"STUDY OF FUNCTIONAL OUTCOME OF FRACTURE NECK OF FEMUR IN THE ELDERLY TREATED WITH UNCEMENTED BIPOLAR PROSTHESIS"

BY

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Date : ***Dr. SAIVE SIDDHARTHA***

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LIST OF ABBREVIATIONS USED

AISI	American Iron and Steel Institute
UHMWPE	Ultra High Molecular Weight Poly Ethylene
THR	Total Hip Replacement
HHR	Harris Hip Rating
COPD	Chronic Obstructive Pulmonary Disease

ABSTRACT

TITLE

"**STUDY OF FUNCTIONAL OUTCOME OF FRACTURE NECK OF FEMUR IN THE ELDERLY TREATED WITH UNCEMENTED BIPOLAR PROSTHESIS"**

AIMS AND OBJECTIVES:

To study the functional outcome of fracture neck of femur in the elderly treated with uncemented bipolar prosthesis and to study the associated complications.

METHODOLOGY:

This is a prospective study of primary hemireplacement arthroplasty of the hip done in 30 patients with fracture neck of femur using uncemented bipolar prosthesis who were admitted into the Department of Orthopaedics in R.L.Jalappa Medical College and Research Center, Tamaka, Kolar, from December, 2010 to June 2012.

Follow up was done for a minimum of 6 months. The results were evaluated using the Harris Hip Rating.

RESULTS:

Out of 30 cases included in our study, there were 17 females and 13 males with a mean age of 68 years. 83% of the cases sustained the hip fracture following a trivial trauma. 56% of the hips were of the left side. Among the associated medical conditions hypertension, diabetes mellitus and anemia were common. 20 of the 30 cases were operated within a week following the fracture.

The complications seen were 3 cases of mortality, 3 cases of superficial infection and 2 cases of deep infection. 22 out of 30 cases in this study had no complications following the surgical procedure. There were no cases of dislocation of the prosthesis, no cases of peri-prosthetic fracture nor any case of implant loosening or subsidence.

In this study, 13 cases had excellent results (43.3%), 9 had good results (30%), 3 had fair results(10%) and 2 had poor results (6.6%). Good to excellent results were seen in 73.3% of the cases.

CONCLUSION:

From our study of 30 patients with displaced intracapsular fracture of femoral neck, we conclude that hemiarthroplasty with uncemented bipolar prosthesis in the elderly produces good functional outcomes with minimal complications and has several advantages. These results are comparable to the other similar studies. The functional limitations after surgery were dependent more on the pre-existing medical conditions than on failure of the prosthesis itself.

KEY WORDS: *Hemiarthroplasty, Fracture neck of femur, Uncemented Bipolar prosthesis, Harris Hip Rating.*

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INTRODUCTION

Fracture neck of femur has been recognized since the time of Hippocrates. It commonly affects the frail and elderly population with devastating consequences for the individuals and places high demands over the health care system and society in general.[1]

Fracture of the femoral neck has always presented great challenges to orthopedic surgeons. It is considered an unsolved fracture even today. The incidence of femoral neck fracture is increasing dramatically as the mean age of population increases. It has been predicted that by 2050, the number of hip fractures would triple. As a consequence, hip fractures are a significant cause of morbidity and mortality in all age groups, especially in the elderly. [1]

The earlier practiced treatment of prolonged immobilization jeopardizes the survival of the elderly patient. This led to the era of surgery where the goal was to expeditiously return patients to their pre-injury function and to minimize the complications.

The hip is a weight-bearing joint with more mobility. The goal of surgery is to provide a painless, stable hip with good range of movements. The current procedures have been able to achieve this to a great extent.

The blood supply to the neck and head of femur is precarious.[2] The viability of the head is often doubtful following a fracture. Under these circumstances, we have to choose from internal fixation or hemi-replacement arthroplasty to total hip arthroplasty. Factors that could play a role in decision making include patient age, activity level and associated medical conditions.

Several authors have considered replacement of the femoral head as an alternative to internal fixation due to the frequent development of nonunion, failures of osteosynthesis and avascular necrosis of femoral head.

Since the last 50 years, Austin Moore and Thompsons prosthesis as hemi replacements devices have been extensively used. [3,4] The complications of these prostheses were erosion of the acetabulum, stem subsidence and loosening.

To overcome these complications a new prosthesis came to use in 1970's. It was called "Bipolar endoprosthesis"[5] This prosthesis has an inner metallic head that articulates with an outer metallic head which is lined on the inside by ultra-high density polyethylene liner of varying size. This outer head articulates with the retained articular cartilage of the acetabulum.

In modern days the bipolar prosthesis with or without cement is the most frequently used prosthesis for hemiarthroplasty of hip as a primary procedure as it is always possible to do total hip replacement at a later date. If it is difficult to produce a snug press-fit of the stem in medullary canal and if the bone is osteoporotic, then poly methyl methacrylate bone cement can be used. Some surgeons might opt for a total hip replacement in an older patient, as a primary procedure.

This study is aimed at evaluating the outcome of primary hemiarthroplasty for fracture neck of femur using uncemented bipolar hemiarthroplasty at our centre.

AIMS AND OBJECTIVES

The aims and objectives of our study were

1. To study the functional outcome of primary hemireplacement arthroplasty of hip for femoral neck fracture in the elderly with uncemented bipolar prosthesis.

2. To study the complications of primary hemireplacement arthroplasty of hip with uncemented bipolar prosthesis.

REVIEW OF LITERATURE

The French surgeon Ambrose Pare [6] initially described fractures of the proximal femur in 1564. In 1882, Sir Jacob Astley Cooper [6] was the first to distinguish between intra and extra-capsular fractures of the proximal femur. In those times therapeutic options were few and patients were treated by bed rest.

In 1867 Phillips introduced the concept of traction with the goal to eliminate shortening and deformity. Multiple schemes for traction were devised, but high rates of nonunion encouraged the efforts to achieve reduction and apply forceful impactions as part of the closed treatment algorithm for femoral neck fracture.

Several authors, including Lead Better, Whitman and Speed published methods of closed reduction. Union rate for closed reduction and spica casting from the 1930's was recorded at only 23%.

Attempts at internal fixation date back to as early as 1850. In 1877, Senn [7] made a plea for internal fixation of femoral neck fractures after his canine trials. But this idea was rejected and he reverted back to closed reduction and impaction. He stated that the only cause of non-union in the case of an intracapsular fracture is to be found in our inability to maintain reduction and immobilizion of the fragments during the time required for bone union to take place. Even today the successful treatment of femoral neck fracture is dependent on these principles.[7]

The first to have nailed a hip fracture appears to have been Von Langenbeck in 1850 [8] .Konig in 1875 [8] and Nicolaysen in 1897 [7] advocated the uses of nails in serious cases.

Lexer in 1908, is quoted as being the first to use autogenous bone graft in an attempt to produce union in an ununited fracture.

In 1908, Davis reported the use of ordinary wood screws for the fixation of femoral neck fractures. Similar screws for internal fixation were used by Dacosta in 1907, Delbet in 1919, and Marting and kay in 1920.

In 1916, Hey Hroves [9] initiated the use of his quadra flanges nail. Though it received wide publicity, the most common devices used for internal fixation in the early part of 20th century were bone pegs-crude medullary devices of ivory or bone used to keep the fracture ends roughly aligned.

Phemister was the first to elucidate the problems with union of intracapsular fractures as stemming from disruption of the blood supply to the femoral head (1930).

n 1931, Smith-peterson [10] reported a series of open nailing with triflanged nail, to achieve maximum purchase of both fragments but allow some impaction along fracture line.

In 1961, Garden evolved the idea of cannulated Smith-Peterson nail insertion with low angle insertion designed to capture low on calcar and centrally in the femoral head.

The same three-point fixation concept introduced at the same time is still relevant in the treatment of fracture of femoral neck, even today. Multiple pin constructs, which permitted open or percutaneous fixation of femoral neck fractures, were introduced by Knowles and Moore [11] and were the precursors of today's cannulated screws.

The use of biological and inorganic materials for hip arthroplasty became popular in early 20th century. Deformed or alkylosed joint surfaces were contoured and an interpositional layer inserted to resurface the joint i.e "Interposition arthroplasty". These substances were fascia lata and periarticular soft tissues. Sir Robert Jones used gold foil in 1912 as interpositional layer.

In 1923, Smith-Peterson [12] introduced the concept of "Mould arthroplasty" as an alternative to an interpositional membrane. Glass was chosen as the first mould; later vitallium moulds were introduced and were used extensively until the advent of modern day total hip arthroplasty.

The 1950's saw the advent of the hemiarthroplasty. The Judet [13] arthroplasty featured an acrylic head and a stabilization short intramedullary peg to be placed in the femoral neck.

The Austin Moore[14] and Thompson[15] prosthesis were femoral implants designed to replace femoral head and neck and secured with an intramedullary stem in the femoral shaft. Longer stem allowed transmission of weight bearing forces along the axis of the femur, rather than generating the shear forces of a short stem placed within the femoral neck. All these depended on a press fit fixation and produced varying degrees of femoral bone loss.

But these implants were extensively used during last 50 years and the results were good for sedentary old patients who were not community ambulators and for those who do not stress their hips excessively. But these implants caused some of the problems in younger and physically active patients. The problems faced with these implants were femoral stem subsidence, stem migration proximally due to loosening. On the acetabular side it caused problems like acetabular erosion due to constant friction and lately protrusio acetabuli.

Hence in an attempt to prevent or retard acetabular wear, bipolar prosthesis was introduced in 1974 by James.E.Bateman [16] and Gilberty.[17]

The biopolar prosthesis has an inner metallic head that articulates with an ultrahigh density polyethylene liner of varying size. This liner is covered with the polished metal outer head of the prosthesis that articulates with the acetabular cartilage.

The movement occurs at two places with this prosthesis. The hip motion occurs primarily at the intra prosthetic joint and only secondarily at the metal cartilage interface, minimizing articular friction and acetabular erosion. Hence the polyethylene liner protects the high contact pressures across the inner bearing.

Depending on the implant design, approximately 40 degree of angular motion is available before the neck impinges on the liner. This reduces stress on the prosthesis and prevents dislocation -intrinsic stability.

Due to the movement occurring at two places, it helps in increasing the range of movement.

Shock absorbing character of the ultra-high density polyethylene insert also reduces impact load on acetabulum during weight bearing thus increasing the life span of prosthesis.

This bipolar prosthesis has several advantages over unipolar devices like-

- Decrease in the acetabular erosion.
- Decreased incidence of protrusio acetabuli.
- Decrease in the loosening of the stem and decrease in the stem subsidence.
- Better stability of the implant, preventing its dislocation
- Increase in the range of movements.
- Longer life span of the prosthesis.
- Lower reoperative rate
- Bipolar prosthesis can be revised to total hip arthroplasty by retaining the femoral stem.

This procedure does not cause much tissue disruption as in total hip arthroplasty as it retains the original acetabulam and shows comparable results. [45]

Comparison of cementless and cemented femoral stems in the management of femur neck fractures has revealed that cementless stems have-

- Shorter operative time
- Lesser intraoperative bleeding
- Comparable results in regard to postoperative pain and mobility
- Economical
- Per-operative death risk is significantly decreased in elderly patients with pre-existing cardiovascular problems, with uncemented stems

Gilberty [17] (1983) reported 200 patients in whom bipolar prosthesis was used 92 % had satisfactory results with a Mean Harris Hip Rating of 87 points, the morbidity and mortality also was low.

Devas, Hinves [18] (1983) used bipolar prosthesis in 161 fractured neck of femur and found no acetabular erosion with a four year follow up.

Philips T.W[19] (1987) examined 100 hips treated with Bateman Bipolar prosthesis in 76 arthritic and 24 femoral neck fractures. In 80% of arthritic hips, motion occurred primarily at the prosthetic internal ball and socket and it did not deteriorate with time. But in acute hip fractures that had normal articular cartilage, primary intraprosthetic motion occurred in only 25% and the majority of implants functioned as unipolar in this group. He concluded that motion would occur at the interface where there is the least frictional resistance; this is the difference between arthritic and fractured hips.

Lausten[20] (1987) examined 75 patients with 77 bipolar prosthesis. Functionally the result was excellent or good in about 75% of the active ambulators. They concluded that since the acetabular erosion and protrusion appears to have been reduced biopolar prosthesis is found to be a good alternative to conventional hemiarthroplasty in elderly patients with a fracture of the femoral neck.

Yamagata M et al[21] (1987) did a retrospective review of 1,001 hip hemiarthroplasties. The prosthetic designs were grouped into fixed-head types (682 cases) and bipolar types (319 cases) for comparison. The main indications for operation were femoral neck fracture and avascular necrosis of the femoral head. They concluded that the bipolar type appears to be indicated in younger and more active patients, whereas the fixed-head design is more suitable for older patients with femoral neck fractures.

Bochner RM et al[22] (1988) reviewed with special emphasis on prosthetic motion in 120 bipolar replacements of femoral head that was done for the treatment of a fracture of femoral neck. The roentgenograms demonstrated the presence and maintenance of motion at both bearing surfaces.

Rae et al [23] (1989) studied hasting bipolar prosthesis in 54 patients for fracture neck of femur. He observed good or excellent results in 64.8%. He also concluded that the poor results were due to poor preoperative mobility and associated system problems.

Wetherall et al[24] (1990) in their 10 years prospective study treated 546 fracture neck of femur patient with hasting bipolar prosthesis and noted that 95% had no pain or slight pain only. Comprision with an earlier series of conventional hemiarthroplasty in their institute showed the clinical results were similar, but the erosion rate had been halved.

Lestrange .N.R[25] (1990) studied 496 patients with bipolar prosthesis over a period of 14 years. His study showed the bipolar prosthesis offered significant improvement over internal fixation in reducing the morbidity and mortality. Additionally it offered advantages over the one-piece prosthesis in terms of fit, decreased erosion and improved function.

Bateman J.E et al[26](1990) study on long term results of Bipolar arthroplasty was done in a total of 1213 hips with follow up of 15 years. Studies of the acetabulum showed healthy bone preservation as long as 15 years after surgery.

La Belle L.W et al[27] (1990) studied 128 patients who were treated with cemented Bateman universal proximal femoral bipolar hemiarthroplasties when compared with studies of noncemented Moore and Thompson fixed head prosthesis, showed that the cemented Bateman bipolar prosthesis had decreased protrusion and less pain.

Gallinaro et al [28] (1990) performed bipolar hemiarthroplasty in 88 patients. They observed 63% good function with no visible protrusion or socket wear radiologically and excellent mobility in 86%.

Torisu et al[29] (1990) performed bipolar hemiarthroplasty in 37 patients for acetabular deficiency like rheumatoid arthritis after bone grafting, reconstruction of malunited bony ankylosis, and revision of failed total hip, dysplastic osteoarthritis. They found usefulness of the expanded application of this prosthesis.

William[30] (1990) reported uniform patient and physician satisfaction and found that the Bipolar prosthesis is easy to insert, fits well, and preserve the aectabulum. In none of their cases showed significant acetabular erosion & protrusion acetabuli.

Garrahan et al (1990) [31]found that Bipolar has less pain and less incidence of acetabular erosion as compared to Moore's & Thompson

prosthesis, after 8 years continuous use of bipolar prosthesis in more than 500 hips. They concluded that the bipolar prosthesis can more appropriately be used in patients who are community ambulators and whose likelihood of success with internal fixation is low.

James[32] et al (1991) in their study of hemiarthroplasty of 323 hips over 7 years with bipolar prosthesis, found no erosion of the acetabulum and advised considering the use of this prosthesis in active young patients.

A meta-analysis by Lu-Yao[33] (1994)compared unipolar with bipolar hemiarthroplasties, they found the rate of reoperation for patients with unipolar was double that of patients who had bipolar. Ambulatory capacity and pain relief also was better in patients with bipolar hemiarthroplasties.

Suryabhan[34] (1995)compared 36 Austin Moore prosthesis with 32 bipolar prosthesis for fracture neck of femur and found 77.8% excellent to good results in Austin Moore group and 90.6% excellent to good results in bipolar group. He concluded that bipolar prosthesis offers better stability, more rapid rehabilitation, and decreased complication at the acetabular side.

Chen TH [35] et al (1998) have done a retrospective study to evaluate the incidence of heterotopic ossification in cemented and uncemented femoral neck fractures treated with Bateman Bipolar hemiarthroplasty. The authors found, after an average follow-up of 46 months, that there was more heterotopic ossification in the cemented group, which also had an increase in surgical time and increased blood loss.

Maricevic et al [36] (1998) did a study to determine effectiveness of bipolar prosthesis in elderly patients with femoral neck fractures in 152 patients. Excellent results were reported in 82%, good in 14.3% and fair

in 13.6%.They concluded that bipolar hemiarthroplasty is the method of choice in elderly patients with femoral neck fractures.

Henning[37] (1999) performed bipolar hemiarthroplasty in 182 elderly patients and followed for 25 months and found the results comparable to total hip replacement.

Sun[38] (2002) performed bipolar hemiarthroplasty for 30 cases and found motion at both the bearing in all the cases without deteriotaion with time.

Haidukewych[39] (2002)revieved the results and survivorship of 212 bipolar hemiarthroplasties and observed that in living patients with surviving implants, 96.2% had no or slight pain. Ten-year survivorship free of reoperation for any reason was 93.6%, free of revision surgery for aseptic loosening or acetabular wear was 95.9%. They concluded that bipolar hemiarthroplasty for femoral neck fractures is associated with excellent component survivorship in elderly patients. The rate of complication was low and the arthroplasty provided satisfactory pain relief for the lifetime of the majority of elderly patients.

Schleicher I , Kordelle J et al[40] (2003) in their study concluded that in elderly patients with femoral neck fracture with high comorbidity, the implantation of hemiarthroplasty is recommended and in healthy active patients with longer life expectancy, the total hip replacement.

Dixon[41] (2004) conducted bipolar hemiarthroplasty for displaced femoral neck fracture in the mobile active elderly patients in 58 cases. 44 had no or mild pain. 11 of 16 patients who were able to walk 1 mile before fracture were able to do so at review. These results were significantly better than conventional hemiarthroplasty and comparable to THR, but without the risk of dislocation.

Maini PS et al[42] (2006) concluded that elderly patients, with displaced fracture of neck of femur, are able to ambulate early after bipolar hemiarthroplasty. The complication rate is low, the component survival long and pre injury functional status is restored in majority of the patients.

