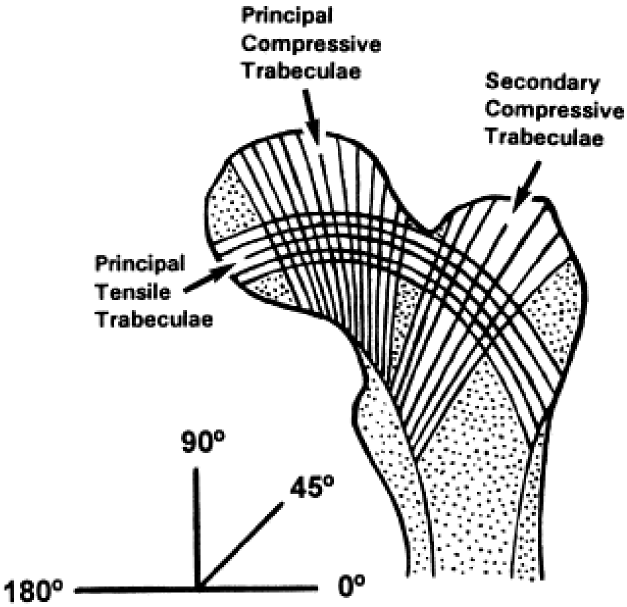
CALCAR FEMORALE

ASSESSMENT OF QUALITY OF BONE IN THE FEMORAL NECK AND HEAD BY SINGH'S INDEX[96]

Many patients with hip fractures have markedly porotic bone. The quality of fixation and stresses which can be tolerated postoperatively is related to the severity of osteoporosis



SINGH'S INDEX OF OSTEOPOROSIS



TRABECULAR PATTERN

In 1838, way before the discovery of roengenography, the internal trabecular system of the femoral head was described by Ward[2]. The orientation of the trabeculae is along lines of stress, and thicker lines come from the calcar and rise superiorly into the weight-bearing dome of the femoral head. Forces acting in this arcade are largely compressive. Lesser trabecular patterns extend from the inferior region of the foveal area across the head and superior portion of the femoral neck into the trochanter and lateral cortex. Ward's triangle is the triangle bounded by primary compressive trabeculae, primary tensile trabeculae and secondary compressive trabeculae.

Singh et al used the trabecular pattern seen on x-rays of the upper end of the femur as an index for the diagnosis and grade of osteoporosis. This system is based on the presence or absence of the five normal groups of trabeculae in the proximal femur, as described by Ward.[96]

- Grade - 6: Normal trabecular pattern with primary compression and tensile trabeculae and secondary compression and tensile trabeculae.
- Grade - 5: Decrease in secondary trabecular pattern and ward's triangle becomes prominent.
- Grade - 4: Secondary trabecular pattern is absent and primary trabecular pattern decreases.
- Grade - 3: A break occurs in tensile trabeculae.
- Grade - 2: Loss of primary tensile trabeculae is complete, marked reduction in compression trabeculae.

Grade -1: Only a few compression trabeculae seen.

Grade 3 and below indicate significant osteoporosis. Examination of this index against more technologically advanced methods has demonstrated a fairly high sensitivity (90%), but a low specificity (35%) for the identification of osteoporosis[96].

Bipolar Prosthesis

BIPOLAR PROSTHESIS

The bipolar prosthesis introduced by James. E. Bateman and Gilberty during 1974[44]. Similar Bipolar prostheses were later manufactured with some modifications, mainly in the design of stem. Other commonly known versions are Monk Duo Pleet (Monk 1976), Hastings's Bipolar Prosthesis (Biotechnic, France) and Bipolar Endoprosthesis (Inor India, Talwalkar Type). In the present study we have used the Bipolar endoprosthesis (Talwalkar Type). The provision of a completely mobile head element and the addition of another head surface for motion in the acetabulum create a compound system. This provides a greater distribution of bearing forces, thus minimizing wear and tear changes both on the implant and on the containing tissues. Such considerations were met initially by Bateman who designed a prosthesis of a cobalt-chromium alloy (Vitallium, Howmedica), consisting of a femoral stem with a collar, neck, and a 22 mm spherical bearing at its proximal end. The spherical bearing is locked into a metallic cup or cap. i.e., the head which constitutes a second bearing surface which articulates with acetabulum[44].

The bipolar prosthesis (Talwalkar Type) has got a stem length of 157mm, thickness is 8 mm and material for the stem is stainless steel AIS 316. The presence of fenestration in the stem is optional. It has a vertical shoulder which sits on the medial calcar, a long neck of length 35.0 mm, neck shaft angle of 125^0 and neck diameter is 19.00 mm. The diameter of the inner bearing is 26 mm. The inner bearing articulates with the inner surface of the outer cup or acetabular cup which articulates with the acetabulum. The inner surface of the acetabular cup is covered by High Density Polyethylene (HDPE) and the outer surface is of stainless steel AIS 316. The size of acetabular cup varies from from 37-53mm.

The simplest of currently available Bipolar prosthesis like Indian version and Monk prosthesis have an Austin Moore type stem and the small femoral head that cannot be detached from the outer metallic cup - UHMWPE insert complex. Newer and modified versions of bipolar prosthesis have a modular system with interchangeable stems (fenestrated, solid, straight, long, porous, press fit). They also come with a feature of small diameter head (metallic or ceramic) which allows adjustment of neck length.

BIPOLAR PROSTHESIS

MODULAR BIPOLAR PROSTHESIS

INDICATIONS FOR BIPOLAR HEMIARTHROPLASTY[97,48]

In neck of femur fractures as an alternative to a Moore type of femoral head prosthesis in active elderly patients with displaced fresh femoral neck fractures and subsequent non-union or avascular necrosis. As an alternative to a fixed acetabular component in younger patients.

Theoretically, should revision to a total hip arthroplasty be required at a later date, only the acetabular component would have to be replaced, assuming the femoral component was not loose and is of modular design. Failure of Internal fixation without arthritis of the hip.

EXTENDED INDICATIONS

1. Diseased acetabulum.
2. Osteonecrosis of the hip – Stage 3
3. Osteoarthritis of the hip.[98]
4. Rheumatoid arthritis.[99]
5. Ankylosing spondylitis.

CONTRAINDICATIONS

1. Pre existing sepsis.
2. Active young patient with fracture of the neck of femur
3. Pre existing disease of acetabular cartilage - osteoarthritis, rheumatoid arthritis

.4. Non- contained segmental deficiency of the acetabular rim.

ADVANTAGES

1. Prosthetic replacement allows immediate weight bearing to return elderly patients to activity and help avoid complications of recumbency and inactivity and helps patients to return early to pre-fracture levels.
2. As a primary procedure, prosthetic replacement eliminates osteonecrosis and nonunion as complications of femoral neck fractures.
3. Prosthetic replacement of displaced femoral neck fractures reduces the incidence of reoperation compared with internal fixation. This applies only to elderly individuals with a limited life expectancy because the cumulative rate of reoperation for prosthetic replacement increases with time.
4. Better pain relief in postoperative period[8].
5. Better range of hip movements[56].
6. Cuts short hospital stay by about 30% compared to internal fixation.

DISADVANTAGES

1. Salvage and revision procedures are complicated when there is sepsis, or mechanical failure.
2. At least two thirds of patients treated by internal fixation have functional hips that last the remainder of lifetime, a fact ignored by prosthetic replacement.
3. Surgery is more extensive than that required for internal fixation.
4. Best results of primary replacement prosthesis are not comparable to the best results of fresh fractures treated by internal fixation.
5. Increased incidence of dislocation requiring open reduction[23].
6. Increased cost[23].

COMPLICATIONS:

Complications accompanying any major orthopaedic surgery are found in bipolar hemiarthroplasty too. Complications can be divided into early, late.

EARLY COMPLICATIONS

1. Embolic complications like – pulmonary embolism, cerebrovascular accident.
2. Cardio-pulmonary complications like cardiac arrest and respiratory failure.

3. Splintering of trochanter / proximal femur while hammering of prosthesis for insertion or during reduction.

4. Injury to sciatic nerve during surgery

5. Malposition - insertion of the prosthesis with too much retroversion, anteversion or seating the prosthesis high on the neck.