Mullar CA et al[43] (2008) concluded that the implementation of bipolar hip prosthesis constitutes an adequate treatment for elderly patients. The physical condition of elderly patients has to be taken seriously while planning surgical treatment of femoral neck fracture.

Marya SKS, Thukral R[44] (2008) concluded that bipolar hemiarthroplasty when compared to open reduction and internal fixation has a very low rate of revision surgery. The primary goal of treatment is to return the patient to his pre-fracture functional status.

Carl JH, Anders E et al[45] (2011) conducted a randomized controlled trial in 120 patients with mean age of 81 years comparing bipolar hemiarthroplasty with total hip replacement for displaced intracapsular fractures of the femoral neck in elderly patients concluding that the duration of surgery was longer in the total hip replacement group. There were no differences between the groups regarding any complications or mortality. There were no dislocations in either group.

Bhushan M Sabnis, Ivan J Brenkel[46] (2011) in their study of 707 cases comparing unipolar (433) and bipolar(274) uncemented hemiarthroplasty for elderly patients with displaced intracapsular femoral neck fractures concluded that in those who were fit and physiologically young, uncemented bipolar hemiarthroplasty seemed to achieve better functional outcome compared to uncemented unipolar prosthesis.

DESCRIPTION OF THE IMPLANT

Fig. No.1 : Bipolar Prosthesis

The bipolar prosthesis can be described as an intermediate between unipolar prosthesis and total hip prosthesis.

The bipolar prosthesis (Talwalkar/Indian type) has got a stem length of 157mm, thickness is 8mm and the material used for the stem is stainless steel AISI-316. The stem may have fenestrations.

It has a vertical shoulder which fits snugly on the calcar femorale, has a long neck measuring 35.0mm, the size of the inner metallic head is 26mm. The head articulates with the inner surface of the acetabular cup made of high density polyethylene and the outer surface made of stainless steel AISI-316. The size of the acetabular cup varies from 39-51mm.

Fig. No.2 : Bipolar Prosthesis

The simplest of the currently available bipolar prostheses like the ones used in this study have an Austin Moore type stem and the small femoral head cannot be detached from outer metallic cup-UHMWPE complex.

Better modified versions of the bipolar prosthesis are available which have a modular system with interchangeable stems (fenestrated, solid, straight, long, porous coated, press fit, cement compatible) interchangeable small diameter head (metallic or ceramic), which allow adjustment of neck length, different sizes of outer metallic cup.[19]

Modular versions of bipolar prosthesis can be easily converted in to total hip replacement in case of any complication occurring on the acetabular side.

In the last 30 years generally good clinical results have been reported with the use of bipolar prosthesis and its indications have been

expanded to include treatment of hip degeneration, ankylosed hip, dysplastic hips and failed THR.

This provision of a completely mobile head element and the addition of another head surface for motion head surface for motion in the acetabulum create a compound system. This provides a greater distribution of weight bearing forces, thus minimizing wear both on the implant and the acetabulum.

INDICATIONS

The indications for bipolar arthroplasty are

1. Fracture neck of femur.
2. Osteoarthritis
3. Rheumatoid arthritis.
4. Ankylosing spondylitis.
5. Diseased or deficient acetabulum.
6. In fracture neck of femur in paraplegics or in patients with Parkinson's disease because of inherent stability of the implant

There are also other justifiable indications for which bipolar prosthesis can be used, like –

1. Nonunion of fracture neck of femur
2. Pathological fracture neck of femur without involvement of the acetabulum.
3. As a salvage procedure in the face of massive acetabular deficiencies when fixed component design cannot be secured to the skeleton with screw or cement.
4. Avascular necrosis of femoral head.
5. Failure after internal fixation.

6. Hip instability caused by deficiency of the abductors because the bipolar component is intrinsically more stable than a fixed component.

The results of the prosthesis are evaluated using **MEAN HARRIS HIP SCORING SYSTEM**[47] (1969).

Maximum points possible – 100

Excellent if	90-100
Good if	80-89
Fair if	70-79
Poor if	<70

The points are allotted for

- Pain relief 44
- Function 47
- Range of motion 05
- Absence of deformity 04

---

100 points.

ANATOMY

The hip joint and the gleno-humeral joint are the true ball and socket joints found in the human skeleton. The hip joint unlike the gleno-humeral joint it is an extraordinarily stable joint. Stability is associated to the bony and labral anatomy of acetabulum and femoral head. The thick fibrous capsule with ligamentous condensations and the local muscular anatomy greatly supplement this stabiIity.

The femoral head forms approximately two thirds of a sphere and is situated on the femoral neck approximately three quarters the diameter of the femoral head. This allows the femoral head, to be deeply seated within its acetabular socket without compromising either stability or range of motion.

The acetabulum is formed from the confluence of ischium, ilium and pubis at the triradiate cartilage. Approximately 40% of the femoral head is covered by the bony acetabulum at any position of hip motion [29.]

The articular surface of the acetabulum is horseshoe shaped, with articular cartilage covering the posterior, superior and anterior portion of the acetabular cavity. The cartilaginous labrum is found attached to the perimeter of the portion of the acetabulum covered by articular cartilage.

In the mid inferior portion of the acetabulum is the acetabular notch or cotyloid fossa. The transverse acetabular ligament traverses the most inferior portion of the acetabular notch extending from the most postero-inferior ridge of the labrum to the most antero-inferior edge of the labrum. The ligamentum teres originates from the acetabular notch.

The effect of labrum is to deepen the acetabulum and increase the stability of the joint. The addition of the labrum ensures that at least 50% of the femoral head is covered by the osteocartilaginous labral-acetabular complex in any position of hip motion. These motions includes extension (from a prone position) of 20° to 30 ， flexion of 120° to 135°, abduction of 45° to 50°， adduction of 20 ° to 30° and internal (medial) and external (lateral) rotation of 45° each. Definite individual variability is seen, and rotational measurements will differ if the rotation is tested in hip extension or hip flexion.[6]

The hip joint is surrounded by a capsule that extends posteriorly from the acetabular rim to the mid femoral neck and anteriorly from the acetabular rim to the intertrochanteric ridge. The primary capsular fibers run longitudinally and are supplemented by much stronger ligamentous condensations that run in a circular and spiral fashion.

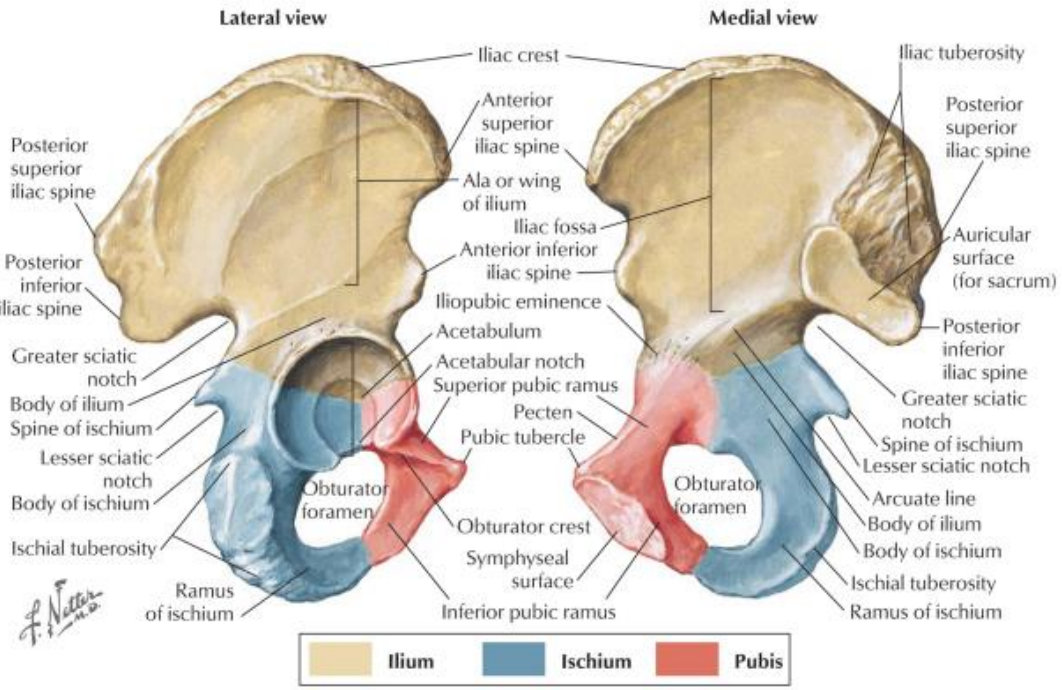


Fig. No.3 : Anatomy of Acetabulum

The illio-femoral ligament courses inferiorly from the iliac body and anteroinferior iliac spine in two distinct directions. One band continues directly inferiorly to insert on the intertrochanteric line just anterior to the lesser trochanter. The second band courses obliquely in a spiral fashion to insert on the intertrochanteric line overlying the greater trochanter.

An additional anterior ligamentous condensation extends from the superior pubic ramus to the intertrochanteric line and is called pubofemoral ligament. This ligament is believed to be a check to rein against pathologic extension of the hip.

Posteriorly, the ischiofemoral ligament is a broad and less dense condensation extending. In an oblique and horizontal fashion from the ischial border of the acetabulum to the superior base of the femoral neck and the region of the trochanteric fossa. The proximal end of the femur consists of the femoral neck; head and greater and lesser trochanter.

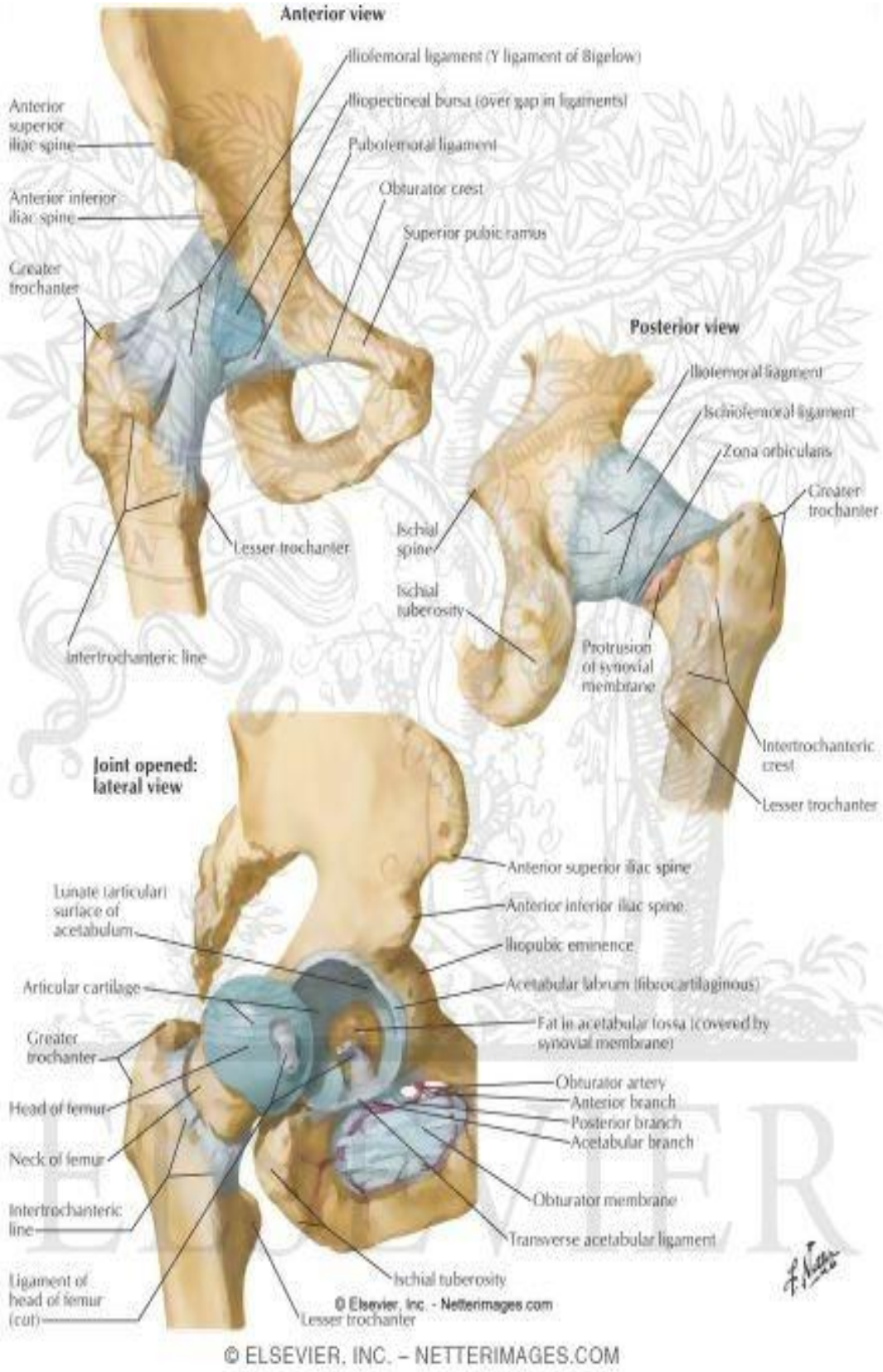


Fig. No.4 : Hip Joint Anatomy

The femoral neck projects superiorly, anteriorly and medially from the upper femoral shaft, medial to the origin of the greater trochanter. The latter quadrilateral-shaped eminence arises from the upper femur and gives attachment to the gluteus medius, minimus and to the short rotators. The lesser trochanter is a conical projection of bone located posteromedialy at a point where the neck arises from the femoral diaphysis. The Psoas inserts partially on the lesser trochanter. Posteriorly a ridge of bone, the intertrochanteric crest, bridges the trochanters. The femoral neck is broader at its base laterally and narrower just below and lateral to the origin of the femoral head. It is flattened in the anteroposterior plane. Vascular foramina are present on the anterior inferior aspect of the neck.

The femoral head forms two thirds of a sphere, arising from the femoral neck and having an axis normally parallel to that of the neck.

The surface of the femoral head is covered with articular cartilage about 4mm in thickness over the superior portion and 3mm at the equator. Medial to the axis of the femoral head is the Fovea Centralis, a small area devoid of articular cartilage that serves as a point of attachment for the ligamentum teres.

Synovial membrane covers the entirety of the femoral neck anteriorly but only the upper portion of the neck posteriorly. It arises at the border of the margin of the articular cartilage of the femoral head and is reflected into the under surface of the capsule of the hip joint. The capsule is attached at the intertrochanteric line anteriorly and approximately 1.5cm proximal to the intertrochanteric crest posteriorly. Synovial membrane also covers the acetubular labrum, the ligamentum teres and the transverse ligament of acetabulum.

Beneath the synovial membrane, periosteum covers the proximal femur. However, the periosteum does not have a cambium layer on the

femoral neck; which accounts for the lack of callus formation after a fracture in this region. [2]

The structure and the Mechanical properties of the bone have been the subject of numerous investigations. "Wolff's law" states essentially that every bone is constructed in such a fashion as to allow to resist the forces applied to it, so that if the direction of the forces change, there will be a corresponding change in the structure of the bone.[12]

Koch's analysis of compressive and tensile stresses in the femur, by mathematical means, leads him to conclude that this rather complex bone accords strictly in structure to the best engineering principles. - maximal strength with a minimal use of material Comparing the calculated lines of tension and compression in the head and neck of the femur, with the actual arrangement of the trabeculae, he apparently showed that the trabeculae are arranged exactly in the pattern demanded by his mathematical analysis.

In general, the trabeculae arising from the lateral side of the femur and arching medially correspond to the calculated tensile stress that is, the internal force in the bone that tends to keep two adjacent planes from being pulled apart – while the trabeculae arising from the medial side of the femur and arching upward and laterally correspond to the lines of compressive stresses - that is resist the compressive forces brought about by a load on the head of the femur.

The calcar femorale is a vertical plate of dense bone that projects from the posteromedial cortex of the femur deep to the lesser trochanter proximally and blends with the posterior cortex of the femoral neck [7]. It is in essence a continuation of the cylindrical cortex of the shaft, and its function is to strengthen the proximal femur around lesser trochanter.

The Singh's Index is a method of assessing the quality of bone based on the trabecular pattern of the proximal femur [48].

Grade 6 - Normal trabecular pattern with primary compression and tension trabeculae and secondary compression and tension trabeculae.

Grade 5 - Decrease in secondary trabecular pattern and Ward's triangle becomes prominent.

Grade 4 - Secondary trabecular pattern is absent. Primarily trabecular pattern is decreased.

Grade 3 - A break occurs in the primary tension trabeculae.

Grade 2 - Loss of primary tension trabeculae is complete. Marked reduction in compression trabeculae.

Grade l - Only a few primary compressile trabeculae seen.

Grade 3 and below indicate significant osteoporosis. These grades should be determined when considering internal fixation and whether or not weigh bearing will be tolerated.

The angle between the axis of the femoral neck and the stem is referred to as neck shaft angle**.** The neck shaft angle is greater at birth, averaging 160 ° and decreases throughout skeletal growth, reaching an average of 135^{o} in the adult. Noble et al; studied 200 femoral radiographs and found an average neck-shaft angle of 124.7° (range 105.7° to 154.50). [49]

Anteversion refers to the degree of forward projection of the femoral neck horn the coronal plane of the shaft. It is the angle between the intersection of the transcondylar plane and the axis of the femoral neck in the coronal plane. Anteversion is larger at bir1h (averaging 31 ° to 40°) and then decreases until skeletal maturity is reached. [17, 34]

Normally the neck projects 8° anteriorly in the adult, but in a small number of cases, the neck projects posteriorly, and is said to be retroverted or in retroversion. The anteversion angle in Caucasians

averaged 7.0° in males (range 2° to 35°) and 10.0° in females (range 2° to 25°) and in Hongkong Chinese, the average in males was14.0° (range 4 to 36°) and 16° in females (range 7° to 28°). Similar measurements have been reported by Kingsley et al and Rodgers. Anteversion in the Japanese male and female has been reported to be 15°

The femoral head is an egg or barrel shaped. This lack of roundness is greater in the male than in the female with a flattened area over its superior lateral surface. The average femoral head bony diameter in Caucasian males was 46mm and 43mm in females, and 45 mm in Hongkong Chinese males and 40mm in females. Noble, et al; found that the average femoral head diameter was 46.1 mm (range 35 to 58mm). The average neck length was 35.5mm (range 30- 41.1 mm) studied in 200 femoral specimens by noble, et al. [49]

VASCULAR ANATOMY

Femoral neck fractures have all the problems associated with healing or intracapsular fracture elsewhere in the body. The portion or the neck that is within the capsule has essentially no cambium layer in its fibrous covering to participate in peripheral callus formation in the healing process. Therefore, healing in the femoral neck is dependent on endosteal union alone, unless the- fracture fragments are carefully impacted, synovial fluid can lyses blood clot formation and thereby destroying another mode of secondary healing by preventing the formation of cells and scaffolding that would allow for vascular invasion of the femoral head. The femoral head is rendered largely avascular by a displaced fracture; the increased pressure within the hip with haemarthrosis will damage the already tenuous circulation due to tamponade effect. The incidence of non union is high and even with optimum treatment signs of aseptic necrosis and later segmental collapse occurs [2].

The arterial supply to the proximal end of the femur has been studied extensively. The description by Crock seems the most appropriate because it is based on three-plane analysis and provides a standardization of anatomical nomenclature. Crock describes the arteries of the proximal end of the femur in three groups:

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

At the margin of the articular cartilage on the surface of the neck of the femur, the ascending cervical arteries form a second ring, which Chung has termed the subsynovial intra articular arterial ring.[2]

Trueta and Harrison believed that the femoral epiphyseal blood supply in the adult arose, largely, from the lateral epiphyseal arteries that enter the head postero-superiorly and secondarily from the medial epiphyseal artery entering through the ligamentus teres

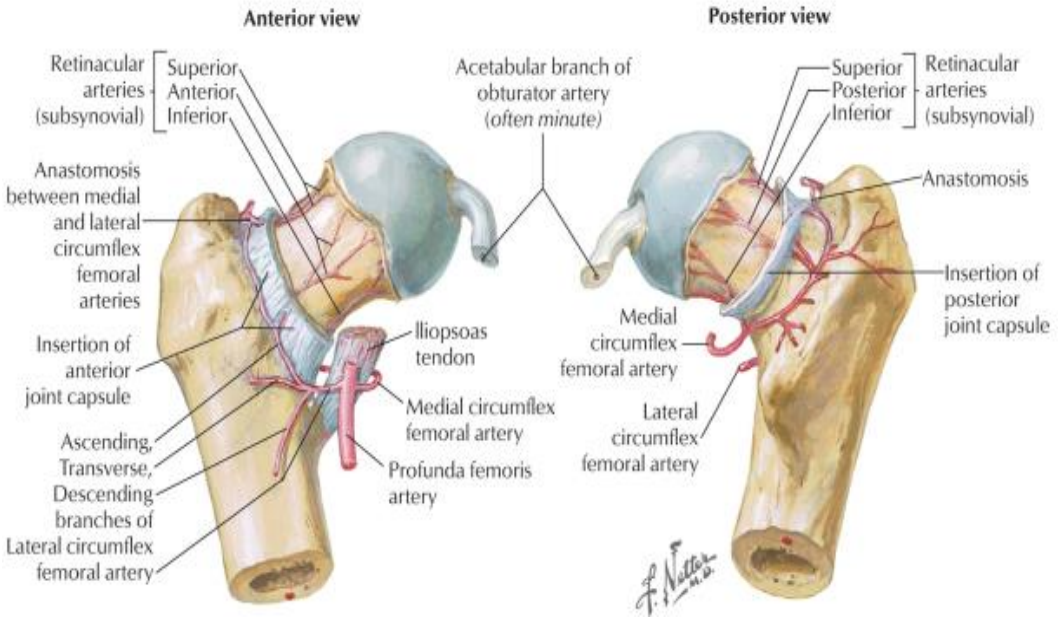


Fig. No.5 : Vascular Anatomy of Femoral Head and Neck

BIOMECHANICS OF THE HUMAN HIP

The hip joint is the pivot upon which the human body is balanced in gait. True bipedalism is limited to birds and man, and in both the stability of this joint is dependent upon the bony configuration of the joint. A simple hinge hip joint would not permit the rotation needed for gait.[50]

The hip joint is slightly incongruous under low loads, so that with the flattening of the subchondral bone the joint achieves maximum surface contact under high load, diminishing the force per unit area and maintaining it within tolerable limits.

The anatomic varus position of the femoral neck vis-a-vis the femoral shaft allows the abductor muscles considerable functional advantage, as they counter balance the, body weight in the frontal plane during one-legged stance. Ideally, the abductors should be as far lateral from hip joint as possible in order to achieve muscle stability in bipedal stance however; a compromise must be made, because too extreme a lateral placement will limit abduction.[50]

In the lateral or saggital plane increase leverage results from the anteverted attitude of the femoral neck. This anteversion provides the gluteus maximus with a lever arm and so multiplies the muscle's effectiveness. The longer this lever arm, the less force the gluteus maximus has to exert to maintain upright posture over the hip joint. Because it is a ball-and-socket joint the hip allows a wide range of motion, greater than would appear to be required for the activities of daily living. Hyperflexion is the most useful range for sitting on chairs which are lower than the knees.

The necessity for rotation in bipedal gait involves the required pivoting on the stance phase leg in order to allow efficient bipedal

forward gait. Quadrupeds do not require significant external rotation of the hips in gait as they pivot the pelvis by rotating the spine relative to the pelvis.

Rydell showed that standing on one leg generated a force 2.5 times the body weight in that hip. In one leg support, with a cane in the opposite hand, the force across the hip was reduced to the body weight. At rest with two leg support, there was a force about half the body weight across each hip joint, whereas standing with the hip and knee flexed 90° increased the force to near body weight across flexed hip. Running was noted t01ncrease these forces to five times the body weight. Lifting the leg from a supine position with knee straight produced a force of 1.5 times the body weight across the hip joint.[51]

Abductor pull x abductor level arm = body weight x load arm.

Ratio of lever arm or body weight to abductor musculature is 2.5: 1 i.e. the abductor muscle must pull 2.5 times the body weight to maintain the pelvis level when standing on single leg.

MECHANISM OF INJURY

Fracture neck of femur in the elderly is commonly caused by a trivial fall because of osteoporosis. In young individuals, it is caused by high velocity injuries such as in road traffic accidents.

Kocher [52] suggested two mechanisms of injury- the first is a fall producing a direct blow over the greater trochanter and the second is the lateral rotation of the extremity. A third suggested mechanism is cyclical loading, which produces micro fractures and macro fractures.

Forces within physiologic limits have shown to produce fractures in an osteoporotic bone. It is suggested that a stress fracture of this type becomes complete after a minor torsional injury preceeding the fall that the patient identifies with the fracture.

BIOMECHANICS IN BIPOLAR ENDOPROSTHESIS

ECCENTRIC OFFSET

In the design of the earliest bipolar prostheses, the centres of the inner and outer bearing coincide. They were concentric. In some cases the outer head became fixed in an extreme varus angulation, so that hip forces were transmitted through the periphery of the polyethylene component resulting in accelerated wear, fracture and component disassociation. A result of this early experience was that the centres of the inner and outer bearing were separated, with the outer head centre moving slightly more distal. This is the eccentric offset.

To understand how the eccentric offset works one must consider that the centre of the inner head, 'x' in the diagram, is fixed. Then the outer head centre V can rotate about "x' as the outer head rotates on the inner bearing.

Off-centre force acting on a wheel will cause the wheel to turn until the centre aligns with the applied force. Bipolar prostheses with an eccentric offset slide in the acetabulum rather than roll, but the effect is the same, the angulation of the cup is restored to take a favorable position with respect to the applied load.

However, physiological loads are cyclical and the friction at acetabular interface may not be negligible.

In a bench-top test, it was shown that the anti-varus eccentric mechanism d< work with a cyclical load, but a high friction acetabulum can limit action. Theoretically, a 22 mm offset can be effective assuming eq friction at the inner and outer bearings. More evidence comes from Wetherall et al[24] who studied bipolar devices in cadaveric acetabulae, using an artificial synovial-like lubricant. Here, eccentric anti-varus mechanism was found to function in most cases even when the acetabular

cartilage was classified as very poor. Perhaps the most compelling evidence for the effectiveness of eccentric offset is the reduction in the incidence of the clinical problem of the early varus bipolar.

FRICTION PROPERTIES

The Bipolar system functions with wear at two levels. This is accomplished by having a 22 mm diameter low torque bearing within the polyethylene head so that the shear stresses on acetabular cartilage are reduced.

Geometric relationship of this 2-layer system between a 22 mm internal bearing and the larger prosthetic outer bearing, acting with the acetabulum allows the coefficient of friction of metal on polyethylene and metal on articular cartilage to function in tandem. It follows that the friction of the prosthetic head within the acetabulum is greater than that required to move the 22 mm artificial bearing which is machined precisely to fit in a polyethylene socket.

In addition, the design of the inner bearing limits motion to a range, which accommodates that required for normal activities such as: walking, climbing stairs and moving from a sitting position to a standing position. Such restriction of range of motion of the inner bearing avoids the possibility of prosthetic head moving into an unfavorable varus position with the femur in neutral position.

The system is locked by a thin outer metal shell snapping on the polyethylene head, securely locking the whole mechanism. The absence of a fixed bearing eliminates acetabular complications inherent in a fixed cup. The implant has functioned well without mechanical flaws. It is felt that "near physiological shear stress levels at the cartilage prosthetic head interface is largely achieved. The system has resulted in minimal wear at

both the inner and outer bearings. The single assembly implant has provided safety and security as major factors for its increasing usefulness.

BIPOLAR PROSTHESIS

In 1974, Dr James Ennis Bateman[16], an orthopaedician and Averill, a bio-engineer devised bipolar prosthesis, which is a self-articulating prosthesis designed for femoral head replacement. The bipolar concept was to establish firm fixation of the stem in femoral shaft, yet eliminate shear forces between the metallic prosthetic head and ace tabular cartilage. Bateman in 1974 and Gilberty[17] 11 years later reported the bipolar endo-prosthesis, an intermediate step between Moore type of endo-prosthesis and a total hip system.

The prosthesis consists of femoral stem with a collar, neck and 22-mm spherical bearing at its proximal end. Locked on to this bearing is a bearing insert made of ultra-high molecular weight polyethylene; this produces a low friction universal joint. The polyethylene bearing is capped with a metallic cup i.e. the head that constitutes a second bearing surface articulating with the acetabulum.

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 greater distribution of bearing forces, thus minimizing wear and tear changes on both the implant and on the containing tissues.

A major advance in the bipolar cup design was making the axis of the metallic and polyethylene cups eccentric so that with loading of the hip, the metallic cup rotates laterally rather than medially and thus avoids

fixation in a varus position, as well as impingement of the head on the edge of the cup, which causes fracture of the polyethylene bearing insert and disassociation of the implant.

MECHANISM OF THE IMPLANT

The implant was designed to permit major motion at the inner bearing, which is geometrically perfect, so that complementary motion follows at the outer bearing triggered by even minimal irregularities of the articular cartilage. Articular cartilage then acts as a brake on outer bearing action while inner bearing continues uninterrupted. Radiological motion studies were done to assess the implant function in a weight bearing or walking stance. The studies revealed that the range of respective motion between inner and outer bearing varied to a degree according to the pathological state.

In fractures 82% inner bearing & 18% outer bearing dominance is seen. In osteoarthritis 95% inner bearing & 5% outer bearing. In osteonecrosis <50yrs, 50% inner bearing and 50% outer bearing. In osteonecrosis >50yrs, 70% inner bearing & 30% at outer bearing is seen. Most recently Torisu et al[29] noted the preponderant use of inner bearing motion increased significantly with weight bearing.

CLASSIFICATION OF FRACTURE NECK OF FEMUR

Classification Based on Fracture Characteristics:

The three common classifications of the femoral neck fractures are those based on

1. Anatomical location of the fracture [53].
2. Direction of the fracture angle.
3. Displacement of fracture fragments [54].

ANATOMIC LOCATION

The **intracapsular** fractures of the neck of the femur are anatomically classified into subcapital and transcervical types. The so called basal neck fractures are **extracapsular.**

The term subcapital is used to describe fractures that occur immediately beneath the articular surface of the femoral head along the old epiphyseal plate. Transcervical fracture pass across the femoral neck between the femoral head and the greater trochanter [55].

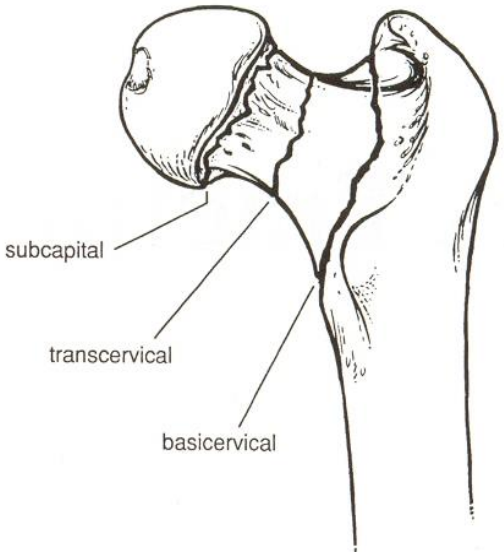


Fig. No.6 : Anatomical Clasification of Fracture of Neck of Femur

FRACTURE ANGLE (PAUWELS CLASSIFCATION)

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

Type I is a fracture 30 ° from the horizontal,

Type II 50° from the horizontal and

Type III 70° from the horizontal

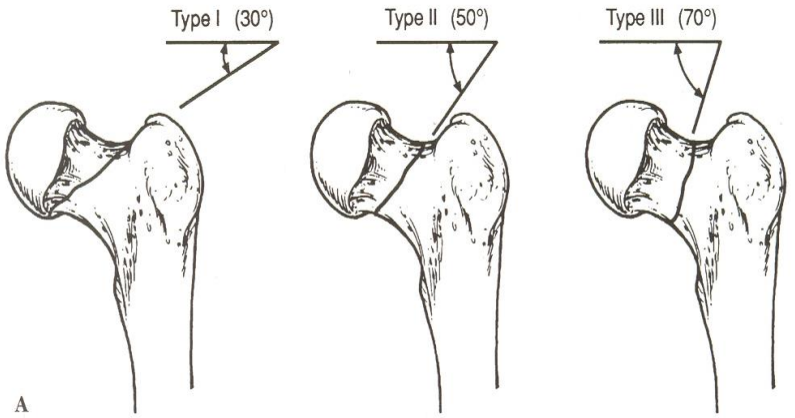


Fig. No.7 : Pauwels Clasification of Fracture of Neck of Femur

FRACTURE DISPLACEMENT (GARDEN CLASSIFICATION)

Garden proposed a classification system based on the degree of displacement of the fracture noted on pre reduction x ray [54].

The Garden I fracture is an incomplete or impacted fracture in this fracture the trabeculae of the inferior neck are still intact. This group includes the "abducted impaction fracture"

Garden II fracture is a complete fracture without displacement. The X-ray demonstrates that the weight bearing trabeculae are interrupted by a fracture line across the entire neck of the femur.

A Garden III fracture is a complete fracture with a partial displacement. In this fracture, there frequently are shortening and external rotations of the distal fragment. The retinaculum of Weitbrecht remains attached to, and maintains continuity between, the proximal and distal fragments.

A Garden IV fracture is a complete fracture with total displacement of the fracture fragments. In this fracture, all continuity between the proximal and distal fragment is disrupted. The femoral head assumes its normal relationship in the acetabulum. Therefore, the

trabecular pattern of the femoral head lines up with that of the acetabulum.

Garden believes that in Garden-I and II fractures, the fracture challenge of the femoral neck fracture has- been solved. Garden III and IV fractures still have a significant degree of failure associated with their management.

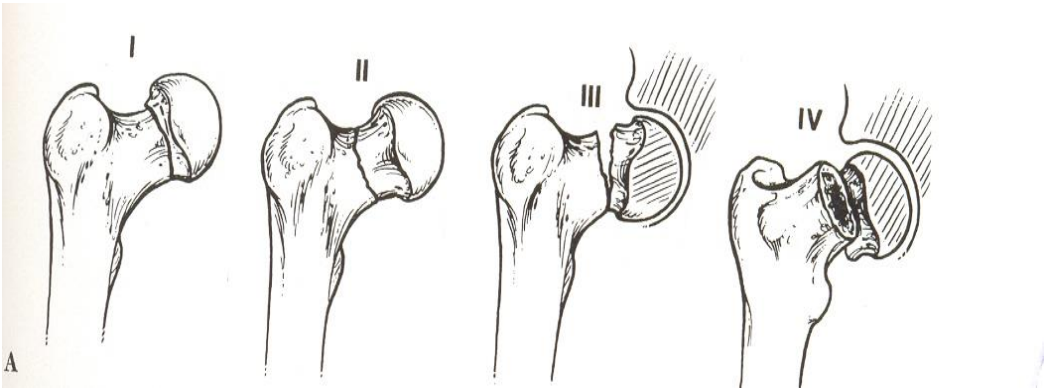


Fig. No.8 : Gardens Clasification of Fracture of Neck of Femur

AO CLASSIFICATION: [56]

B = Neck fracture

B1 Neck fracture, sub capital, with slight displacement

1. Impacted in valgus ≥ 15
2. Impacted in valgus < 15
3. Non - impacted

B2 Neck fracture, Transcervical .

1. basi - cervical.
2. mid - cervical adduction.
3. mid - cervical shear.

B3 Neck fracture, subcapital, non-impacted, displaced

1. Moderate displacement in varus and external rotation.
2. Moderate displacement with vertical translation and external rotation.
3. Marked displacement.