6. Dislocation of prosthesis - in the operating theatre, or immediately postoperatively.

LATE COMPLICATIONS

1. Dislocation of prosthesis – Frequently requiring open reduction
2. Infection
3. Limb length discrepancy
4. Broken prosthesis
5. Metallic erosion and tissue reaction6. Trochanteric bursitis
7. Loosening of prosthesis with stem distal migration (femoral subsidence)
8. Protrusio acetabuli
9. Idiopathic pain
10. Heterotopic ossification
11. Fracture of femur at the lower third of stem (peri-prosthetic fractures)

Materials and Methods

MATERIALS AND METHODS

Source of data:

In this retrospective study, patients who underwent bipolarhemiarthroplasty for neck of femur fractures in Government Royapettah hospital was considered for the study

Total number of cases : 34

Patients who came for follow up – 30 cases

Inclusion criteria:

1. Patients who were treated with bipolar hemiarthroplasty
2. Age of patient > 60 years
3. minimum period of 2 years post op

Methodology:

The contact list of neck of femur fracture patients who were treated by bipolar hemiarthroplasty were obtained from medical records department. All the patients were communicated either thro' letter or phone.

A proforma were postulated, which after thorouh wetting by the guide was used for this study. All the patients were analysed uniformly with the same.

All the patients were analysed in single visit.

At the time of presentation all the patients analysed for

1. Functional outcome using modified hip score
2. Radiological assessment
3. Fluoroscopy analysis for interprosthetic movement

Functional outcome:

Modified harris hip score was used for analysis of the functional outcome for all the patients

Radiological assessment:

X ray – anteroposterior view with internal rotation of 15 – 20 degrees was taken for all the patients and analysed for radiological parameters like joint space, any subluxation, acetabular changes, based on which grading was done.

Fluoroscopy analysis:

Then patients were taken to theatre, where fluoroscopy examination was done without anaesthesia. Patient in supine position on radiolucent table, initially static images were obtained. Hip in neutral position, then flexion, then abduction, adduction, then rotator movements. Then in continuous mode of fluoroscopy, all the movements were recorded and analysed for interprosthetic movements. Inter prosthetic movements considered to be presents when there is more than 15^0 degrees of movements atleast in two planes Patient categorized based on number of years of follow up.

Finally all three parameters compiled and analysed.

TABLE – 1 AGE DISTRIBUTION

Age	Numbers	percentage
61-70	21	70
71-80	7	23.33
>80	2	6.66

Table-1 shows the age distribution pattern of the patients. The average age was noted to be 72 years. The youngest patient in the study was 61 years and the oldest was 85 years.

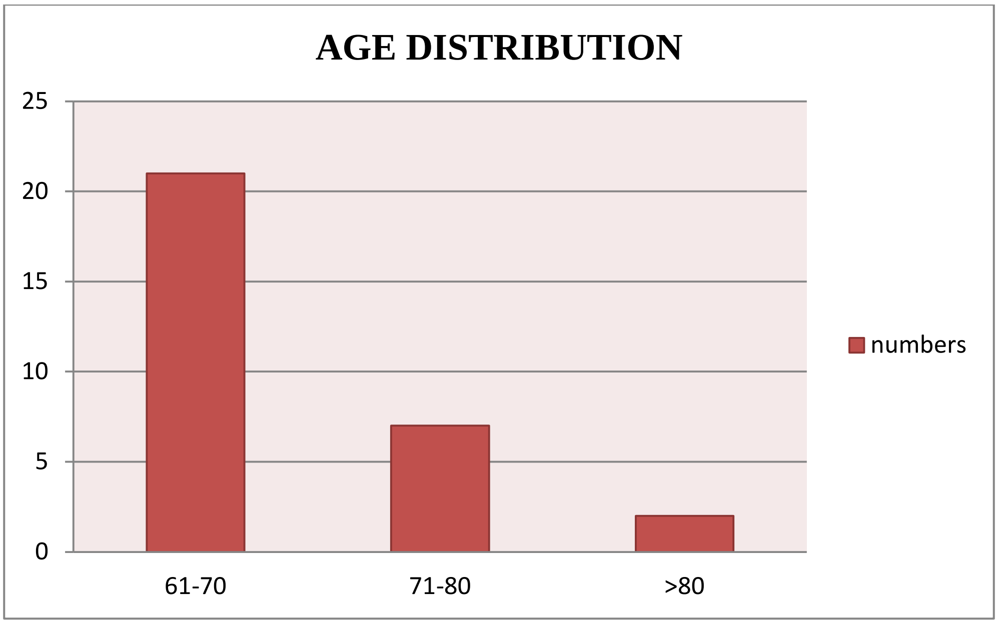


TABLE – 2 SEX DISTRIBUTION

Sex	**No. of patients**	**Percentage**
Males	19	63.33
Females	11	36.66

Table-2 shows the sex distribution pattern of the study patients. Most of the patients were found to be male

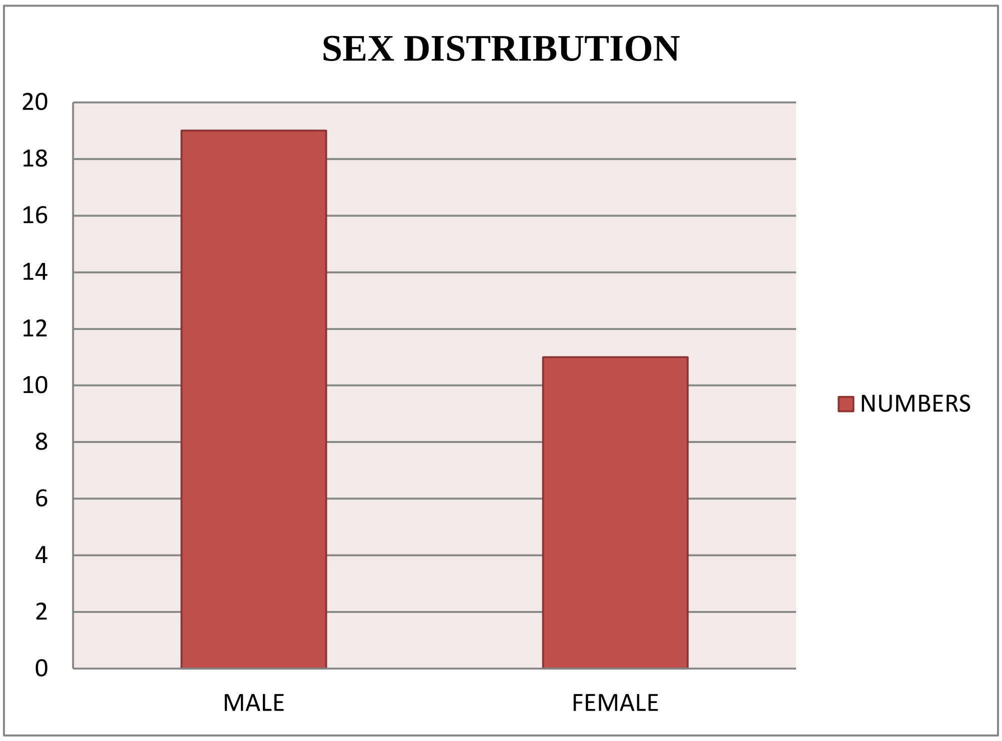
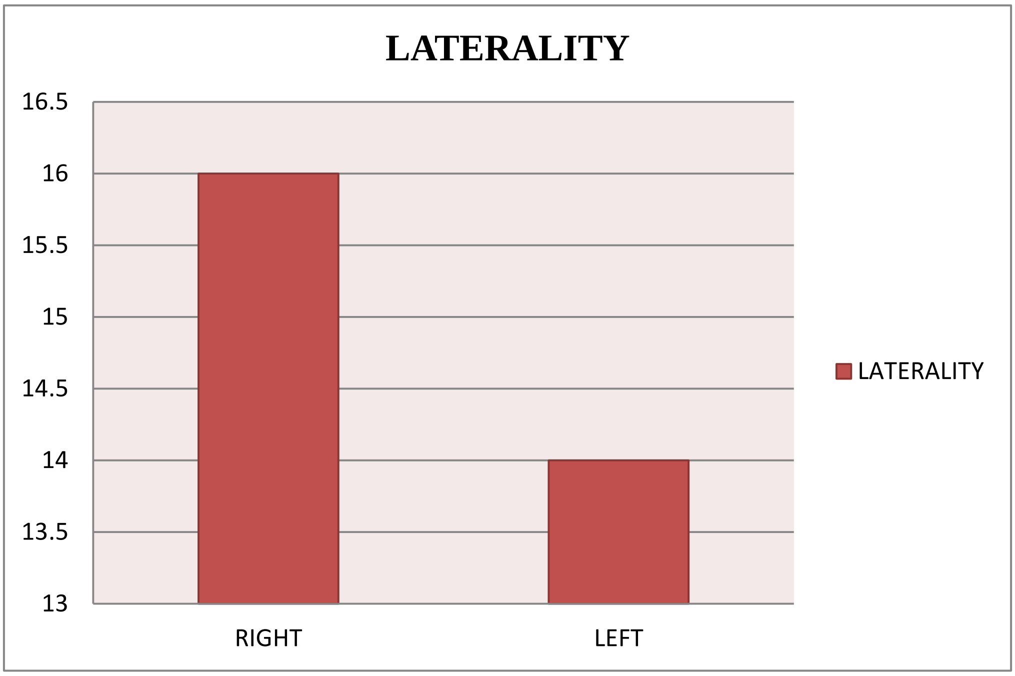


TABLE – 3 LATERALITY

Side affected	No. of patients	Percentage
Right	16	53.3
Left	14	46.6

Table – 3 shows the laterality pattern



Patients with left side being affected in 47% , with right side about 53 %

TABLE – 4 MODE OF INJURY

Mode of Injury	No. of patients	Percentage
Tripping/slipping	20	66.66
RT	6	20
Fall from a height	4	13.33

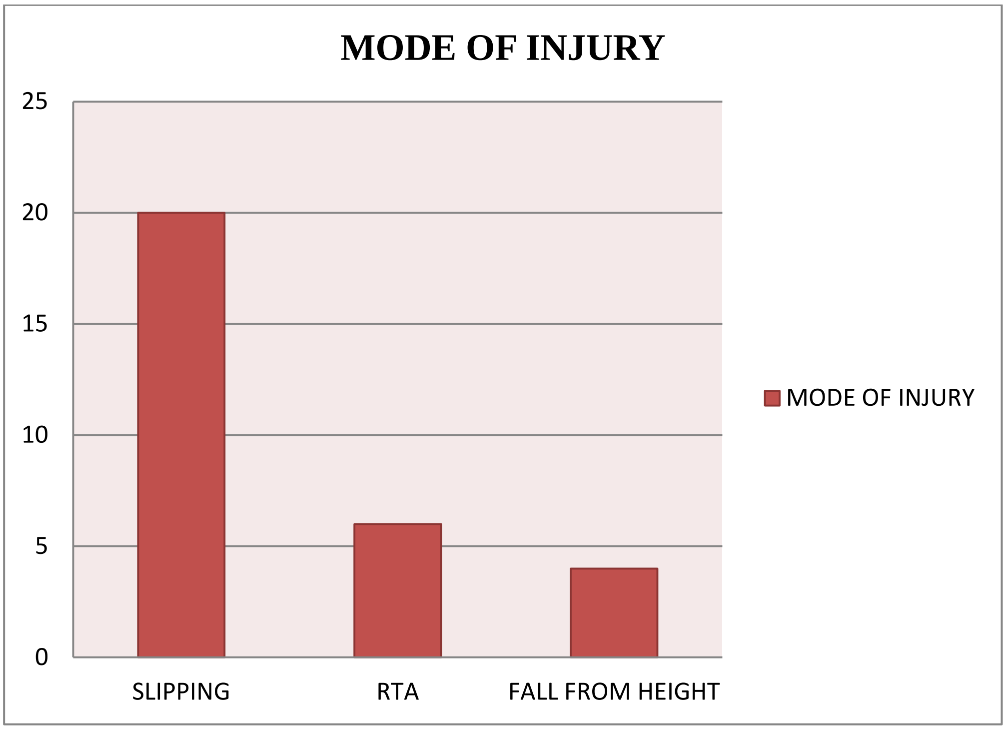


Table-4 depicts the mode of injury causing the fracture of the neck of femur. 66.66% of the patients sustained the injury by tripping or slipping, 20% due to RTA and the remaining 13.33% by a fall from a height.

Observation and Results

OBSERVATION AND RESULTS:

Out of 34 patients, only 30 patients came for the follow up. Data was collected with respect to history, clinical examination, radiological examination and fluoroscopy examination. The patients who have completed post op period minimum of 2 years included in the study.

Prosthesis: Talwaker Type

TABLE – 5 RADIOLOGICAL TYPE OF FRACTURE

Radiological Type	Number of Patients	Percentage
Trans-cervical	24	80
Basicervical	4	13.3
Sub-capital	2	6.66

Table – 5 shows that the majority of study patients (80%) had a trans- cervical type of fracture basicervical – 13.3 % and sub- capital fractures – 6.66% .

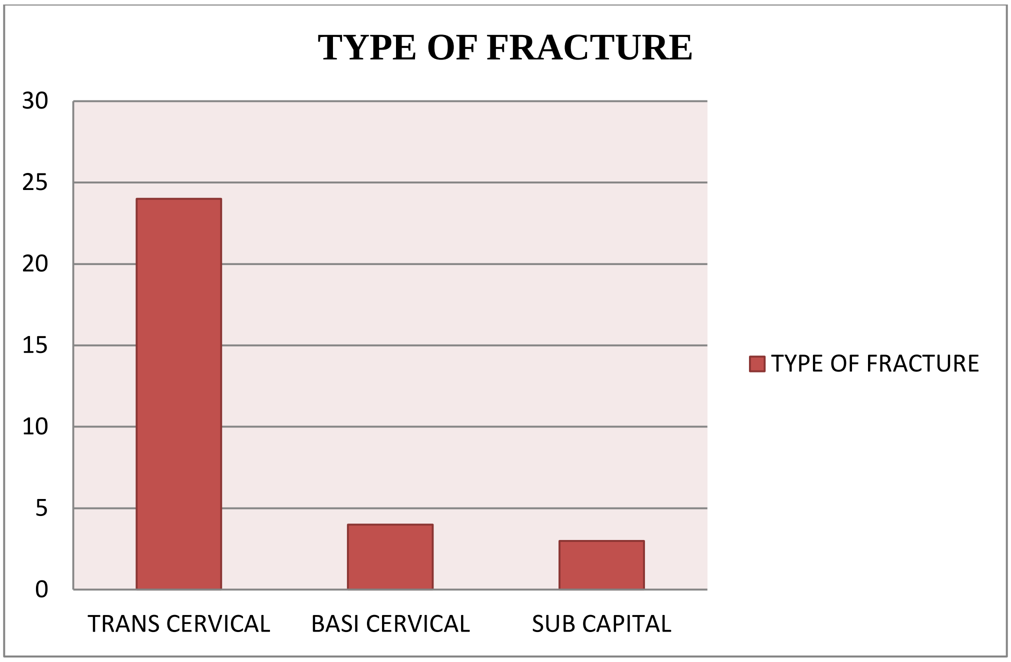


TABLE – 6 SIZE OF PROSTHESIS

Size of the prosthesis	No. of patients	Percentage
39 mm	2	6.66
41 mm	4	13.33
43 mm	7	23.33
45 mm	10	33.33
47 mm	4	13.33
49 mm	2	6.66
51 mm	1	3.33

Table - 6 Depicts that the most commonly used prosthesis size was 45mm followed by 43mm, 47mm and 41mm and 47 mm