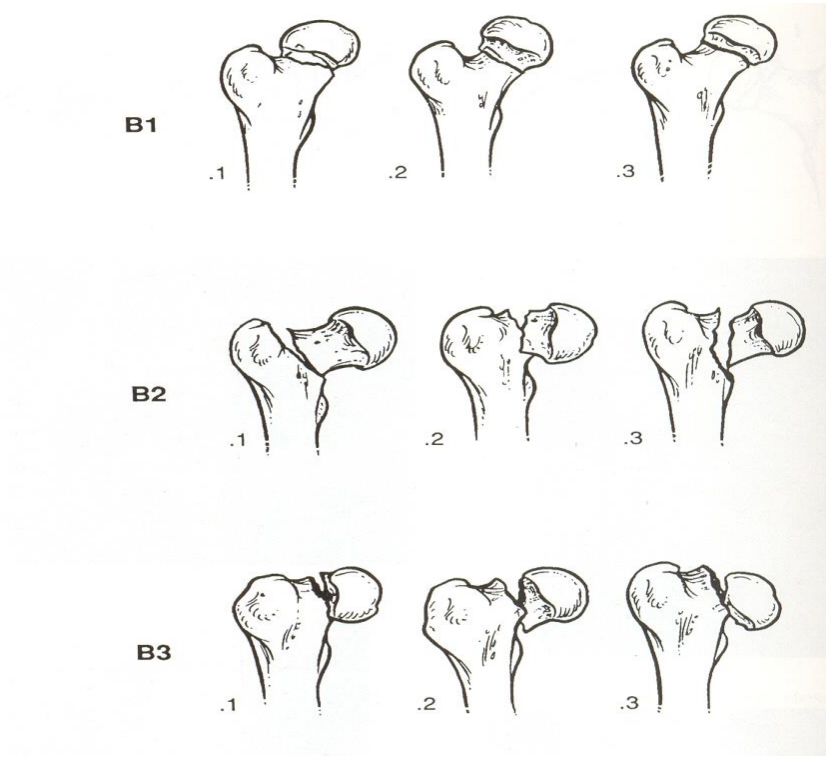


Fig. No.9 : AO Clasification of Fracture of Neck of Femur

DIAGNOSIS

Stress fractures and impacted fractures.

Patients with stress fractures and those with impacted fractures may complain of only a slight pain in the groin or referred pain along the medial side of the knee. They may be able to walk with an antalgic limp and, therefore, delay in seeking treatment, thinking that they are suffering from only a muscle problem.[25]

Physical examination reveals no obvious clinical deformity. Only mild discomfort is produced by active or passive range of motion or the

hip, but some muscle spasms usually is associated with the extremes of motion. Percussion over the greater trochanter is particularly painful. Failure to recognize non displaced stress fractures or impacted fractures may result in fracture displacement on weight bearing. This complication can be prevented if all patient complaining of hip and thigh pain after an injury, or those exposed to stress (e.g. military recruits, joggers) are assumed to have a fractured hip. If the initial X-rays are normal but pain persists, the patients still should be suspected of having a femoral neck fracture in some cases, X-rays, tomograms, MRI, or bone scans are required in the diagnosis of these fractures.

DISPLACED FRACTURES

Patients with displaced intracapsular fracture have pain in the entire hip region. They lie with the leg in external rotation, abduction and slight shortening. These patients do not have the extreme deformity that present in the dislocations of the hip or intertrochanteric fractures because of partially intact capsule.

Efforts to move the leg to elicit crepitus are condemnable. The limb should be splinted when the diagnosis is suspected and a Buck's traction applied.

The diagnosis in displaced fractures is easily confirmed by routine X-ray. X-ray evaluation of the fracture type, the degree of posterior comminution and the presence or absence of osteoporosis is essential before selection of the treatment regimen. The routine X-ray evaluation of a patient with a hip fracture should include a true anteroposterior view with the maximum degree or internal rotation possible, as well as lateral X-ray[33]

MATERIALS AND METHODS

In this study, primary hemireplacement arthroplasty of the hip was done in 30 patients with fracture neck of femur using uncemented bipolar prosthesis who were admitted into the Department of Orthopaedics in R.L. Jalappa Medical College and Research Center, Tamaka, Kolar, from December, 2010 to June 2012.

Follow up was carried out at 6 weeks, 3 months and 6 months. The results were evaluated in terms of pain, function, range of movement and any visible deformity using the Harris Hip Rating.

Inclusion Criteria:

Patients with fracture neck of femur aged above 60 years.

Exclusion criteria:

1. Patients who were non ambulatory prior to the fracture.
2. Patients who are medically unfit for surgery.

PRE-OPERATIVE EVALUATION

These patients were admitted in the hospital and details like name, age, sex, occupation, address were noted. History regarding the mode of injury, past history of any medical disorders, pre injury ambulatory status was recorded and detailed clinical examination was done.

INVESTIGATIONS

X-ray of the pelvis with both hips, anteroposterior view was taken with both the limbs in 15^0 of internal rotation.

Thickness of the cortex of the femur, width and shape of medullary canal, bone stock, type of fracture (Garden's classification[54]), amount of calcar present, level of· femoral neck cut to be made, pre-operative size of the head and bone stock of acetabulum was noted.

Chest, X-ray and ECG were done. A complete blood analysis including Hb %, TC, DC, ESR, RBS, FBS, PPBS, Serum urea, Serum creatinine, blood grouping and typing, bleeding time and clotting time were done. Urine analysis was done and urine culture done if required. Liver function tests and renal function tests were done if required.

PRE-OPERATIVE TREATMENT

For fresh fractures Bucks traction with 3 - 4 kg weight was applied to relieve the pain and muscle spasm. For fractures more than 1 week and for those with limb shortening, an upper tibial skeletal traction with 5 kg to 10 kg of weight was applied till the limb length could be equalized.

The part was prepared 24 hours before operation taking care to prevent abrasions. Preoperative anaesthetic assessment was done.

The following training was given to the patients preoperatively so that the same could be carried out post-operatively like,

1.Deep breathing exercise.

2.Static quadriceps exercises.

3.Ankle and toe movement.

4.Active hip exercises (of the normal hip to familiarize the exercises)

5. Building of muscle power of the upper extremities.

A written consent of the patient and relatives was taken.

Injection cefotriaxone 1 gm was administered intravenously prior to surgery.

SURGICAL PROCEDURE

The patient is placed in a lateral position under spinal anaesthesia with the affected hip facing upwards. The part is scrubbed with 10%

Povidone iodine scrub (betadine scrub) and then painted with 5% Povidone iodine solution (betadine solution) and draped.

Posterior approach (Moore's/ Southern) was used in all the cases in this study. The incision begins approximately 10cms distal and slightly lateral to the posterior superior iliac spine and is extended distally and laterally parallel to the fibers of Gluteus maximus to the posterior margin of the greater trochanter.

Then the incision is directed distally parallel to the femoral shaft for approximately 5cms or more depending upon the built of the patient.

The deep fascia is divided in line with the skin incision; blunt dissection of gluteus maximus is done and is retracted.

The short external rotators, viz; from below upward, the Quadratus femoris, the Obturator internus; Gemelli and the Pyriformis are exposed. The Obturator internus and gemelli and if necessary the piriformis are divided close to their insertions, and reflected backwards. These muscles, when retracted, will cover the sciatic nerve and thus protect it from injury. Thus, posterior part of capsule is well exposed.

A T-shaped incision is made in the hip capsule, in line with the femoral neck and across its base. The capsule is retracted and labrum is preserved.

Then the thigh and knee are flexed to 90°, adducted and, internally rotated thus dislocating the hip posteriorly. The femoral head is extracted using bone levers or a cork screw. The remnant of ligamentum teres is excised and any loose pieces of bone in the acetabulum removed, the cartilage of the acetabulum is inspected for any degenerative changes.

The femoral neck is cut using an oscillating motor saw or an osteotome in such a way that enough of the calcar (5mm to 10 mm) remained to support the medial aspect of the prosthesis.

The size of the femoral head removed from the acetabulum is measured using a head gauge and trial or definitive prosthesis was checked for the fit. The head size should be neither too loose nor too tight.

Then an awl or straight currete is inserted in line with the femoral shaft to aid in entering the diaphyseal medullary canal. Then with an appropriate broach or rasp medullary canal is enlarged in valgus and 10°-15° of anteversion relative to the plane in which the knee joint axis lies.

Then the appropriate sized prosthesis is seated in the prepared medullary canal with l0-15°of anteversion and a valgus position. The prosthesis is impacted with gentle blows into the medullary canal. Then prosthesis is reduced gently into the acetabulum.

Muller noted that the center of the head of the prosthesis should be slightly superior to the level of the upper edge of the greater trochanter. If it is too high riding, some more neck should be osteotomized to enable easy reduction of prosthesis and prevent post-operative limb lengthening.

The hip is tested for full range of movements and stability intra-operatively.

The wound is closed meticulously in layers over a suction drain, if necessary, maintaining hemostaisis throughout the procedure and dressing is applied. Blood loss is assessed and blood transfusion carried out if required.

During the insertion of the prosthesis into the proximal femur, if the implant was found be loose within the medullary canal, Poly Methyl Methacrylate Bone Cement has to be used so that the prosthesis fits snugly.

All the cases in the current study were done without using bone cement.

OPERATIVE INSTRUMENTS

SURGICAL PROCEDURE

Patient Positioning

Incision

Prepared Neck

Extracted Head with Template

Rasping

Reduction Maneuver

After Reduction

POST - OPERATIVE MANAGEMENT

A pillow was kept in between both the legs so that the limb can be maintained in abduction. Foot end of the bed was elevated and regular half hourly T.P.R. and blood pressure charts were maintained for initial 24 hours.

Antibiotics in the form of parenteral Ceftriaxone 1gm, twice a day was given for the first three days and later shifted to oral antibiotics.

Analgesics in the form of intra-muscular Diclofenac sodium or Tramadol were administered in first 24 hrs and then shifted to oral analgesics.

The drain, if present, was removed depending on the amount of collection at 48 to 72 hours. Static quadriceps exercises were advised to all the patients as soon as they recovered from anaesthesia.

A Post-operative check X-ray was taken and the valgus seating with 10°-15° of anteversion was confirmed. Any limb length discrepancy was noted.

The patient was mobilized with the help of a walker with partial weight bearing as early as possible as pain permits (1 to 5 post-operative day)

All the patients were advised to sit up with back rest from the 2nd post-operative day. Deep breathing exercises were advised.

Knee flexion, isotonic quadriceps exercises and Hip abduction, flexion and extension exercises were started on 3rd postoperative day and

Sutures were removed on 10th day and patient discharged with a walker or a cane (which was discarded after 6 weeks). The patient was advised to use a straight high chair with arms to facilitate getting out of the chair and avoid using a sofa. The patient was strongly advised not to sit cross legged or squat on the floor or squat for Indian style of toilet and

patient was advised to use elevated toilet seat. The patient was advised not to adduct or flex the hip excessively or involve in activities that place heavy load or stresses on the hip.

The patient was advised to carry out the isotonic and isometric exercises to strengthen the muscles around the hip.

The follow up was carried out at 6 weeks, 3 months, 6 months, 1 year, and half yearly thereafter.

The results were evaluated using the **Harris Hip Rating** [47] (1969).

Maximum point's possible-	100
Excellent	90-100
Good	80-89
Fair	70-79
Poor	<70

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

I. Pain (44)

A. None or ignores it 44

B. Slight, occasional, no compromise in activities 40
Mild pain, no effect on average activities, rarely

C. Moderate Pain with unusual activity, may take aspirin 30

D. Moderate pain, tolerable but makes concessions to pain, 20
some limitation of ordinary activity or work, may require occasional pain medicine stronger than aspirin

E. Marked pain, serious limitation of activities 10

F. Totally disabled, crippled, pain in bed, bed ridden 0

II. Function (47)

A. Gait (33) 1. Limp

a. None -11

b. Slight -8

c. Moderate -5

d. Severe -0

2. Support

a.None -11

b.Cane for long walks -7

c.Cane most of the time -5

d.One crutch -3

e. Two canes -2

f . Two crutches -0

g. Not able to walk (specify reason) -0

3. Distance walked

a.Unlimited -11

b.Six blocks -8

c.Two or three blocks -5

d. Indoors only -2

e. Bed and chair -0

B. Activities (14)

1. Stairs

a. Normallv without using a railing	-4
b. Nornlally using a railing	-2
c. In any manner	-1
d. Unable to do stairs	-0

2. Shoes and socks

a. With ease	4
b. With difficulty	2
c. Unable	0

3. Sitting

a.Comfortably in ordinary chair for one hour	5
b.On a high chair for half an hour	3
c. Unable to sit comfortably in any chair	0

4. Enter public transportation

III. Absence of Deformity (4)

Points (4) are given if the patient demonstrates

A. Less than 30^0 fixed flexion contracture

B. Less than 10^0 fixed adduction

C. Less than 100 fixed internal rotation in extension.

D. Limb length discrepancy less than 3.2cm.

IV. Range of Motion (5 points)

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

RESULTS

In our study of 30 cases of fracture neck of femur treated with hemiarthroplasty using uncemented Bipolar prosthesis, the results obtained are as follows-

1. AGE DISTRIBUTION

The mean age of patients in our study is 68.3 years with a range of 60 to 94 years, with most patients between the ages 60 to 70.

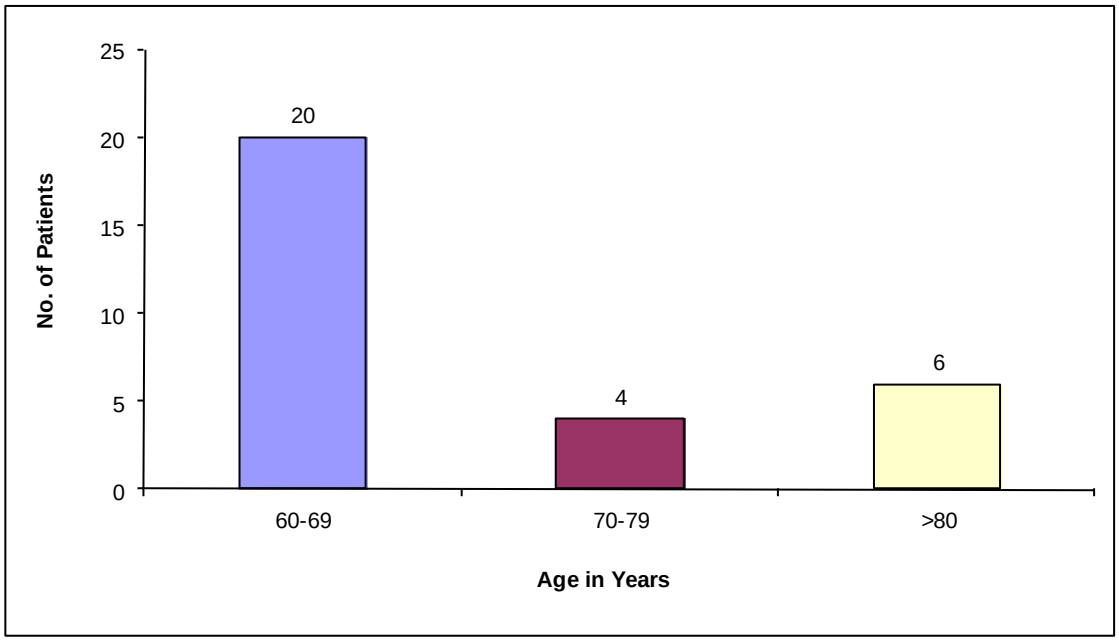
Table No.1

Age of the patients

Age in Years	No. of Patients	Percentage
60-69	20	66.6%
70-79	4	13.3%
>80	6	20%

Chart No.1

Age of the patients



2. SEX DISTRIBUTION

Fracture neck of femur is more common in elderly females than in males due to osteoporosis.

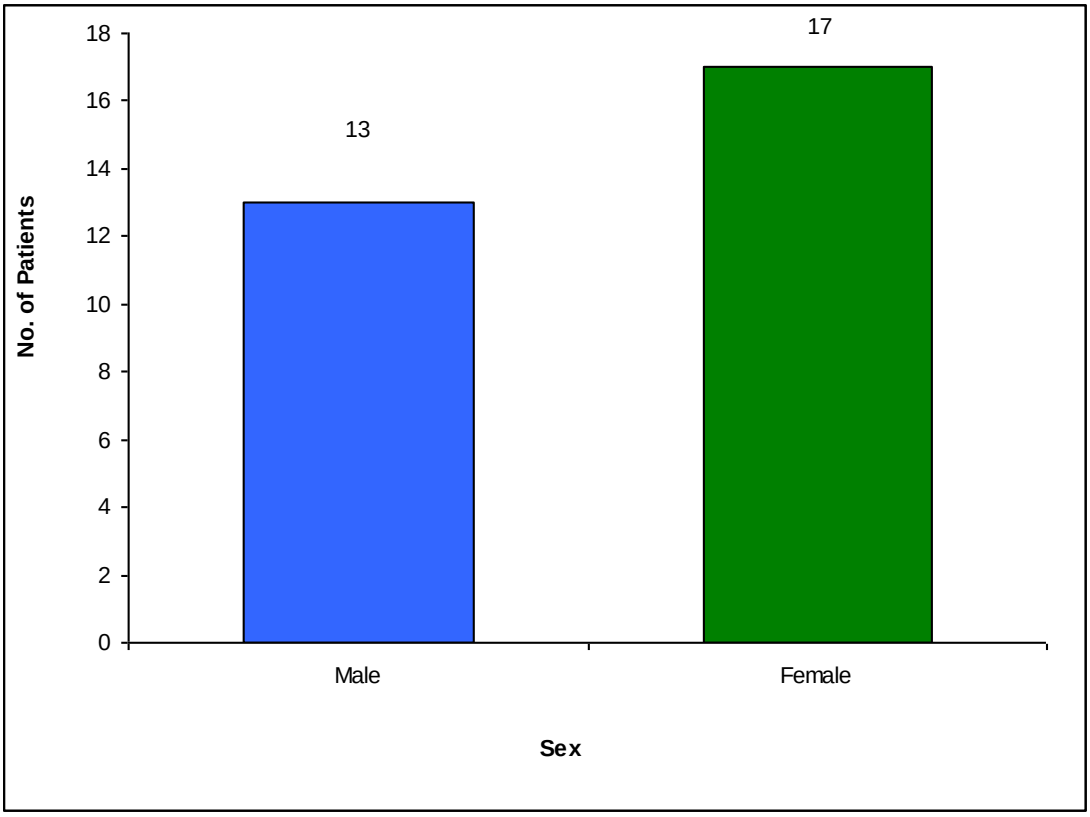
Table No.2

Sex distribution

Sex	No. of Patients	Percentage
Male	13	43.3%
Female	17	56.6%

Chart No.2

Sex distribution



3. SIDE INVOLVED

17 out of 30 cases involved the left hip.

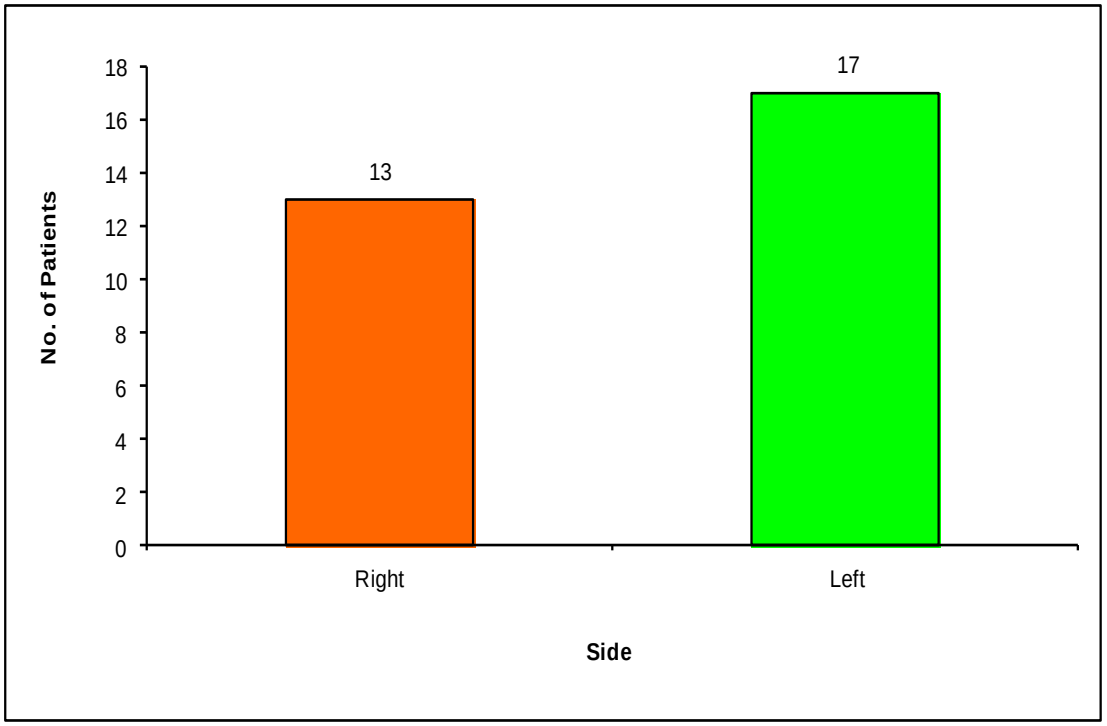
Table No.3

Side

Side	No. of Patients	Percentage
Right	13	43.3%
Left	17	56.6%

Chart No.3

Side



4. MODE OF INJURY

Most of the cases in our study sustained a hip fracture following a trivial fall like fall from bed, while walking, from a bicycle, fall on a slippery floor etc.

3 patients sustained a road traffic accident leading to a hip fracture. 2 cases sustained the fracture following a fall down the stairs.

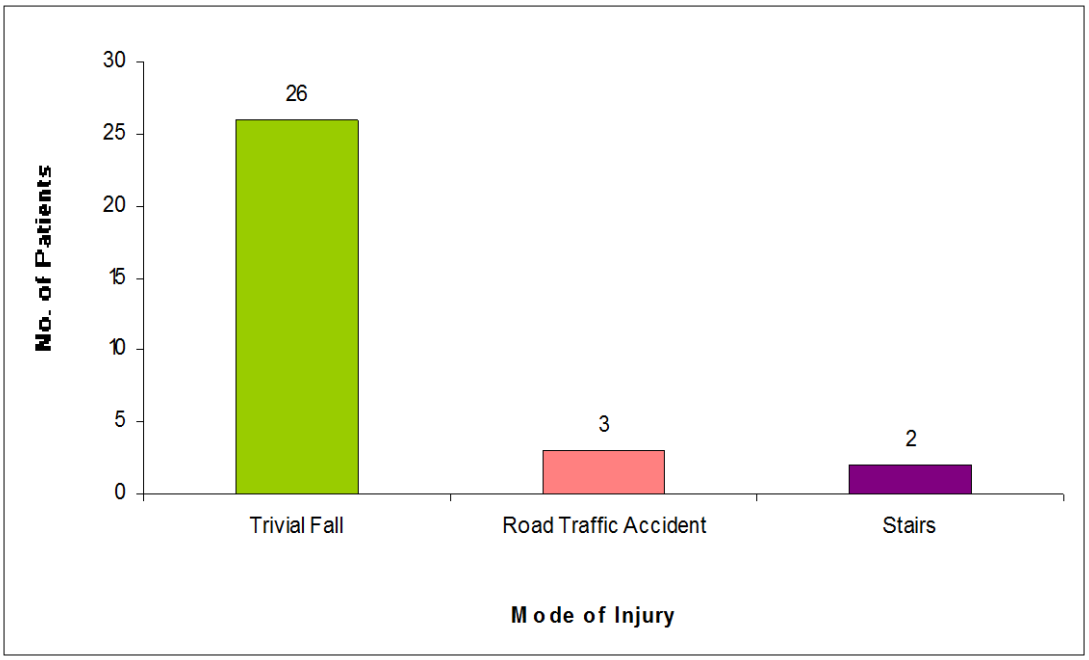
Table No.4

Mode of injury

Mode of injury	No. of Patients	Percentage
Trivial Fall	26	83.3%
Road Traffic Accident	3	10%
Stairs	2	6.6%

Chart No.4

Mode of injury



5. TYPE OF FRACTURE

All the cases included in our study were displaced fracture neck of femur.

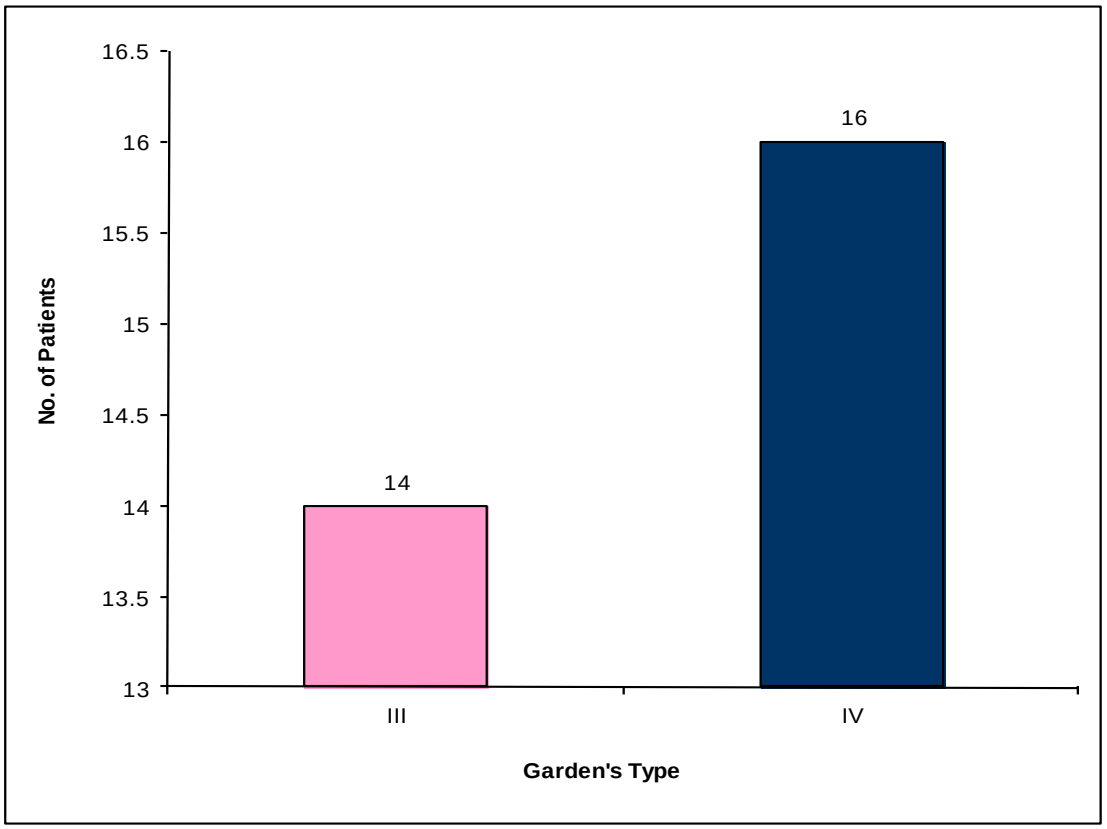
Table No.5

Garden's Type

Garden's Type	No. of Patients	Percentage
I	0	0%
II	0	0%
III	14	46.6%
IV	16	53.3%

Chart No.5

Garden's Type



6. ASSOCIATED DISORDERS

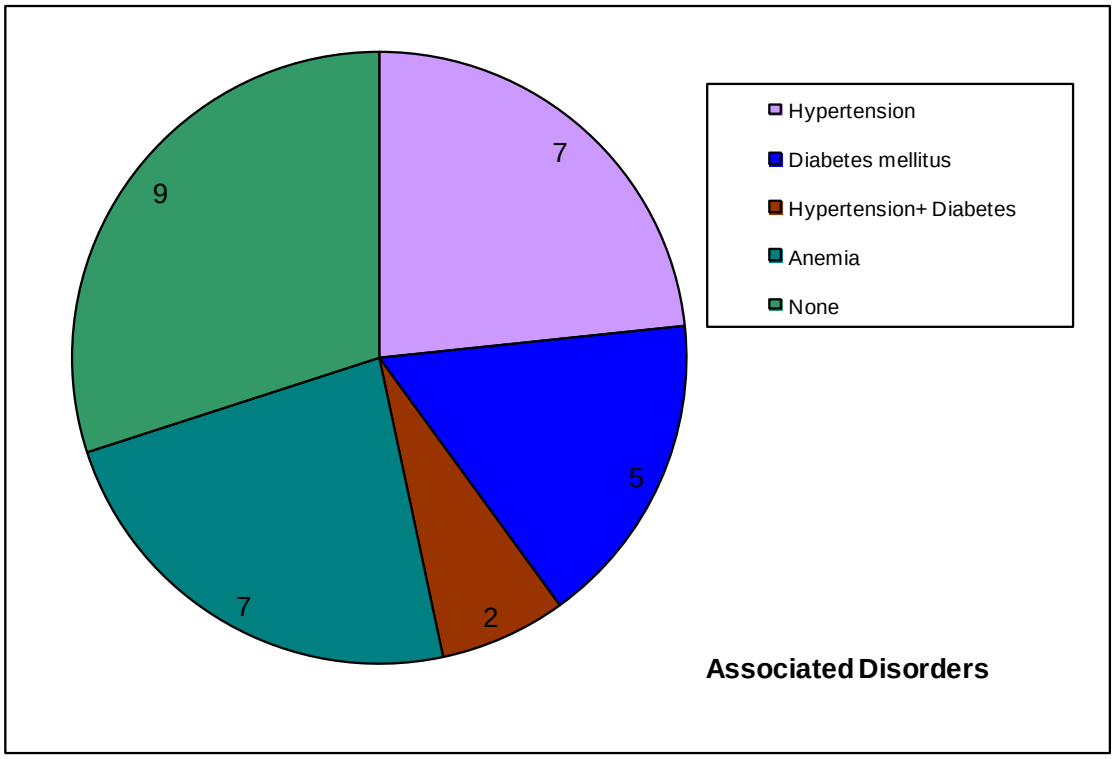
Table No.6

Associated Disorders

Disease	No. of Patients	Percentage
Hypertension	7	23.3%
Diabetes mellitus	5	16.6%
Hypertension+ Diabetes	2	6.6%
Anemia	7	23.3%
None	9	30%

Chart No.6

Associated Disorders



7. INTERVAL BETWEEN INJURY AND SURGERY

3 of the cases included presented more than 2 weeks following the fracture and were put on skeletal traction to regain the limb length. The cases associated with medical disorders were stabilized and physicians' advice was taken and only then operated. Cases without any significant medical disorder were operated on the following OT day.

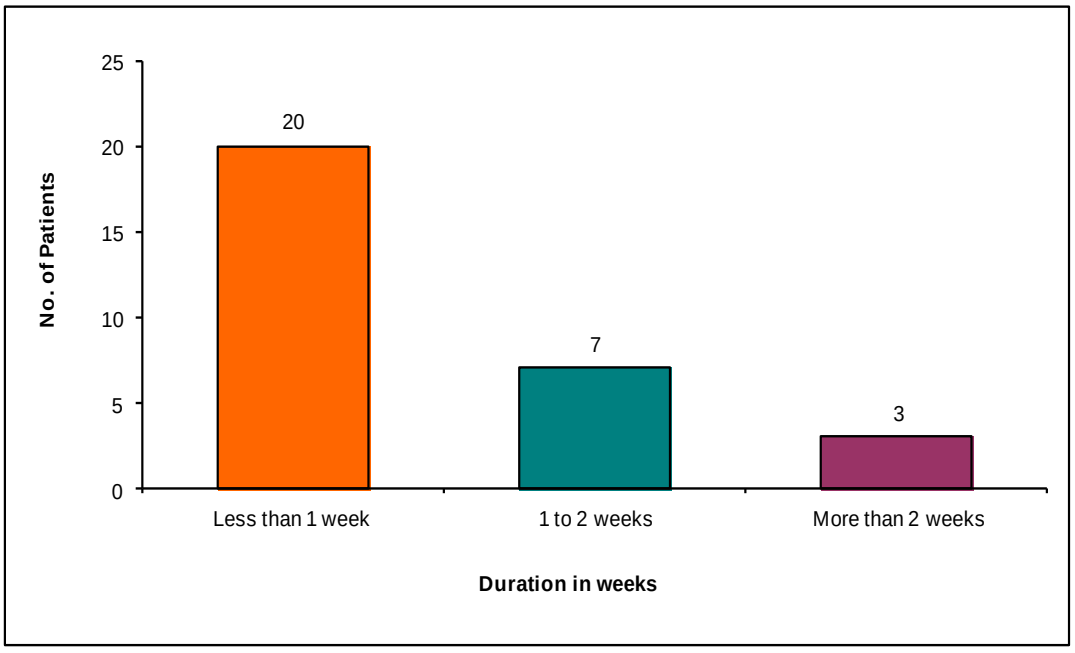
Table No.7

Duration

Duration in Weeks	No. of Patients	Percentage
Less than 1 week	20	66.6%
1 to 2 weeks	7	23.3%
More than 2 weeks	3	10%

Chart No.7

Duration



8. SIZE OF THE PROSTHESIS USED

In this study the size of the prosthesis ranged from 41-49mm. The most frequently used size was 45mm.

Table No.8

Prosthesis size

Head Size in mm	No. of Patients	Percentage
41	4	13.3%
43	8	26.6%
45	12	40%
47	4	13.3%
49	2	6.6%

9. OCCUPATION

Most of the patients in our study are villagers who are involved in agricultural work or are physically active with household work.

10. COMPLICATIONS

22 out of 30 cases in this study had no complications following the surgical procedure.

There were no cases of dislocation of the prosthesis, no cases of peri-prosthetic fracture nor any case of implant loosening or subsidence.

The complications seen were 3 cases of mortality, 3 cases of superficial infection and 2 cases of deep infection.

Table No.9

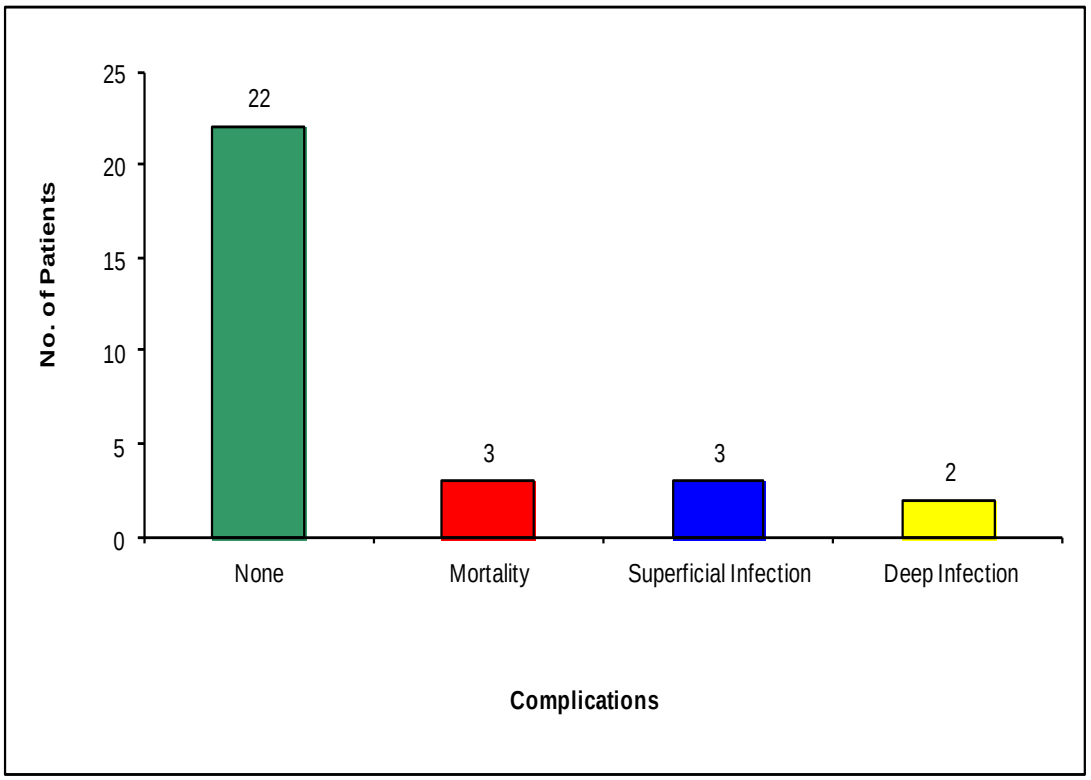
Complications

Complication	No. of Patients	Percentage
None	22	73.3%
Mortality	3	10%
Superficial Infection	3	10%
Deep Infection	2	6.6%

In about 40% of the cases (12 cases), limb length discrepancy was noted which averaged around 1 cm. There was no case with significant limb length discrepancy(> 3cm) that affected the functional outcome of the procedure.

Chart No.9

Complications



11. RESULTS

Out of 30 cases included in our study, 13 had excellent results (43.3%), 9 had good results (30%), 3 had fair results(10%) and 2 had poor results (6.6%).

The 2 cases with poor results had a prior fracture of the contralateral hip which was operated with hemiarthroplasty elsewhere. These patients had difficulty in ambulation prior to the recent hip fracture and fared poorly following the surgery.