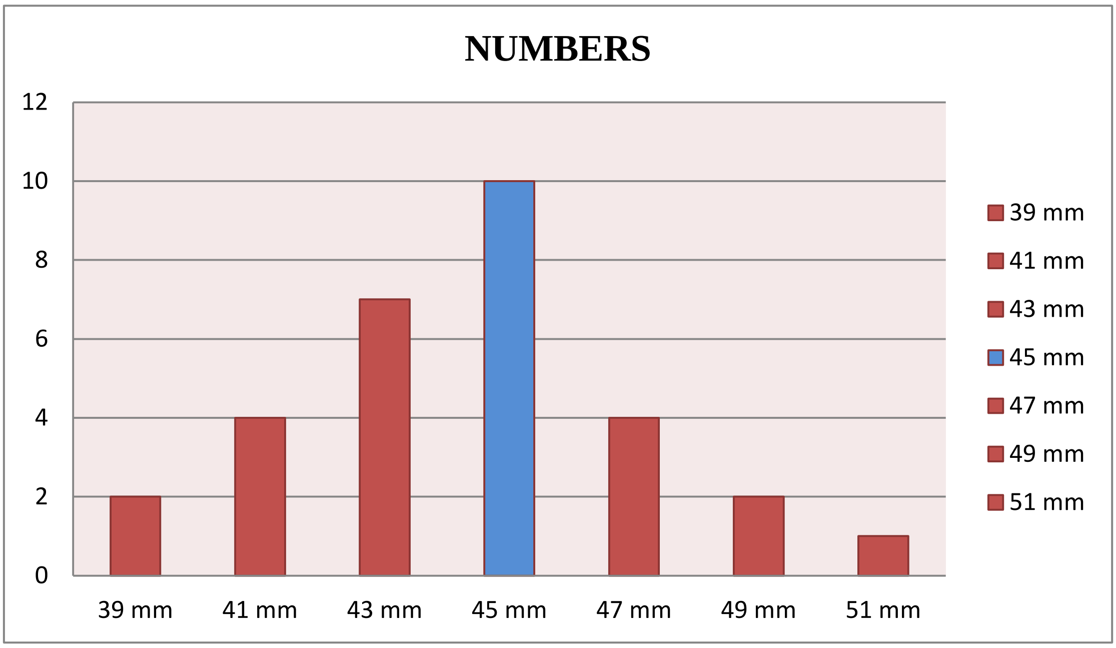
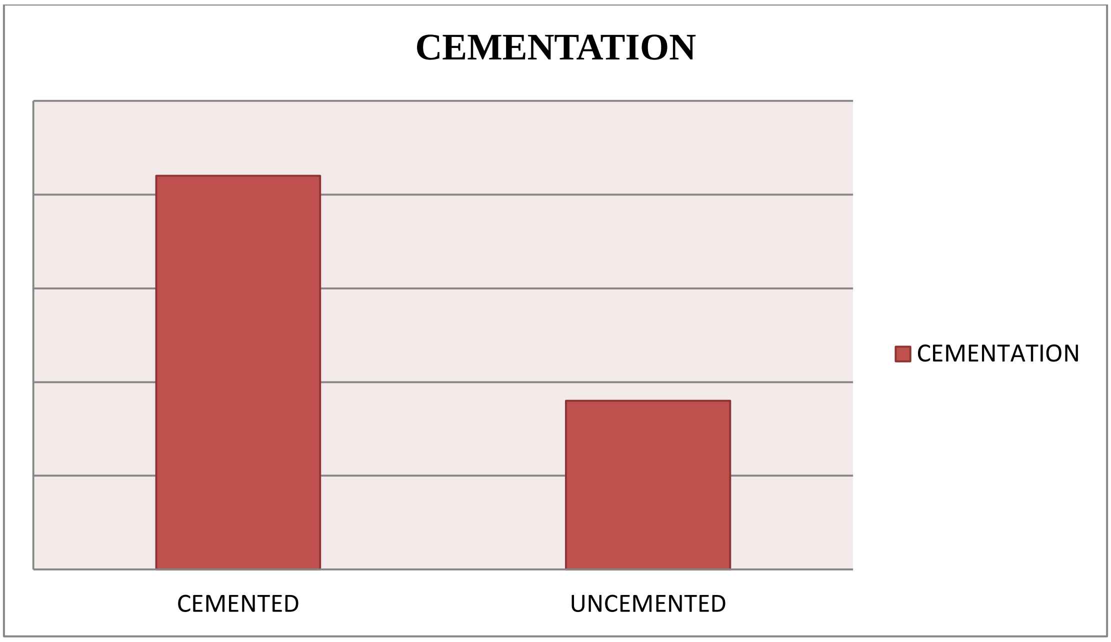


TABLE – 7 CEMENTED VS UNCEMENTED

Cemented/ not	No. of patients	percentage
Cemented	21	70
Uncemented	9	30



In this study, 21 patients were cemented, 9 pateints were uncemented.

TABLE – 8 COMPLICATIONS

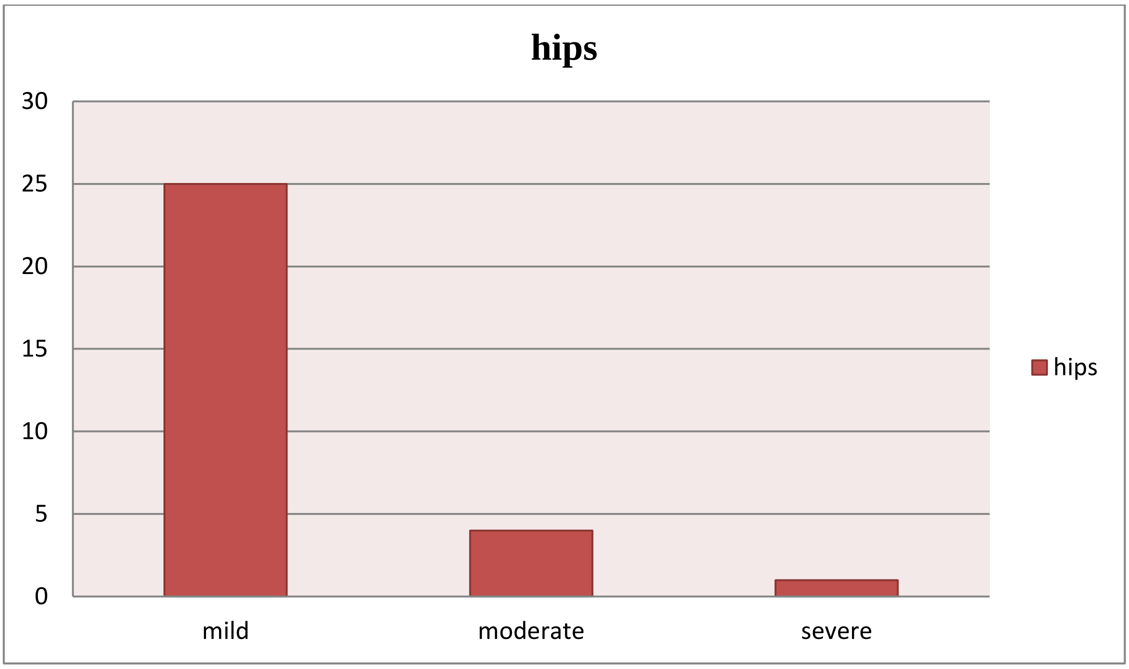
Complications	No. of patients	Percentage
Limb	2	6.66
Shortening < 2 cm	5	16.66

Limb lengthening (< 1cm) was observed in two patients (6.66%), limb shortening > 2 cm observed in 5 patients(16.66%) post- operatively due to technical errors in the form of the prosthesis sitting proud of the calcar.

ANALYSIS OF THE HARRIS HIP SCORE

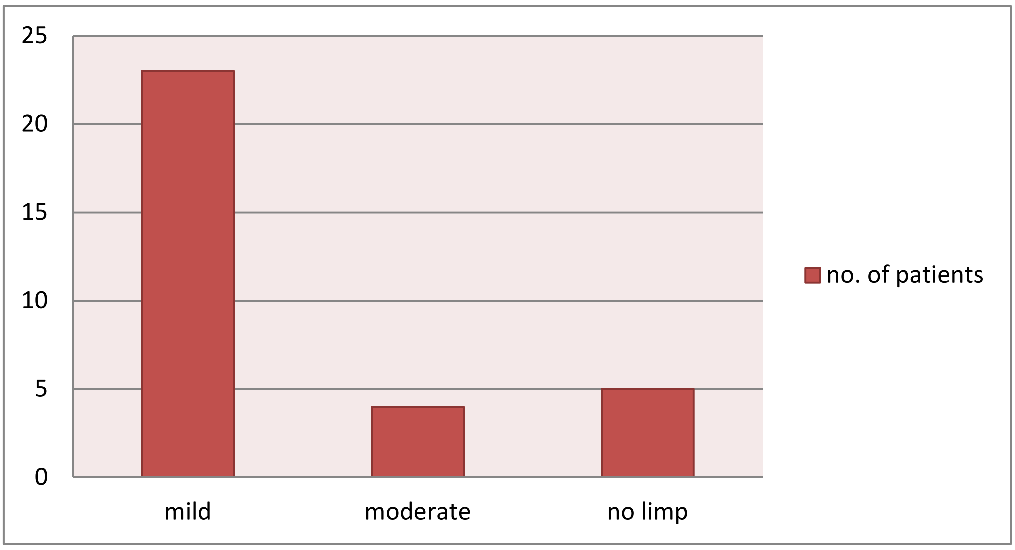
Pain – At the final follow-up, 25 patients (83.33%) had slight, occasional, no compromise in activities while 4 patients (11.66%) had mild pains with no effect on average activities. Our study compares favourably with other standard studies evaluating pain relief with Bipolar Hemiarthroplasty

Pain	**No. of patients**	**Percentage**
Mild pain	25	83.33
Moderate pain	4	13.33
Severe pain	1	3.33



Gait Analysis

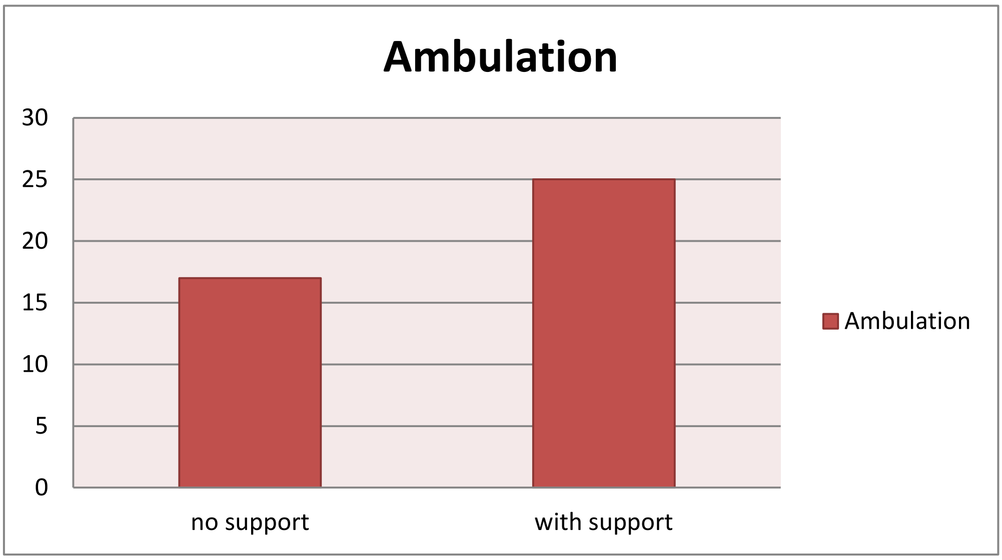
Limp	**No. of patients**	**Percentage**
Mild	23	76.66
Moderate	4	13.33
No limp	3	10



23 (76.66%) of the study patients had slight limp while 4 patients (13.33%) had a moderate limp.

Ambulation:

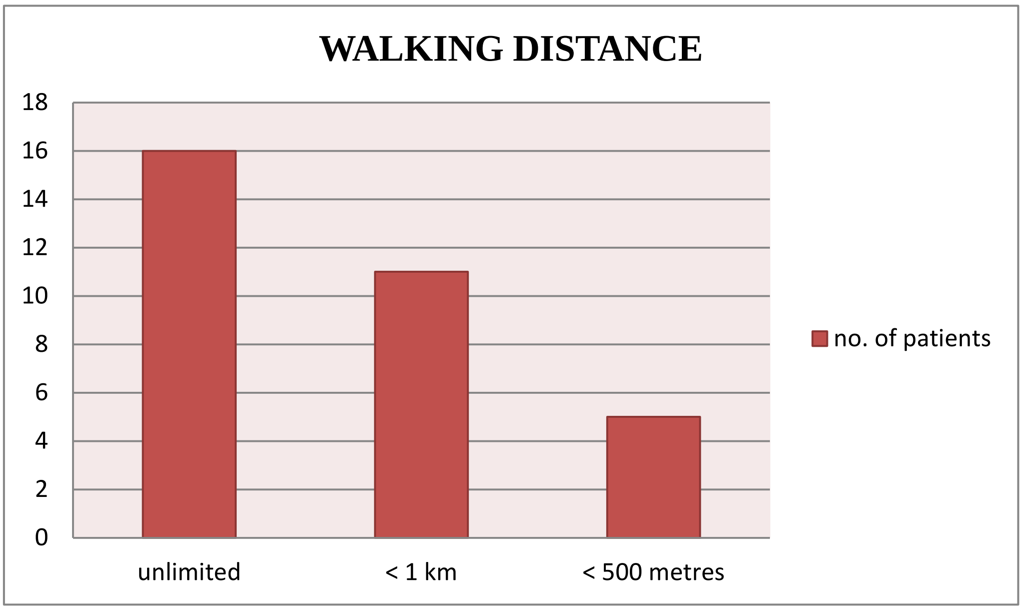
Ambulation	**No.of patients**	**Percentage**
Without support	17	56.66
With support	13	43.33



17 patients (56.66%) were found to be ambulating without the help of any support and the remaining 13 patients (43.33%) needed some support in the form of a cane or walker for long walks.

Walking Distance

Distance	No. of patients	Percentage
unlimited	16	53.33
<1 km	11	36.66
< 500 metres	3	10



16(53.33%) of the study patients could walk an unlimited distance at any given point of time while 11 patients (36.66%) could walk no more than 1000 meters at a time and 3 patients (10%) could only manage 500 meters at a time.

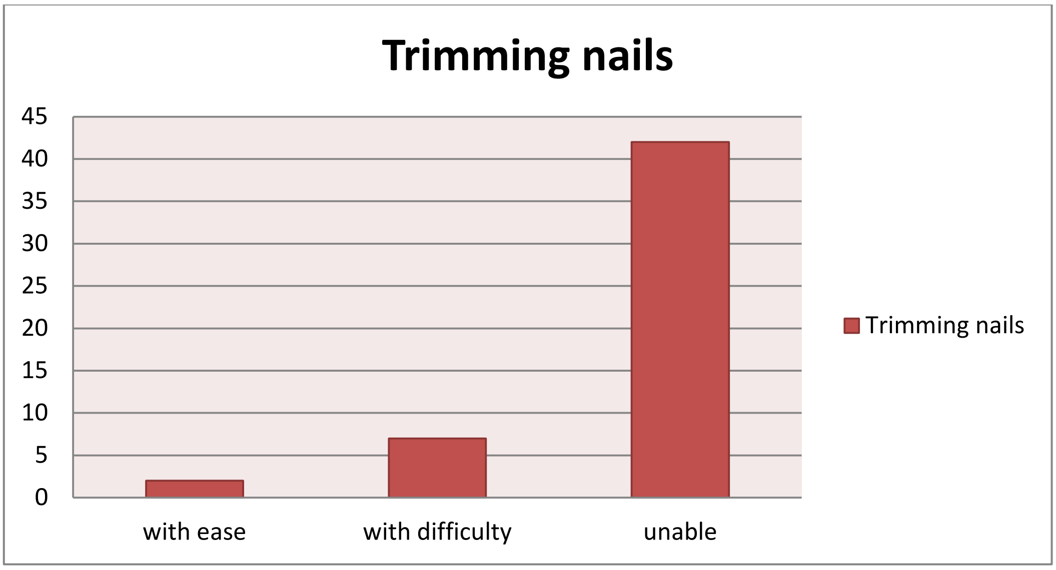
Climbing Stairs

Climbing stairs	**No. of patients**	**Percentage**
Without support	6	20
With support	22	73.33
Not able to climb	2	6.66

Activity – On evaluation of the patients ability to climb stairs it was found that 6 patients (20%) were able to climb stairs without the use of any support or railing while the remaining 22 patients (73.33%) were able to do so with the support of the railing, 2 patients (6.66%) not able to climb .