Table No.10

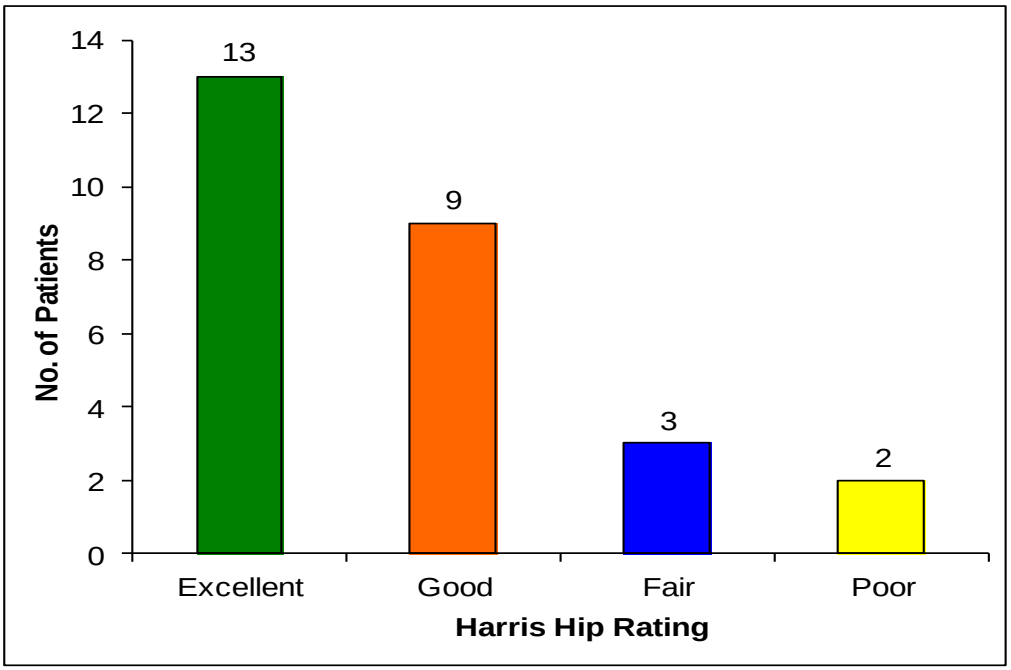
Results

Harris Hip Rating	No. of Patients	Percentage
Excellent	13	43.3%
Good	9	30%
Fair	3	10%
Poor	2	6.6%

In this study, good to excellent results were seen in 73.3% of the cases which is comparable with other similar studies.

Chart No.10

Results



Case No.21
EXCELLENT RESULT

Hip Flexion Following Surgery

Sitting Comfortably

Walking without Support

Surgical Wound

After Suture Removal

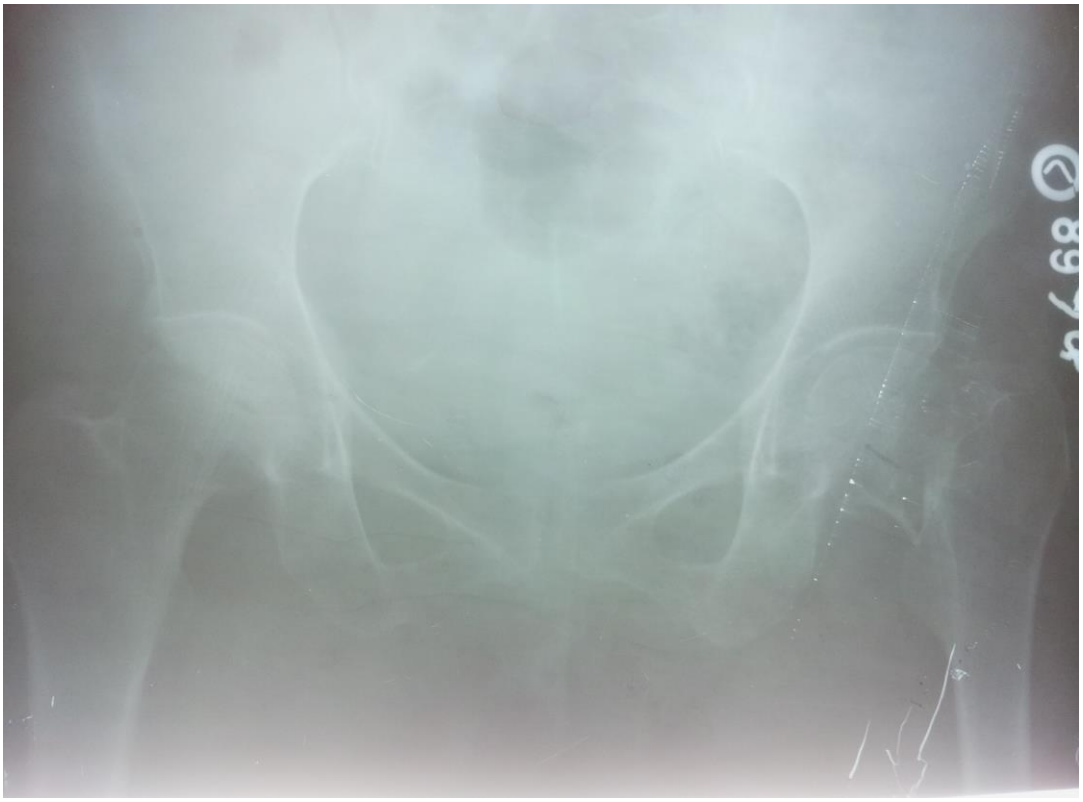
PRE OPERATIVE AND POST OPERATIVE X-RAYS OF FRACTURE NECK OF FEMUR TREATED WITH BIPOLAR PROSTHESIS

EXCELLENT RESULT

Case No.9

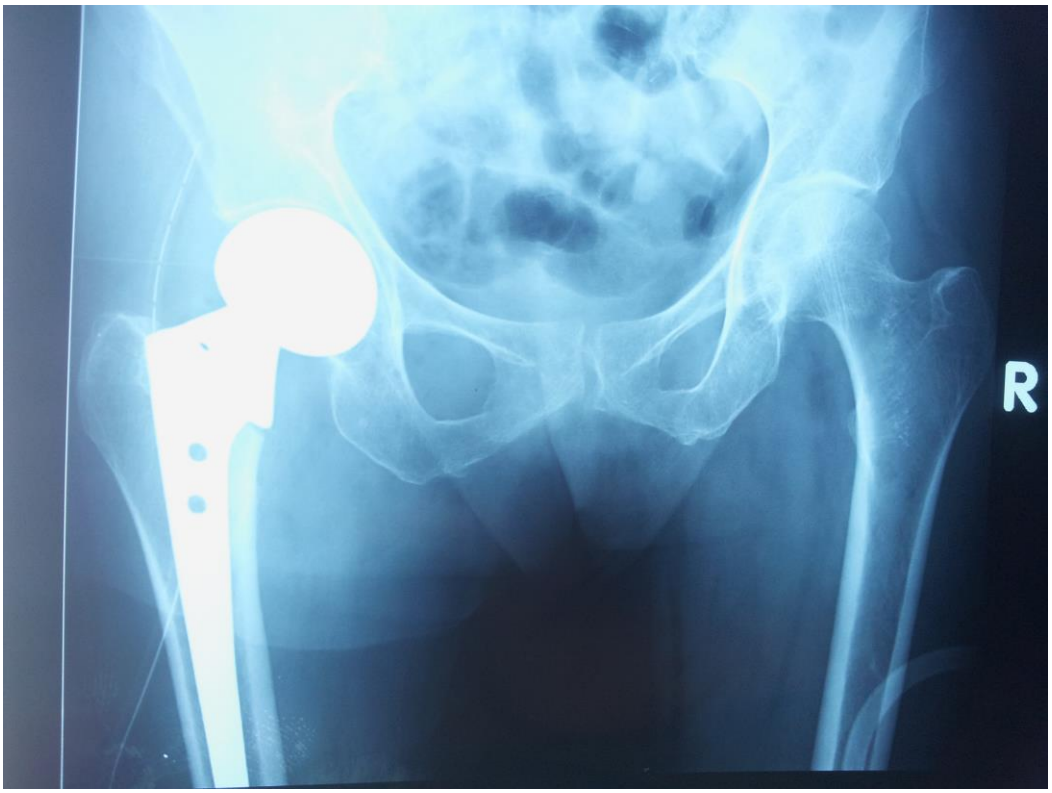
EXCELLENT RESULT

Case No.21



GOOD RESULT

Case No.14



FAIR RESULT

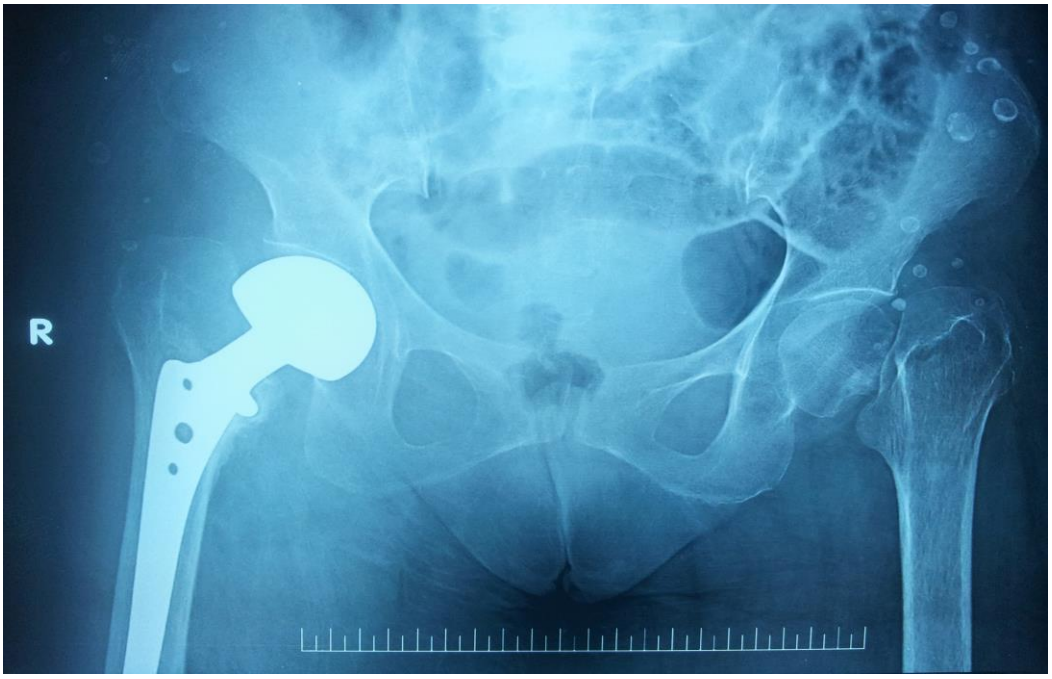
Case No.28

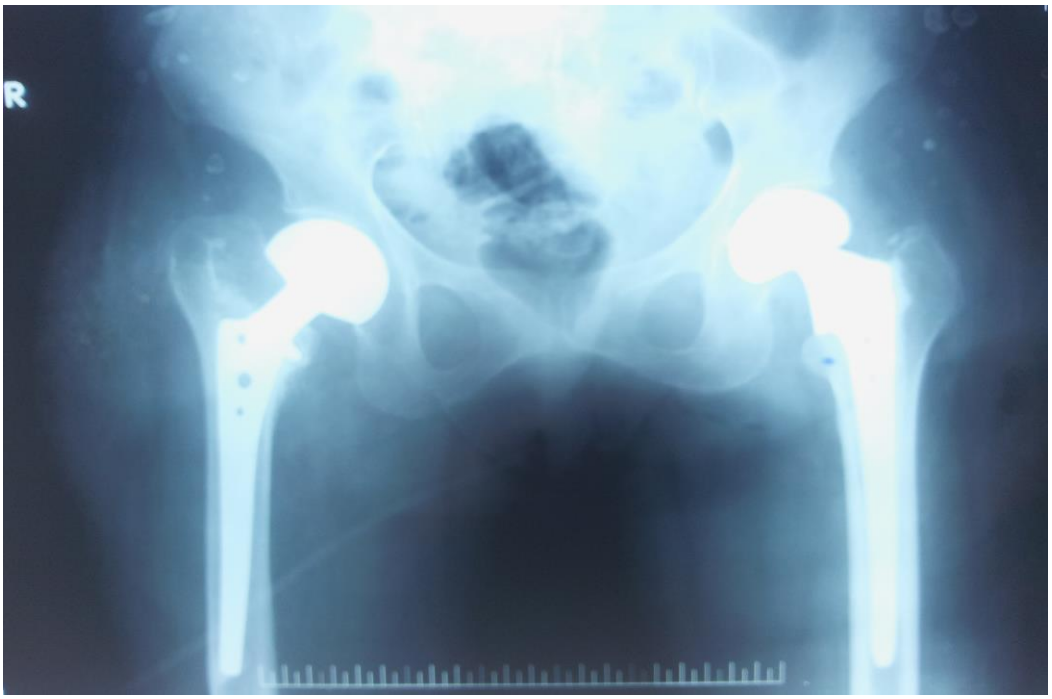
POOR RESULT

OLD FRACTURE NECK OF CONTRA LATERAL SIDE OPERATED WITH HEMIARTHROPLASTY

Pre-operative and Post-operative X-Rays of Fracture Neck of Left Femur

Case No.25





DISCUSSION

Management of fracture of femoral neck still remains a major and difficult undertaking for the orthopaedic surgeon. It is now the general consensus that reduction and internal fixation should be reserved for the younger patients in whom if needed revision surgery may be done at a later date. Primary prosthetic replacement should be considered in older patients who are active and need early mobilization.

In our study 30 cases of intracapsular displaced fracture neck of femur were treated with hemiarthroplasty with uncemented Bipolar Prosthesis in elderly patients. The observations were made and results analysed. The study was also compared with studies of other authors. Various aspects of the procedure have been observed and discussed in detail.

AGE DISTRIBUTION

The mean age in our series was 68.6 years with a range of 60-94 years with the majority of patients in the 60-70 year age group. Mean age of the male patients is 71.2 years and mean age of the female patients is 66.6 years.

This is comparable with other studies.

Anderson[57] (1904) - 65.7 years, Burwell[58] (1967) 73.8 years, Saxena & Saraf[59] (1978) 66 years, Mukherjee , Puri[60] (1986) 65 years, Arwade[61] (1987) 72 years.

SEX DISTRIBUTION

In our study the intracapsular fracture of femoral neck was found to be more common in females -56.6%.

The elderly females are more prone to fracture neck of femur due to osteoporosis (Choudhari & Mohite[62] 1987).

Female preponderance has been reported in several series. Moore[3] (1957) 62.5%, Campbell (1960) 80.9%; Cone (1963) 73.6%; Anderson & Neilson (1972) 85%; Sikroski & Barrington (1981) 66.7%; Arwade[61] (1987) 68.3%, Chen CH[35] (1998) 77.4%.

SIDE INVOLVED

13 of the 30 (43.3%) cases had fractures on right side while 17(56.6%) cases had fractures on the left side. But no specific reasons for the more frequent involvement of the left side were made. According to Hinchey (1964) 49% right and 51% left[63].

COMPLICATIONS

22 out of 30 cases(73.3%) in this study had no complications following the surgical procedure.

The complications seen were 3 cases of mortality, 3 cases of superficial infection and 2 cases of deep infection.

Mortality: Out of 30 cases in our study, 3 cases (10%) expired within the first six months following the surgery.

One 84 year old patient had poor general condition prior to the surgery with Hypertension, Diabetes and COPD and succumbed to cardio pulmonary arrest in a few months following the surgery.

One case had poor nutrition prior to the surgery and was non-compliant in following advice regarding mobilization and expired at home after a few months. The cause of death was not known.

The other case of mortality had hemiparesis of the contralateral side and poor general condition who had difficulty in ambulation prior to his hip fracture and expired within two months following the surgery. He died of cardio pulmonary arrest.

The incidence of early Post-operative mortality in reported series according to Riskea is 9.8% and Hinchey[63] is 2.3%.

Mortality mentioned in our series is mostly due to pre-existing medical conditions.

Table No.11 : Mortality reported after primary prosthetic replacement

Investigator	No. of patients	Mean Age	Time	Percentage
Moore(1957)	153	60-70	Operative 6 months	1.9 16.6
Stinchfield and Cooperman (1957)	14	72	1 year	22.2
Addison (1959)	54	79	6 weeks	30
Graclia et al (1961)			6 months	18
Hinchey and Day (1964) [63]	288		3 months 6 months	10 14
Burwell (1967) [58]	137		1 month 6 months	14 27
Anderson and Hamsa(1967) [57]	356	75	6 months	1.4
Lunt (1971)	98		1 month 6 months	22.5 31
Raine (1973)	52	77	6 months	33
Salvatti et al (1973)	251	59	1 month 6 months	13 14.4
Hunter (1979)	104	79	6 months	20
D'Acry and Devas (1976)	361	81.3	6 months 1 year	23 27
Johonson and Cr others (1975)	68	80.5	2 years	22
Sikroski and Barrington (1981)		70	6 months	36
Saraf and Saxena (1978)[59]	82	66	6 weeks	2.4
Mukherjee and Puri (1986)[60]	55	70		Nil
Arvade (1987)[61]	104	72	1 month	1.9
Bavadekar and Manelkar (1987)	328	75	1 year	10
C.M.Robinson(1994)	170		1 year	11
John E. Kenzora(1998)	232		1 yaer	17.2
Frank J. Raia (2003)[64]	115		1 year	20.8

Infection: 3 cases of superficial infection (10%) and 2 cases of deep infection (6.6%) were seen.

Table No.12 : Reported incidences of infection after primary prosthetic arthroplasty

Author Superficial infection Deep infection	**Total**
Salvatti et al[65] (1973) 8.3% 1.2%	9.5%
D'Acry and Devas[66] (1976) 7.4% 4.7%	12.1%
Hunter (1979) 7%	7%
Saraf and i: Saxena (1978)[59] 3.7% 2.4%	6.1%
Mukherjee and Puri[60] (1986) 3% 1%	4%
Bavadekar and Manelkar (1987) 7.6% 1.5%	9.5%
Jack and Moshein (1990) 2.3% 0.9%	3.2%
Our series (2012) 10% 6.6%	16.6%

The superficial infections were managed with regular dressings and antibiotic cover.

Organism grown in culture and sensitivity	No. of deep infections
Staphylococcus aureus	1
Pseudomonas aerugenosa	1

The 2 cases of deep infections were managed aggressively with appropriate antibiotics according to culture and sensitivity reports, regular dressings.

In both the cases, the wounds healed gradually and the patients' hospital stay was prolonged till the wound healed.

Salvatti et al[65] (1974) , Moore[3] (1940) and Whittaker (1974) have reported extremely high mortality rates following infection of the prosthesis.

Table No.13 : Organisms isolated in the infected cases after hemiarthroplasty

Nature of Infection	Organisms	Percentage of infections	
		Salvatti et al[65] (1973)	Our series
Superficial	Staphy. aureus	42.85	
	Staphy. albus		
	Pseudornonas	14.2	
	Proteus	5.7	
	E. Coli	66.67	
Deep	Staphy. aureus	25	50
	Staphy. albus	50	
	Diptheriod	12.5	
	E. Coli	12.5	
	Pseudomonas	12.5	50

In our study, there were no cases of dislocation of the prosthesis nor peri-prosthetic fractures, no cases of fat embolism and no cases of implant loosening or subsidence.

Limb length discrepancy

In about 40% of the cases (12 cases), limb length discrepancy was noted which averaged around 1 cm. There was no case with significant limb length discrepancy (> 3cm) that affected the functional outcome of the procedure.

RESULTS

Out of 30 cases included in our study, 13 had excellent results (43.3%), 9 had good results (30%), 3 had fair results (10%) and 2 had poor results (6.6%).

Therefore good to excellent results were seen in 73.3% of the cases which is comparable with other similar studies.

In the reported series – Anderson[57] (1964) had satisfactory result in 87.5%

Hinchey (1964)[63] had excellent to good result in 72.8%, fair in 10.6% and poor in 16.4% of cases

Burwell[58] (1967) had excellent to good results in 61.3%, fair in 26.3% and poor in 12.4% of cases

Both the cases with poor results in our study had a prior fracture of the contralateral hip which was operated with hemiarthroplasty elsewhere. These patients had difficulty in ambulation prior to the recent hip fracture and fared poorly following the surgery.

Hinchey[8] (1964) concluded that functional limitations after surgery were dependent more on the pre-existing medical conditions than on failure of the prosthesis itself.

CONCLUSION

From our study of 30 patients with displaced intracapsular fracture of femoral neck, we conclude that hemiarthroplasty with uncemented bipolar prosthesis in the elderly produces good functional outcomes with minimal complications and has several advantages. These results are comparable to the other similar studies.

Prosthetic replacement in individuals of waning years for displaced femoral neck fracture is a rational step as the period of hospitalization is reduced and early mobilization, return to independence are possible. It avoids late complications like non - union and avasacular necrosis.

With bipolar hemiarthroplasty there were few complications. Shorter hospital stay, earlier ambulation can be safely practiced. It is a cost effective, simple procedure with good outcome, but following hemiarthroplasty squatting and sitting cross legged are to be avoided.

Using an uncemented prosthesis has added benefits of shorter operative time, decreased intraoperative blood loss with similar results. It is not associated with any untoward cardiac events in the peri-operative period and is a viable treatment option in this select group.

Our study results and short follow up are encouraging and reinforced earlier studies.

SUMMARY

1. This study of uncemented bipolar hip hemiarthroplasty was done in 30 elderly patients for fracture neck of femur to evaluate the functional outcome.
2. The mean age of the patients was 68 years.
3. Female preponderance was seen (57%).
4. In this study 17 hips were on left side and 13 hips were on right side.
5. Most of the cases sustained the hip fracture following a trivial fall.
6. All the cases included in the study were displaced fractures of the femoral neck- Gardens' type III and IV.
7. All the cases were done through posterior approach.(Moore's)
8. The final results were evaluated in terms of pain, walking ability and range of motion (Harris Hip Score).
9. Most of the patients had good to excellent results.
10. Uncemented bipolar hip hemiarthroplasty is a good mode of treatment for fracture neck of femur with satisfactory results as confirmed by this study. However the patients need to modify their daily routine activities, preferably avoid squatting and sitting cross-legged on the floor.

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ANNEXURES

ANNEXURE - I

PROFORMA OF THE CASE SHEET

NAME:	**I.P. NO.:**
AGE:	**DATE OF ADMISSION:**
SEX: **ADDRESS:**	**DATE OF SURGERY:** **DATE OF DISCHARGE:**

I) PRESENTING COMPLAINTS:

1. Pain in the hip – Right/Left
2. Inability to walk after the injury
3. History of trauma and duration
4. Any other complaint

I) H/O OF PRESENTING ILLNESS

5. **Pain**
    a. Site
    b. Onset – Sudden/gradual
    c. Nature- continuous/intermittent
    d. Radiation to knee- Yes/No
    e. Relation with movements- increased/no change

6. **Ability to walk**
    a. Not able to walk
    b. Able to walk – with support/ without support

7. **Mechanism of injury**

Trivial –

a. Falling on a slippery floor
b. Missing a step and falling
c. Fall from a vehicle

Violent-

a. Road traffic accident
b. Fall from a height

II) TREATMENT HISTORY:- Yes/ No

III) METHOD OF FIRST AID GIVEN:-

IV) PAST HISTORY

a. History of previous injury
b. Hypertension
c. Diabetes Mellitus
d. Pulmonary Tuberculosis
e. Any other disease

V) FAMILY AND PERSONAL HISTORY

a. Married/unmarried
b. Smoker/non smoker
c. Alcoholic/ non alcoholic
d. Vegetarian/ mixed
e. Bladder and Bowel- Normal/ Altered
f. Nature of work

VI) GENERAL PHYSICAL EXAMINATION

a. Built- well/ moderate/ poor
b. Nourishment- well/ moderate/ poor
c. Height-
d. Weight-
e. Pallor, Icterus, Cyanosis, Clubbing, lymphadenopathy, edema
f. Temperature- febrile/ non febrile
g. Pulse rate-
h. Blood pressure-
i. Respiratory rate-

VII) SYSTEMIC EXAMINATION

1) Respiratory system
2) Cardio vascular system
3) Per- abdomen
4) Central nervous system

VII) LOCAL EXAMINATION

A) GAIT

B) INSPECTION

1) Anterior Superior Iliac spine – Same level/ raised
2) Lumbar lordosis- Yes/ No
3) Attitude of limb- a. External rotation/ internal rotation
   b. Abduction/adduction/flexion
4) Apparent shortening- Yes/ No
5) Swelling around the hip- Yes/ No
6) Muscle wasting- Yes/ No
7) Skin changes- scars, sinuses

C) PALPATION

1) Tenderness- Yes/ No
2) Local rise of temperature- Yes/ No
3) Broadening/ Migration of the greater trochanter- Yes/ No
4) Swelling
5) Vascular sign of Narath – Yes/ No
6) Crepitus
7) Transmitted movement- Yes/ No

D) MOVEMENT

	Active	**Passive**
a. Flexion		
b. Extension		
c. Adduction		
d. Abduction		
e. External rotation		
f. Internal rotation		

E) MEASUREMENTS

1) Length of the limb - Normal Affected

a. Apparent length
b. Total length (true)
c. Thigh segment
d. Leg segment
e. Girth of the limb

2) Shortening above the greater trochanter

Normal Affected

i. Bryant's triangle
ii. Nelalon's line
iii. Chiene's lines
iv. Shoemaker's line

VIII) EXAMINATION OF THE SPINE

a. Kyphosis
b. Scoliosis
c. Lordosis

IX) ANY ASSOCIATED INJURIES/ FRACTURES

X) INVESTIGATIONS

1. X-Ray hip- AP/ Lateral (Garden's type)
2. Chest X-Ray PA view
3. ECG

4. Routine Blood investigations-

Hb:	**PCV:**	**TC:**	**DC:**	
ESR:	**RBS:**	**B.Urea:**	**S.Creat:**	
HIV:	**Hbs Ag:**	**BT:**	**CT:**	**BLOOD GP:**

5. Urine routine
6. Special investigations- (if required)
   Liver Function Tests
   Renal Function Tests

XI) DIAGNOSIS

XII) IMMEDIATE MANAGEMENT

7) I.V. fluids

8) Parenteral antibiotics & analgesics

9) Blood transfusion

10) Splinting

11) Fixed skin traction in thomas splint

12) Upper tibial skeletal traction

XIII) INDICATIONS FOR SURGERY

Displaced fracture neck of femur in elderly patients

XIV) SIZE OF BIPOLAR PROSTHESIS USED

XV) APPROACH USED

XVI) ANAESTHESIA USED- SA/ GA

XVII)INTRA-OPERATIVE PROBLEMS

a. Excessive bleeding
b. Difficulty in dislocation(osteotomy of remaining portion of neck)
c. Difficulty in reduction
d. Prosthesis very loose- osteoporotic

XVIII) CHEMOPROPHYLAXIS

XIX) POST OPERATIVE MANAGEMENT

XX) COMPLICATIONS

XXI) FOLLOW UP

1. 6 weeks
2. 3 months
3. 6 months

ANNEXURE – II : MASTER CHART

No.	Name	Hospital No.	Age	Sex	Occupation	Mode of Injury	Side	Garden's Type	Duration before Surgery	Prosthesis Size	Associated Disorders	Complications	Result
1	Sabiyan Sab	630149	87	M	-	Fall	L	III	3 days	45	None	None	Excellent
2	Chikka Muniyappa	630566	60	M	Agriculture	Fall	L	III	5 days	47	None	None	Excellent
3	Muniyamma	630894	60	F	Housewife	Fall	R	IV	7 days	41	Anemia	None	Good
4	Kothur Muniyappa	646820	94	M	-	Fall	R	IV	12 days	45	Anemia	Superficial infection	Fair
5	Chikkaramappa	649915	60	M	Agriculture	RTA	L	IV	2days	45	None	None	Excellent
6	Shantha	657615	60	F	Housewife	Fall	R	III	5 days	43	DM	Deep infection	Good
7	Thimmiah	658825	68	M	Agriculture	RTA	L	IV	4 days	49	HTN	None	Good
8	Bissappa	667908	84	M	-	Fall	L	III	8 days	47	HTN,DM	Mortality	
9	Muniyamma	684395	65	F	Agriculture	Fall	L	IV	9 days	45	DM	None	Excellent
10	Shaffunnisa	691926	62	F	Housewife	Fall	R	IV	4 days	41	Anemia	Superficial infection	Good
11	Subramanya Gowda	695448	65	M	Agriculture	Fall	R	III	30 days	45	Anemia	Mortality	
12	Nagappa	696241	65	M	Agriculture	Stairs	L	III	5 days	49	None	None	Excellent
13	Ramamma	700878	86	F	-	Fall	R	III	3 days	45	DM	None	Fair
14	Munivenkatamma	703139	70	F	Agriculture	Fall	L	III	5 days	45	DM	None	Good
15	Munivenkatappa	716308	70	M	-	Fall	L	IV	6 days	45	HTN	None	Good
16	Yarramma	724262	61	F	Housewife	Fall	R	IV	4 days	41	HTN	None	Excellent
17	Rajamma	726431	65	F	Agriculture	Fall	R	IV	10 days	43	HTN	None	Excellent
18	Narayanamma	729554	65	F	Housewife	Fall	L	III	6 days	41	None	None	Excellent
19	Nanjamma	730129	80	F	Housewife	Fall	L	IV	2 days	45	Anemia	Superficial infection	Good
20	Alayamma	741712	60	F	Housewife	Fall	L	III	2 days	43	DM	None	Excellent
21	Venkatamma	745223	68	F	Housewife	Fall	R	IV	5 days	43	None	None	Excellent
22	Dasappa	747092	70	M	Agriculture	Fall	R	III	4 days	45	None	None	Good
23	Lakshman	747296	83	M	-	Fall	L	IV	10 days	47	Hemiparesis, Anemia	Mortality	
24	Shankaramma	749125	68	F	Housewife	Fall	R	IV	6 days	45	HTN	None	Excellent
25	Nagarathnamma	758864	78	F	Housewife	Fall	L	IV	30 days	43	HTN,DM	Deep infection	Poor
26	Selva Kumar	764918	60	M	-	Fall	L	IV	4 days	45	HTN	None	Poor
27	Krishnappa	785160	60	M	Agriculture	RTA	R	III	3 days	47	None	None	Excellent
28	Lakshmamma	795998	60	F	Agriculture	Stairs	L	IV	20 days	43	Anemia	None	Fair
29	Rajamma	799152	60	F	Housewife	Fall	L	III	5 days	43	None	None	Excellent
30	Nandishamma	823532	65	F	Housewife	Fall	R	III	8 days	43	HTN	None	Good

TITLE

"STUDY OF FUNCTIONAL OUTCOME OF FRACTURE NECK OF FEMUR IN THE ELDERLY TREATED WITH UNCEMENTED BIPOLAR PROSTHESIS"

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ABSTRACT

AIMS AND OBJECTIVES:

To study the functional outcome of fracture neck of femur in the elderly treated with uncemented bipolar prosthesis and to study the associated complications.

METHODOLOGY:

This is a prospective study of primary hemireplacement arthroplasty of the hip done in 30 patients with fracture neck of femur using uncemented bipolar prosthesis who were admitted into the Department of Orthopaedics in R.L.Jalappa Medical College and Research Center, Tamaka, Kolar, from December, 2010 to June 2012.

Follow up was done for a minimum of 6 months. The results were evaluated using the Harris Hip Rating.

RESULTS:

Out of 30 cases included in our study, there were 17 females and 13 males with a mean age of 68 years. 83% of the cases sustained the hip fracture following a trivial trauma. 56% of the hips were of the left side. Among the associated medical conditions hypertension, diabetes mellitus and anemia were common. 20 of the 30 cases were operated within a week following the fracture.

The complications seen were 3 cases of mortality, 3 cases of superficial infection and 2 cases of deep infection. 22 out of 30 cases in this study had no complications following the surgical procedure. There were no cases of dislocation of the prosthesis, no cases of peri-prosthetic fracture nor any case of implant loosening or subsidence.

In this study, 13 cases had excellent results (43.3%), 9 had good results (30%), 3 had fair results(10%) and 2 had poor results (6.6%). Good to excellent results were seen in 73.3% of the cases.

CONCLUSION:

From our study of 30 patients with displaced intracapsular fracture of femoral neck, we conclude that hemiarthroplasty with uncemented bipolar prosthesis in the elderly produces good functional outcomes with minimal complications and has several advantages. These results are comparable to the other similar studies. The functional limitations after surgery were dependent more on the pre-existing medical conditions than on failure of the prosthesis itself.

KEY WORDS: *Hemiarthroplasty, Fracture neck of femur, Uncemented Bipolar prosthesis, Harris Hip Rating.*

INTRODUCTION

Fracture neck of femur has been recognized since the time of Hippocrates. It commonly affects the frail and elderly population with devastating consequences for the individuals and places high demands over the health care system and society in general.[1]

Fracture of the femoral neck has always presented great challenges to orthopedic surgeons. It is considered an unsolved fracture even today.

The blood supply to the neck and head of femur is precarious.[2] The viability of the head is often doubtful following a fracture. Under these circumstances, we have to choose from internal fixation or hemi-replacement arthroplasty to total hip arthroplasty. Factors that could play a role in decision making include patient age, activity level and associated medical conditions.

Several authors have considered replacement of the femoral head as an alternative to internal fixation due to the frequent development of nonunion, failures of osteosynthesis and avascular necrosis of femoral head.

Since the last 50 years, Austin Moore and Thompsons prosthesis as hemi replacements devices have been extensively used. [3,4] The complications of these prostheses were erosion of the acetabulum, stem subsidence and loosening.

To overcome these complications a new prosthesis came to use in 1970's. It was called "Bipolar endoprosthesis"[5] This prosthesis has an inner metallic head that articulates with an outer metallic head which is lined on the inside by ultra-high density polyethylene liner of varying size. This outer head articulates with the retained articular cartilage of the acetabulum.

In modern days the bipolar prosthesis with or without cement is the most frequently used prosthesis for hemiarthroplasty of hip as a primary procedure as it is always possible to do total hip replacement at a later date. If it is difficult to

produce a snug press-fit of the stem in medullary canal and if the bone is osteoporotic, then poly methyl methacrylate bone cement can be used. Some surgeons might opt for a total hip replacement in an older patient, as a primary procedure.

This study is aimed at evaluating the outcome of primary hemiarthroplasty for fracture neck of femur using uncemented bipolar hemiarthroplasty at our centre.

MATERIALS AND METHODS

In this study, primary hemireplacement arthroplasty of the hip was done in 30 patients with fracture neck of femur using uncemented bipolar prosthesis who were admitted into the Department of Orthopaedics in R.L.Jalappa Medical College and Research Center, Tamaka, Kolar, from December, 2010 to June 2012.

Follow up was carried out at 6 weeks, 3 months and 6 months. The results were evaluated in terms of pain, function, range of movement and any visible deformity using the Harris Hip Rating.

Inclusion Criteria:

Patients with fracture neck of femur aged above 60 years.

Exclusion criteria:

1. Patients who were non ambulatory prior to the fracture.
2. Patients who are medically unfit for surgery.

PRE-OPERATIVE EVALUATION

These patients were admitted in the hospital and details like name, age, sex, occupation, address were noted. History regarding the mode of injury, past

history of any medical disorders, pre injury ambulatory status was recorded and detailed clinical examination was done.

INVESTIGATIONS

X-ray of the pelvis with both hips, anteroposterior view was taken with both the limbs in 15^0 of internal rotation.

Thickness of the cortex of the femur, width and shape of medullary canal, bone stock, type of fracture (Garden's classification[6]), amount of calcar present, level of· femoral neck cut to be made, pre-operative size of the head and bone stock of acetabulum was noted.

Chest, X-ray and ECG were done. A complete blood analysis including Hb %, TC, DC, ESR, RBS, FBS, PPBS, Serum urea, Serum creatinine, blood grouping and typing, bleeding time and clotting time were done. Urine analysis was done and urine culture done if required. Liver function tests and renal function tests were done if required.

PRE-OPERATIVE TREATMENT

For fresh fractures Bucks traction with 3 - 4 kg weight was applied to relieve the pain and muscle spasm. For fractures more than 1 week and for those with limb shortening, an upper tibial skeletal traction with 5 kg to 10 kg of weight was applied till the limb length could be equalized.

The part was prepared 24 hours before operation taking care to prevent abrasions. Preoperative anaesthetic assessment was done.

The following training was given to the patients preoperatively so that the same could be carried out post-operatively like,

1.Deep breathing exercise.

2.Static quadriceps exercises.

3.Ankle and toe movement.

4.Active hip exercises (of the normal hip to familiarize the exercises)

5. Building of muscle power of the upper extremities.

A written consent of the patient and relatives was taken.