Ability to trim nails:

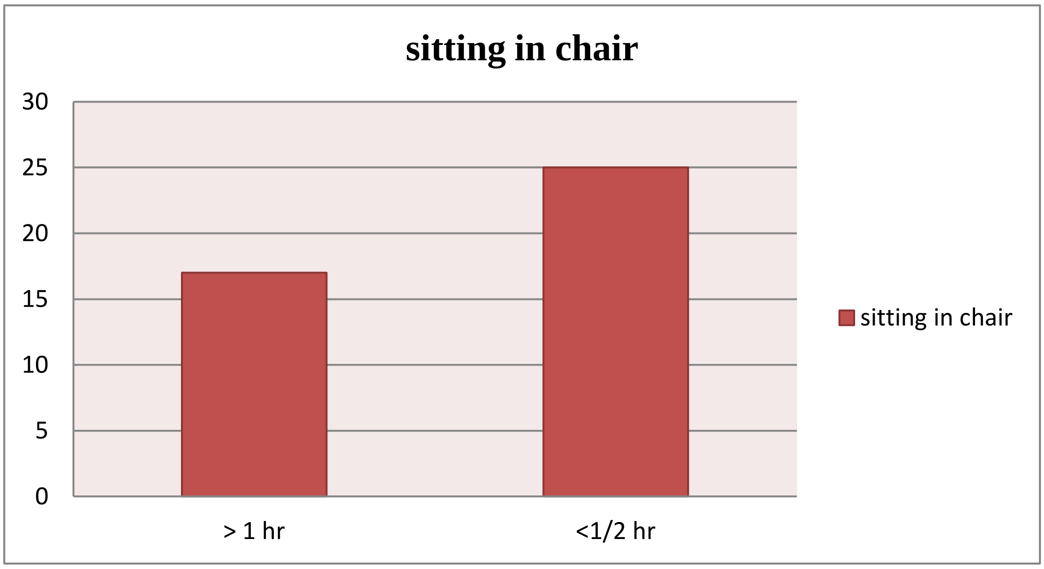
Trimming nails	**No. of patients**	**Percentage**
Able to do with ease	2	6.66
Able to do difficulty	7	23.33
Not able to do	21	70



Our patients did not have the habit of using shoes and socks, their ability to trim their toe nails was used as a parameter for evaluation. It was found that 2 patients (6.66%) were able to trim their toe nails without any difficulty while 7patients (23.33%) found it difficult to do so, 21 patients (70%) not able to do.

Ability to sit long duration on chair:

Ability to sit	**No. of patients**	**Percentage**
>1 hour	17	56.66
< 1/2 hour	13	43.33

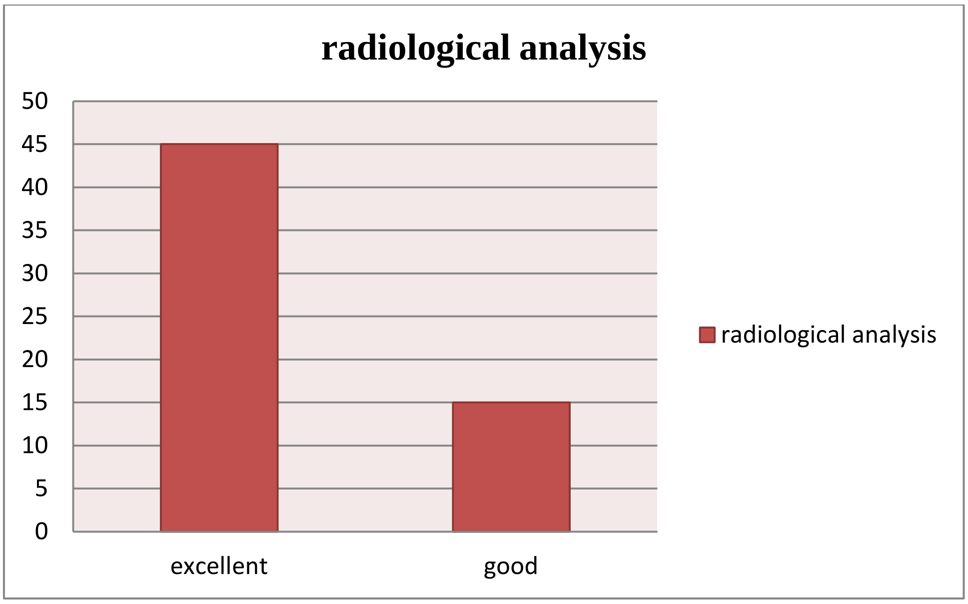


With regards to the ability to sit for a long duration it was found that 17 (56.66%) of the study patients were able to sit comfortably on a chair for upto one hour while 13 patients (43.33%) were not able to sit on a chair for more than half an hour at a stretch..

Evaluation of deformities - None of the 30 study patients had fixed deformities. 2(6.66%) of the patients had post-operative limb lengthening by 1 cm. 5 patients(16.66%) have shortening < 2.5 cm

RADIOLOGICAL PARAMETERS:

On analyzing the anteroposterior view x ray of pelvis with hip in 15 degrees of internal rotation. It was found that 75 percent patient had good results, 25 percent patients with excellent results.



FLUOROSCOPY ANALYSIS:

On analysis of fluoroscopy in continuous mode it was found that , patient supine position

Interprosthetic movement	**Our study**	**J PHodgkinson**
Yes	83.33 percent	82.6 percent
No	16.66 percent	17.4 percent

In our study 83 percent of patients had inter prosthetic movements.

Interprosthetic movement	**Percentage**
4-5years	66.66percent
3-4 years	80 percent
3-2 years	89.4 perecnt

In general the interprosthetic movements seems to decrease as years pass on.

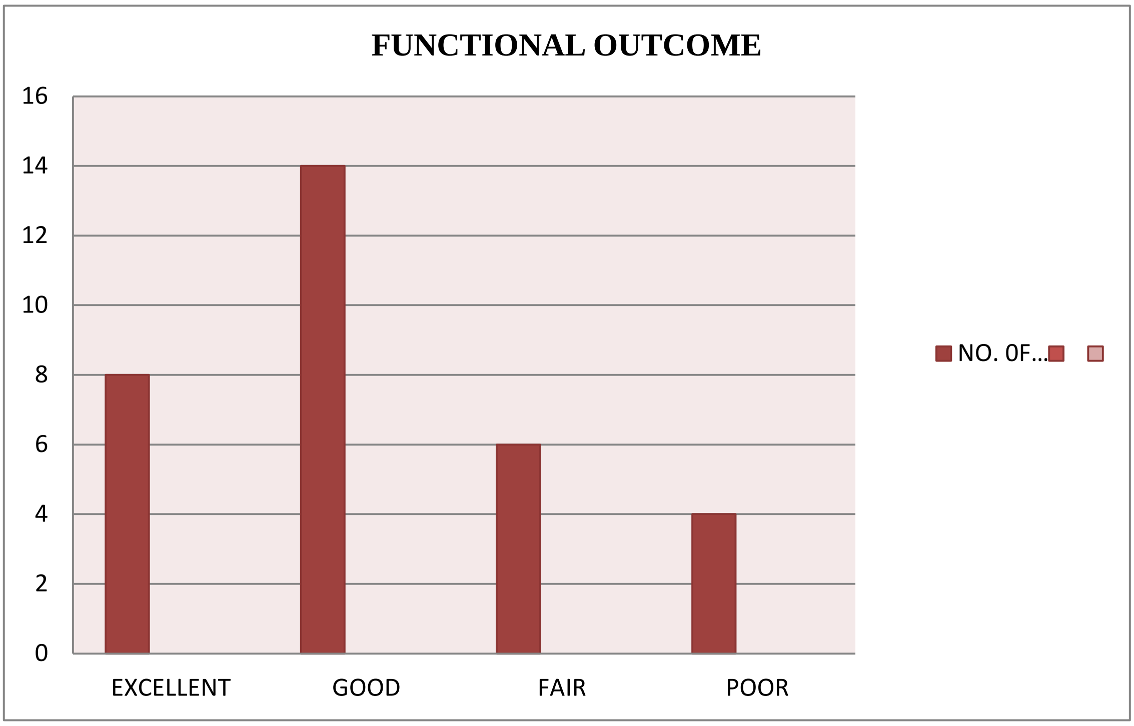
HARRIS HIP SCORE

Harris Hip Score evaluated at maximum follow-up averaged 85.68 with the maximum score being 95 and the minimum score being 65.8. Overall, 8 patients (26.66%) achieved Excellent result, 14 patients (46.66%) achieved Good result, 6 patients (20%) achieved fair result and 2 patients (6.66%) achieved poor result.

FINAL HARRIS HIP SCORE AND CLINICAL RESULT

Grade	Harris Hip Score	No. of patients	Percentage
Excellent	90-100	8	26.66
Good	80-89	14	46.66
Fair	70-79	6	20
Poor	<70	2	6.66

In our study 73.32% of the patients achieved an excellent or good result.