Injection cefotriaxone 1 gm was administered intravenously prior to surgery.

SURGICAL PROCEDURE

The patient is placed in a lateral position under spinal anaesthesia with the affected hip facing upwards. The part is scrubbed with 10% Povidone iodine scrub (betadine scrub) and then painted with 5% Povidone iodine solution (betadine solution) and draped.

Posterior approach (Moore's/ Southern) was used in all the cases in this study. The incision begins approximately 10cms distal and slightly lateral to the posterior superior iliac spine and is extended distally and laterally parallel to the fibers of Gluteus maximus to the posterior margin of the greater trochanter.

Then the incision is directed distally parallel to the femoral shaft for approximately 5cms or more depending upon the built of the patient.

The deep fascia is divided in line with the skin incision; blunt dissection of gluteus maximus is done and is retracted.

The short external rotators, viz; from below upward, the Quadratus femoris, the Obturator internus; Gemelli and the Pyriformis are exposed. The Obturator internus and gemelli and if necessary the piriformis are divided close to their insertions, and reflected backwards. These muscles, when retracted,

will cover the sciatic nerve and thus protect it from injury. Thus, posterior part of capsule is well exposed.

A T-shaped incision is made in the hip capsule, in line with the femoral neck and across its base. The capsule is retracted and labrum is preserved.

Then the thigh and knee are flexed to 90°, adducted and, internally rotated thus dislocating the hip posteriorly. The femoral head is extracted using bone levers or a cork screw. The remnant of ligamentum teres is excised and any loose pieces of bone in the acetabulum removed, the cartilage of the acetabulum is inspected for any degenerative changes.

The femoral neck is cut using an oscillating motor saw or an osteotome in such a way that enough of the calcar (5mm to 10 mm) remained to support the medial aspect of the prosthesis.

The size of the femoral head removed from the acetabulum is measured using a head gauge and trial or definitive prosthesis was checked for the fit. The head size should be neither too loose nor too tight.

Then an awl or straight currete is inserted in line with the femoral shaft to aid in entering the diaphyseal medullary canal. Then with an appropriate broach or rasp medullary canal is enlarged in valgus and 10°- 15° of anteversion relative to the plane in which the knee joint axis lies.

Then the appropriate sized prosthesis is seated in the prepared medullary canal with l0-15°of anteversion and a valgus position. The prosthesis is impacted with gentle blows into the medullary canal. Then prosthesis is reduced gently into the acetabulum.

Muller noted that the center of the head of the prosthesis should be slightly superior to the level of the upper edge of the greater trochanter. If it is too high riding, some more neck should be osteotomized to enable easy reduction of prosthesis and prevent post-operative limb lengthening.

The hip is tested for full range of movements and stability intra-operatively.

The wound is closed meticulously in layers over a suction drain, if necessary, maintaining hemostaisis throughout the procedure and dressing is applied. Blood loss is assessed and blood transfusion carried out if required.

During the insertion of the prosthesis into the proximal femur, if the implant was found be loose within the medullary canal, Poly Methyl Methacrylate Bone Cement has to be used so that the prosthesis fits snugly.

All the cases in the current study were done without using bone cement.

RESULTS

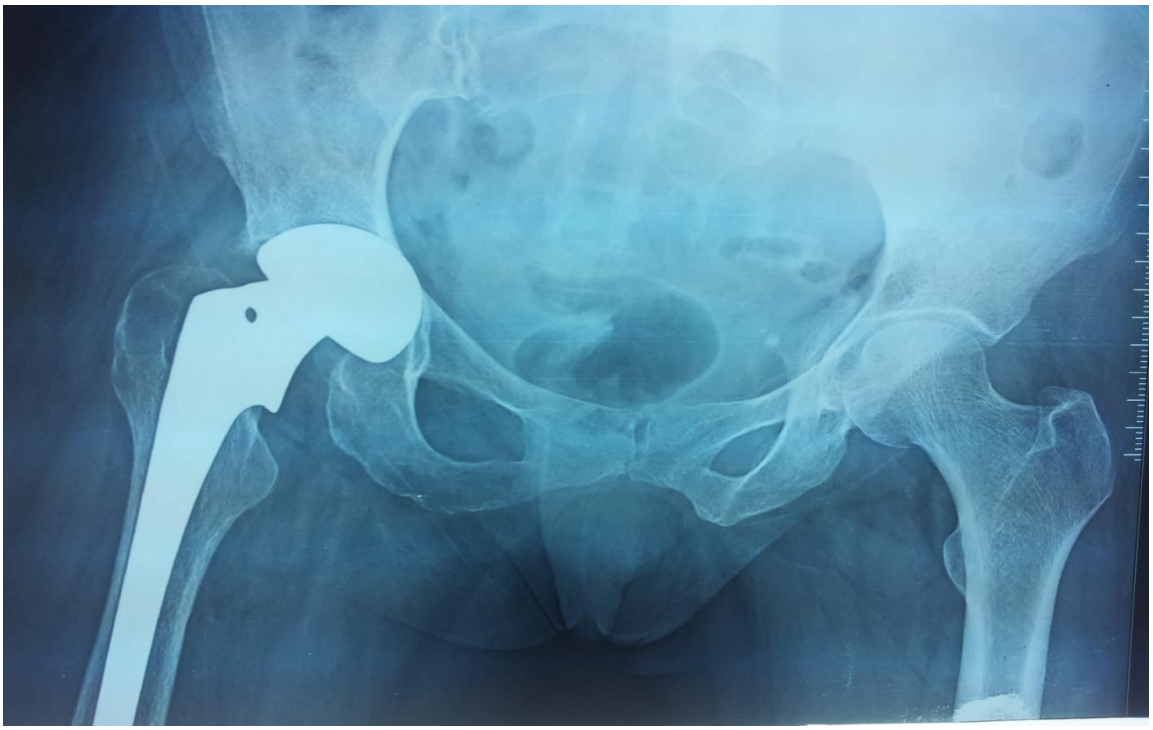
In our study of 30 cases of fracture neck of femur treated with hemiarthroplasty using uncemented Bipolar prosthesis, the results obtained are as follows-

- The mean age of patients in our study is 68.3 years with a range of 60 to 94 years, with most patients between the ages 60 to 70.
- Out of 30 cases, 17 were females(57%) and 13 were males(43%).
- 17 out of 30 cases involved the left hip.
- Most of the cases in our study sustained a hip fracture following a trivial fall like fall from bed, while walking, from a bicycle, fall on a slippery floor etc. 3 patients sustained a road traffic accident leading to a hip fracture. 2 cases sustained the fracture following a fall down the stairs.
- All the cases included in our study were displaced fracture neck of femur- Gardens' type III(47%) and type IV(54%)
- Among the associated medical conditions hypertension (23%), diabetes mellitus (16%), hypertension and diabetes together (6%) and anemia(23%) were seen. No associated disorders were seen in 30% of the cases.
- 20 out of the 30 cases were operated within a week following the fracture.
- In this study the size of the prosthesis ranged from 41-49mm. The most frequently used size was 45mm.
- Most of the patients in our study are villagers who are involved in agricultural work or are physically active with household work.
- The complications seen were 3 cases of mortality, 3 cases of superficial infection and 2 cases of deep infection. 22 out of 30 cases in this study had no complications following the surgical procedure.There were no cases of dislocation of the prosthesis, no cases of peri-prosthetic fracture nor any case of implant loosening or subsidence.
- Out of 30 cases included in our study, 13 had excellent results (43.3%), 9 had good results (30%), 3 had fair results(10%) and 2 had poor results (6.6%). Good to excellent results were seen in 73.3% of the cases.

PRE OPERATIVE AND POST OPERATIVE X-RAYS OF FRACTURE NECK OF FEMUR TREATED WITH BIPOLAR PROSTHESIS

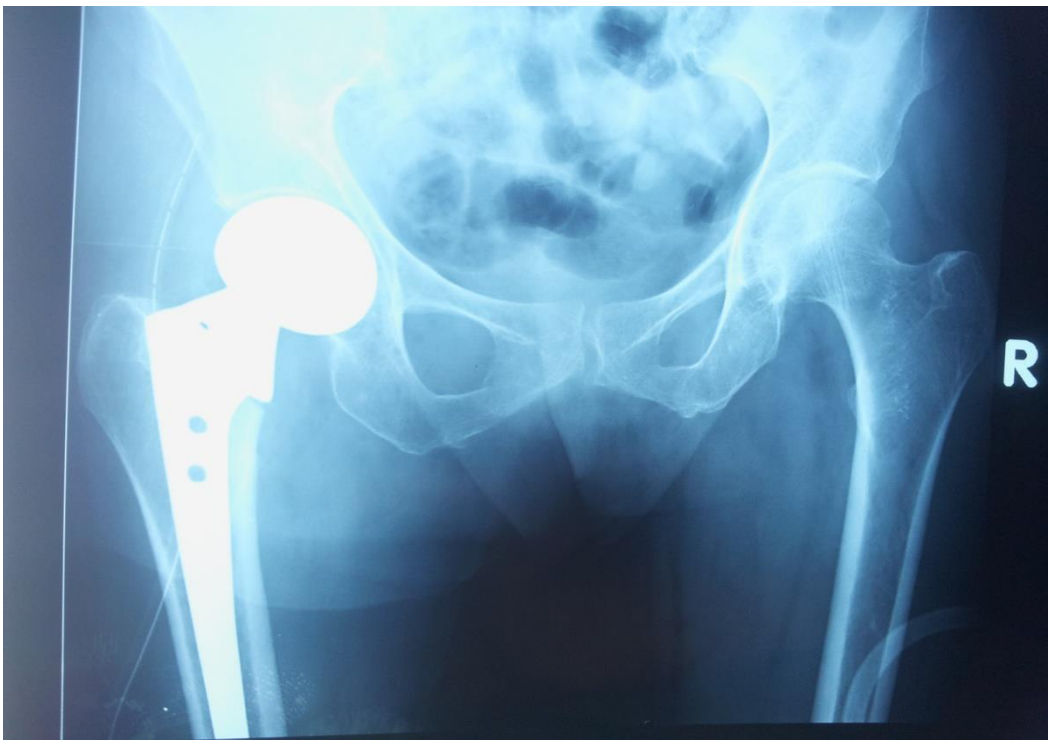
EXCELLENT RESULT

Case No.9



GOOD RESULT

Case No.14



DISCUSSION

Management of fracture of femoral neck still remains a major and difficult undertaking for the orthopaedic surgeon. It is now the general consensus that reduction and internal fixation should be reserved for the younger patients in whom if needed revision surgery may be done at a later date. Primary prosthetic replacement should be considered in older patients who are active and need early mobilization.

In our study 30 cases of intracapsular displaced fracture neck of femur were treated with hemiarthroplasty with uncemented Bipolar Prosthesis in elderly patients. The observations were made and results analysed. The study was also compared with studies of other authors. Various aspects of the procedure have been observed and discussed in detail.

AGE DISTRIBUTION

The mean age in our series was 68.6 years with a range of 60-94 years with the majority of patients in the 60-70 year age group. Mean age of the male patients is 71.2 years and mean age of the female patients is 66.6 years.

This is comparable with other studies.

Anderson[7] (1904) - 65.7 years, Burwell[8] (1967) 73.8 years, Saxena & Saraf[9] (1978) 66 years, Mukherjee , Puri[10] (1986) 65 years, Arwade[11] (1987) 72 years.

SEX DISTRIBUTION

In our study the intracapsular fracture of femoral neck was found to be more common in females -56.6%.

The elderly females are more prone to fracture neck of femur due to osteoporosis (Choudhari & Mohite[12] 1987).

Female preponderance has been reported in several series. Moore[3] (1957) 62.5%, Campbell (1960) 80.9%; Cone (1963) 73.6%; Anderson & Neilson (1972) 85%; Sikroski & Barrington (1981) 66.7%; Arwade[11] (1987) 68.3%, Chen CH[17] (1998) 77.4%.

SIDE INVOLVED

13 of the 30 (43.3%) cases had fractures on right side while 17(56.6%) cases had fractures on the left side. But no specific reasons for the more frequent involvement of the left side were made. According to Hinchey (1964) 49% right and 51% left[13].

COMPLICATIONS

22 out of 30 cases(73.3%) in this study had no complications following the surgical procedure.

The complications seen were 3 cases of mortality, 3 cases of superficial infection and 2 cases of deep infection.

Mortality: Out of 30 cases in our study, 3 cases (10%) expired within the first six months following the surgery.

One 84 year old patient had poor general condition prior to the surgery with Hypertension, Diabetes and COPD and succumbed to cardio pulmonary arrest in a few months following the surgery.

One case had poor nutrition prior to the surgery and was non-compliant in following advice regarding mobilization and expired at home after a few months. The cause of death was not known.

The other case of mortality had hemiparesis of the contralateral side and poor general condition who had difficulty in ambulation prior to his hip fracture and expired within two months following the surgery. He died of cardio pulmonary arrest.

The incidence of early Post-operative mortality in reported series according to Riskea is 9.8% and Hinchey[13] is 2.3%.

Mortality mentioned in our series is mostly due to pre-existing medical conditions.

Table No.11 : Mortality reported after primary prosthetic replacement

Investigator	No. of patients	Mean Age	Time	Percentage
Moore(1957)	153	60-70	Operative 6 months	1.9 16.6
Stinchfield and Cooperman (1957)	14	72	1 year	22.2
Addison (1959)	54	79	6 weeks	30
Graclia et al (1961)			6 months	18
Hinchey and Day (1964) [13]	288		3 months 6 months	10 14
Burwell (1967) [8]	137		1 month 6 months	14 27
Anderson and Hamsa(1967)[7]	356	75	6 months	1.4
Lunt (1971)	98		1 month 6 months	22.5 31
Raine (1973)	52	77	6 months	33
Salvatti et al (1973)	251	59	1 month 6 months	13 14.4
Hunter (1979)	104	79	6 months	20
D'Acry and Devas (1976)	361	81.3	6 months 1 year	23 27
Johonson and Cr others (1975)	68	80.5	2 years	22
Sikroski and Barrington (1981)		70	6 months	36
Saraf and Saxena (1978)[9]	82	66	6 weeks	2.4
Mukherjee and Puri (1986)[10]	55	70		Nil
Arvade (1987)[11]	104	72	1 month	1.9
Bavadekar and Manelkar (1987)	328	75	1 year	10
C.M.Robinson(1994)	170		1 year	11
John E. Kenzora(1998)	232		1 yaer	17.2
Frank J. Raia (2003)[14]	115		1 year	20.8

Infection: 3 cases of superficial infection (10%) and 2 cases of deep infection (6.6%) were seen.

Table No.12 : Reported incidences of infection after primary prosthetic arthroplasty

Author Superficial infection Deep infection	Total
Salvatti et al[15] (1973) 8.3% 1.2%	9.5%
D'Acry and Devas[16] (1976) 7.4% 4.7%	12.1%
Hunter (1979) 7%	7%
Saraf and i: Saxena (1978)[9] 3.7% 2.4%	6.1%
Mukherjee and Puri[10] (1986) 3% 1%	4%
Bavadekar and Manelkar (1987) 7.6% 1.5%	9.5%
Jack and Moshein (1990) 2.3% 0.9%	3.2%
Our series (2012) 10% 6.6%	16.6%

The superficial infections were managed with regular dressings and antibiotic cover.

Organism grown in culture and sensitivity	No. of deep infections
Staphylococcus aureus	1
Pseudomonas aerugenosa	1

The 2 cases of deep infections were managed aggressively with appropriate antibiotics according to culture and sensitivity reports, regular dressings.

In both the cases, the wounds healed gradually and the patients' hospital stay was prolonged till the wound healed. Salvatti et al[15] (1974) , Moore[3] (1940) and Whittaker (1974) have reported extremely high mortality rates following infection of the prosthesis.

Table No.13 : Organisms isolated in the infected cases after hemiarthroplasty

Nature of Infection	Organisms	Percentage of infections	
		Salvatti et al[15] (1973)	Our series
Superficial	Staphy. aureus	42.85	
	Staphy. albus		
	Pseudornonas	14.2	
	Proteus	5.7	
	E. Coli	66.67	
Deep	Staphy. aureus	25	50
	Staphy. albus	50	
	Diptheriod	12.5	
	E. Coli	12.5	
	Pseudomonas	12.5	50

In our study, there were no cases of dislocation of the prosthesis nor peri-prosthetic fractures, no cases of fat embolism and no cases of implant loosening or subsidence.

Limb length discrepancy

In about 40% of the cases (12 cases), limb length discrepancy was noted which averaged around 1 cm. There was no case with significant limb length discrepancy (> 3cm) that affected the functional outcome of the procedure.

RESULTS

Out of 30 cases included in our study, 13 had excellent results (43.3%), 9 had good results (30%), 3 had fair results (10%) and 2 had poor results (6.6%).

Therefore good to excellent results were seen in 73.3% of the cases which is comparable with other similar studies.

In the reported series – Anderson[7] (1964) had satisfactory result in 87.5%

Hinchey (1964)[13] had excellent to good result in 72.8%, fair in 10.6% and poor in 16.4% of cases

Burwell[8] (1967) had excellent to good results in 61.3%, fair in 26.3% and poor in 12.4% of cases

Both the cases with poor results in our study had a prior fracture of the contralateral hip which was operated with hemiarthroplasty elsewhere. These patients had difficulty in ambulation prior to the recent hip fracture and fared poorly following the surgery.

Hinchey[13] (1964) concluded that functional limitations after surgery were dependent more on the pre-existing medical conditions than on failure of the prosthesis itself.

CONCLUSION

From our study of 30 patients with displaced intracapsular fracture of femoral neck, we conclude that hemiarthroplasty with uncemented bipolar prosthesis in the elderly produces good functional outcomes with minimal complications and has several advantages. These results are comparable to the other similar studies.

Prosthetic replacement in individuals of waning years for displaced femoral neck fracture is a rational step as the period of hospitalization is reduced and early mobilization, return to independence are possible. It avoids late complications like non - union and avasacular necrosis.

With bipolar hemiarthroplasty there were few complications. Shorter hospital stay, earlier ambulation can be safely practiced. It is a cost effective, simple procedure with good outcome, but following hemiarthroplasty squatting and sitting cross legged are to be avoided.

Using an uncemented prosthesis has added benefits of shorter operative time, decreased intraoperative blood loss with similar results. It is not associated with any untoward cardiac events in the peri-operative period and is a viable treatment option in this select group.

Our study results and short follow up are encouraging and reinforced earlier studies.

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