COMPARISON OF OUR CLINICAL RESULT WITH OTHER STUDIES

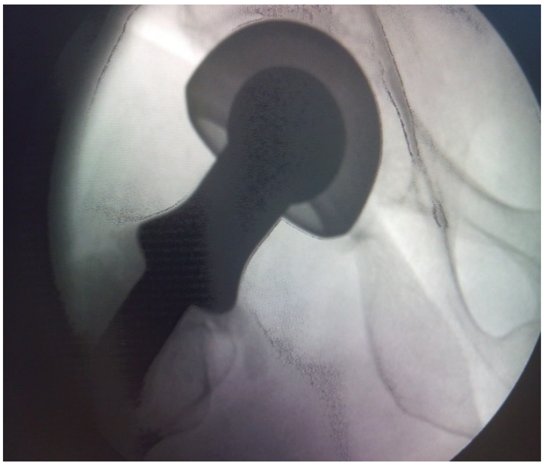
Grade	Our study	Moshein[103]	Lestrange study[104]
Excellent	26.	40	39.6
Good	46.	25	31.2
Fair	20	23	15.3
Poor	6.	12	13.9

Table shows the comparison of the present study with other studies. The results obtained with bipolar hemiarthroplasty in the current study are comparable with standard studies. Although the excellent are comparatively less than standard studies. It was found that our patients associated with comorbids, late presentation to hospital, delay in getting the patients for surgery and associated has influenced the outcome.

Case illustrations:

Case 1

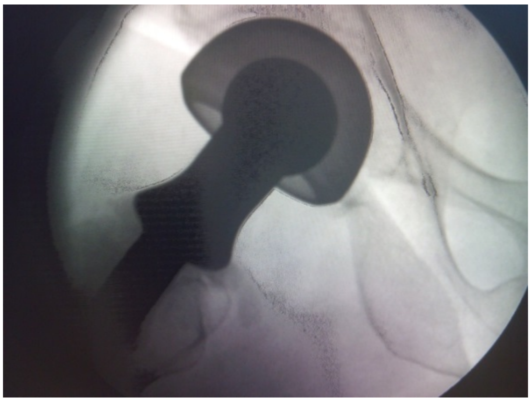
Case 2:

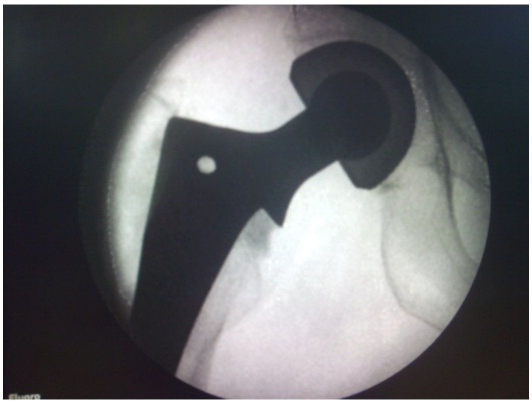


Case 3 :

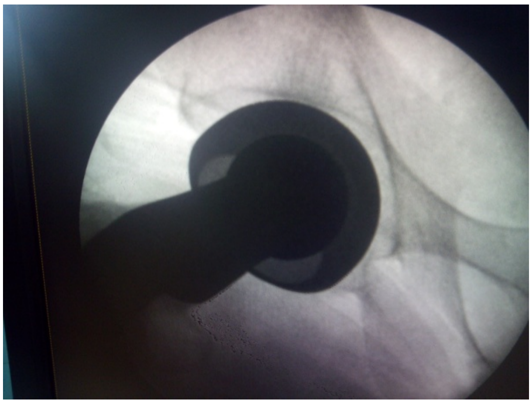

Fluoro
97 KVP
4.0 mA

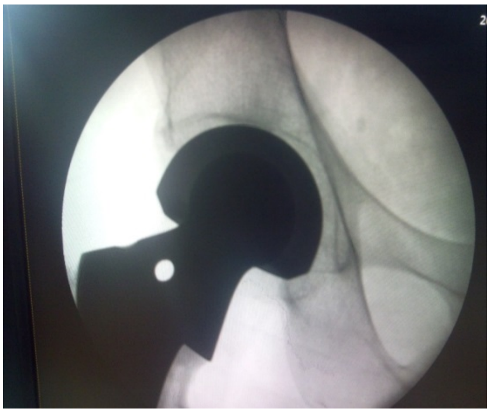
Case 4 :





Case 5:





Discussion

DISCUSSION

The aim of replacement surgery in fracture neck femur is early return to daily activities. This is particularly applicable to the elderly age group where complications need to be prevented.

The mean age of the patients in the present study was 65 years. The aim of assessing age is to estimate the patient's mean survival time and their ability to comply with rehabilitation protocol. Patients with hip fractures have an increased mortality rate during the first year after fracture but after one year the mortality rate is comparable to that of the general population. The results of our study showed that age of the patient had minimal influence on the final clinical result.

- In our study males affected in higher numbers.
- Right side more commonly affected than the left
- Majority of our study patients (66.66%) sustained the injury due to a trivial trauma like tripping or slipping. This is a very common occurrence in elderly population where poor vision and lack of neuro-muscular coordination is a problem.
- 36.62 % of the patients were brought to the hospital within 24 hours of the injury while 43.33% presented for treatment within 24 hrs - 72 hrs. This is a common scenario in our country where

patients present to a doctor much late given the seriousness of the condition.

- All of our study patients had a displaced fracture of the neck of femur. Majority of the patients (80%) had a trans-cervical fracture. The anatomical type of fracture and the displacement did not have any bearing on the final function.
- All patients were operated after being put into lateral decubitus position by the lateral approach or posterior approach of Moore. The lateral approach was preferred because of the familiarity of most of the surgeons at our institution with the approach.
- The size of the prostheses used, in general matched well with the pre- operatively measured size of the head as assessed by X-rays. In 33.33% of the cases 45 mm prostheses were used. This was followed in frequency by 43 mm (23.33%), 47 mm (13.33%) and 41 mm (13.33%) prostheses in the order of frequency
- Limb lengthening (<1 cm) was observed in 2 patients (6.66%) , limb shortening(<2 cm) observed in 5 patients (16.66%) post- operatively due to technical errors in the form of the prosthesis sitting proud of the calcar.

- The minimum duration of hospital stay amongst the study patients was 16 days and maximum duration was 39 days with the average being 22 days. Average hospital stay of 21 days with bipolar hemiarthroplasty has been reported by Lestrange.[104] Drinker and Murray have reported an average hospital stay of 23 days with the same procedure.[107]
- There were no late postoperative complications like loosening, dislocation, erosion, secondary osteoarthritis, protrusio acetabuli or periprosthetic fracture in our study.
- All the patients who completed a 2 years year follow-up were included in the final analysis. The Harris Hip Scores, radiological parameters, fluoroscopy analysis were done in order to find out any correlation that exists between these parameters.
- With radiological parameters analysis, 75 percent had good results, 25 percent had excellent results. The radiological parameters which we analysed attached in the annexure.
- There is no correlation between the functional outcome and radiological outcome.
- On fluoroscopy study, in 86.66 percent of patients there were some interprosthetic patients, in 13.33 percent of patients no interprosthetic movements occurred.

- We found that intreprosthetic movements seen more in the rotatory movements.
- The interprosthetic movements seems to decrease as years passes on.
- There is no correlation between functional outcome and interprosthetic movements.
- In our study, the final Harris Hip Score as evaluated at maximum follow-up averaged 85.68 with the maximum score being 93 and the minimum score being 65.8. Overall, 8 patients (26.66%) achieved Excellent result, 14 patients (46.66%) achieved Good result, 6 patients (20%) achieved fair result and 2 patients (6.66%) achieved poor result. Overall, 73% of the patients achieved an excellent or good result. Our results are comparable with other studies of bipolar hemiarthroplasty performed for fracture neck femur.
- Although the excellent results are comparatively less than other studies,it was found that our patients associated with comorbids, late presentation to hospital, delay in getting the patients for surgery had influenced the outcome.
- All the patients were also evaluated towards level of satisfaction with the procedure and their ability to return to pre-fracture

level of activity, 36.36% were ‘very satisfied’, 45.45% were ‘fairly satisfied’ and 18.18% were ‘not satisfied’. The level of satisfaction being a subjective assessment did not correlate well with the Harris Hip Score which was an objective assessment.

- Our study is not without its shortcomings. our duration of follow- up of minimum two year and maximum five years is a short term study in assessing the longevity and functional endurance of the prosthesis used.

Conclusion

CONCLUSION

- Bipolar hemiarthroplasty for fractures of the femoral neck provides freedom from pain and more rapid return to unassisted activity with an acceptable complication rate.
- The end functional results depend on the associated co- morbidity and optimum post-operative rehabilitation.
- There is no correlation between functional outcome and interprosthetic movements also radiological outcome.
- Our study patients has good radiological outcome with significant interprosthetic movements, bipolar seems to be a cost effective prosthesis in active elderly individuals.
- Similar study on long term follow up would provide more affirmative findings.

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Annexures

PROFORMA

Patient’s Name :
Age:
Sex:
Occupation:
Address:

Contact no:
Date of Injury:
Mode of Injury:
Date of admission:
I.P.No:
Diagnosis: (gardens classification)

Treatment given on admission:

Investigations : Complete haemogram ,
Blood urea,sugar,Sr.Creatinine
Bleeding time and clotting time
ECG
Chest X-ray
Plain X-ray AP and Lateral view of the affected limb

Associated illness :

Plan:

Date of surgery:

Time delay for surgery:

Procedure done:

Implants used:

Intra operative complications if any:

Post operative complications:
Immediate:

Delayed:

Late:

Post operative mobilisation started at:

Post operative weight bearing started at:
Partial:
Full:

Follow up:
Evaluated with AP view of pelvis – radiological assessment and harris hip score, c- arm examination

Immediate post op
4 weeks post op
8 weeks post op
3 months post op
6 months post op

C- ARM EXAMINATION:

Timing of examination :

Method of examination :

MOVEMENT	**polarity**
Flexion	
Adduction	
Abduction	
Internal rotation	
External rotation	

Inference of examination :

Any other findings:

RADIOLOGICAL ASSESSMENT :

Timing of assessment :

EXCELLENT – No joint space
Narrowing
No medial migration
No superior migration
No sclerosis

GOOD - Joint space narrowing
No medial migration
No superior migration
Subluxation < 1/4th of head
Slight sclerosis

FAIR - Complete loss joint space

Migration < 1cm
Subluxation > 1/4th diameter
No dislocation
Moderate pelvic reaction

POOR - Complete loss of joint space
Migration > 1 cm
Dislocation
Pelvic discontuity or severe sclerosis

HARRIS HIP SCORE

Pain

- None or ignores it (44)
- Slight, occasional, no compromise in activities (40)
- Mild pain, no effect on average activities, rarely moderate pain with unusual activity; may take aspirin (30)
- Moderate Pain, tolerable but makes concession to pain. Some limitation of ordinary activity or work. May require Occasional pain medication stronger than aspirin (20)
- Marked pain, serious limitation of activities (10)
- Totally disabled, crippled, pain in bed, bedridden (0)

Limp

- None (11)
- Slight (8)
- Moderate (5)
- Severe (0)

Support

- None (11)
- Cane for long walks (7)
- Cane most of time (5)
- One crutch (3)
- Two canes (2)
- Two crutches
- Not able to walk (0)

Distance Walked

- Unlimited (11)
- Six blocks (8)
- Two or three blocks (5)
- Indoors only (2)
- Bed and chair only (0)

Sitting

- Comfortably in ordinary chair for one hour (5)
- On a high chair for 30 minutes (3)
- Unable to sit comfortably in any chair (0)

Enter public transportation

- Yes (1)

o No (0)

Stairs

o Normally without using a railing (4)

o Normally using a railing (2)

o In any manner (1)

o Unable to do stairs (0)

Put on Shoes and Socks

o With ease (4)

o With difficulty (2)

o Unable (0)

Absence of Deformity (All yes = 4; Less than 4 =0)

Less than 30° fixed flexion contracture	Yes	No
Less than 10° fixed abduction	Yes	No
Less than 10° fixed internal rotation in extension	Yes	No
Limb length discrepancy less than 3.2 cm	Yes	No

Range of Motion (*indicates normal)*

Flexion (*140°) _____
Abduction (*40°) ________
Adduction (*40°) ________
External Rotation (*40°) ___
Internal Rotation (*40°) _____

Range of Motion Scale

211° - 300° (5)	61° - 100 (2)
161° - 210° (4)	31° - 60° (1)
101° - 160° (3)	0° - 30° (0)

Range of Motion Score ____________

Total Harris Hip Score ____________

At maximum period of follow up

FUNCTIONAL ASSESSMENT :

Radiological assessment:

c-arm assessment :

Harris hip score:

Overall the patient has _______functional outcome

S.NO	patient number	**AGE** 60-70 -1 71-80 -2 >80 -3	**GENDER** male -M female -F	**SIDE** Right-R left -L	MODE OF INJURY Slipping -1 Rta -2 Fall from height -3	**PRESENTATION** <24 HRS -1 24-72 HRS -2 72HRS- 1 WK -3 > 1 WEEK - 4	**TYPE OF #** Transcervical- 1 Basicerical -2 Subcapital-3	**PROSTHESIS SIZE(IN MM)**	**CEMENTING** YES -1 NO -2	**RADIOLOGICAL EXCELLENT-1 GOOD -2**	**FLUROSCOPY BIPOLAR -1 UNIPOLAR-2**	**HARRIS HIP SCORE EXCELLENT -1 GOOD -2 AVERAGE -**
1	1	1	M	R	1	1	1	45	2	2	1	1
2	2	2	F	L	2	2	1	43	1	1	1	3
3	3	3	M	R	3	4	1	45	1	2	1	2
4	4	1	M	L	1	1	3	45	1	1	1	3
5	5	1	F	R	1	2	1	41	2	1	1	1
6	6	1	M	L	2	2	1	45	1	2	1	4
7	7	2	F	R	1	1	1	39	2	1	1	2
8	8	1	M	L	1	2	1	43	1	1	1	1
9	9	1	M	L	1	1	1	43	2	1	2	1
10	10	1	M	R	2	4	3	45	2	1	1	3
11	11	1	F	L	1	2	1	41	1	2	1	2
12	12	2	M	L	3	2	1	45	1	1	1	2
13	13	1	M	L	2	1	1	47	1	1	1	2
14	14	1	F	R	1	3	2	43	1		1	2
15	15	1	M	L	1	2	1	51	1	1	1	3
16	16	1	F	R	1	2	1	45	2	2	1	1
17	17	1	M	R	1	1	1	41	1	1	2	2
18	18	2	M	L	3	3	1	49	1	1	1	2
19	19	1	M	R	1	1	2	47	1	2	1	2
20	20	2	F	L	2	2	1	43	1	1	1	4
21	21	1	M	R	1	2	1	45	2	1	1	1
22	22	1	M	L	1	1	1	49	2	1	1	2
23	23	3	F	R	3	3	2	41	1	2	1	2
24	24	1	M	L	1	2	1	45	1	1	2	3
25	25	1	F	R	2	3	2	43	2	1	1	1
26	26	1	M	L	1	1	1	47	1	1	1	2
27	27	2	M	R	1	2	1	47	2	1	1	2
28	28	1	F	R	1	1	1	39	1	2	1	2
29	29	1	M	R	1	2	1	43	2	1	2	1
30	30	2	M	L	1	1	1	45	1	1	1	3

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Functional outcome analysis of neck of femur fractures treated with bipolar

hemiarthroplasty-

An institutional study

By

Dr.T.KALAIYARASAN., M.B.B.S.,

Under the guidance of

Prof.Dr.R.BALACHANDRAN

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INSTITUTIONAL ETHICAL COMMITTEE
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Ref.No.5098/ME-1/Ethics/2014 Dt:10.07.2014.
CERTIFICATE OF APPROVAL

The Institutional Ethical Committee of Govt. Kilpauk Medical College, Chennai reviewed and discussed the application for approval "A Study of functional outcome analysis of nect of femur fractures treated with bipolar Hemiarthroplasty" – For Project Work submitted by Dr.T.Kalaiyarasan, MS (Ortho), PG Student, KMC / 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.

8/8/14

CHAIRMAN,
Ethical Committee
Govt.Kilpauk Medical College,Chennai

8/8/2014