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A Study of Functional and Radiological Outcome of Unipolar and bipolar Hemiarthroplasty In fracture neck of femur

Dr.Kokkinti Vijay Bharath
Postgraduate, Department of orthopaedics,
Alluri Sitarama Raju Academy of Medical Sciences,
Eluru, West Godavari District, Andhra Pradesh, 534005, India.

Dr.Puli chandrahasgayathree
Post graduate,Department of orthopaedics,
Alluri Sitarama Raju Academy of Medical Sciences,
Eluru, West Godavari District, Andhra Pradesh, 534005, India.

Dr.S.V.Gopalakrishna
Assistantprofessor, Department of orthopaedics,
Alluri Sitarama Raju Academy of Medical Sciences,
Eluru, West Godavari District, Andhra Pradesh, 534005, India.

Dr.C. V. Dasaraiah
HOD &Proffesor, Department of orthopaedics,
Alluri Sitarama Raju Academy of Medical Sciences,
Eluru, West Godavari District, Andhra Pradesh, 534005, India.

ABSTRACT
BACKGROUND AND OBJECTIVES:
Femur neck fractures and its consequences are a major cause of morbidity and mortality. Both unipolar and bipolar hemiarthroplasty aid in the patient's early mobilisation and increase their useful life.
MATERIALS AND METHODS:
This study comprised 40 individuals with intracapsular neck of femur fractures. 20 patients received bipolar hemiarthroplasty treatment, while 20 patients received unipolar hemiarthroplasty treatment.
Patients in both groups had their functional outcomes assessed using the Harris Hip score. Patients had radiological evaluation as well. The Chi-square test was used to analyse the data using SPSS 20.00.
RESULTS:
Our overall mean Harris hip score prior to surgery for unipolar and bipolar hemiarthroplasty was 36.2 and 39.1, respectively. These scores climbed to 81.8 and 85.05, respectively, with a p-value of 0.561. Also, according to our results, the bipolar group had a 35% outstanding success whereas the unipolar group had a 15% good result for hemiarthroplasty.
CONCLUSION:
According to the findings of our investigation, uncemented bipolar hemiarthroplasty performed better than uncemented unipolar hemiarthroplasty. Our Results further indicate that, clinically and radiologically, cemented bipolar hemiarthroplasty performed better than cemented unipolar hemiarthroplasty. In general, bipolar hemiarthroplasty performed better than unipolar hemiarthroplasty

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I. INTRODUCTION

The pelvic girdle and lower leg are connected by the hip joint. The hip joint can perform a variety of movements and is built for stability. This multiaxial ball and socket joint works as a crucial shock absorber for the torso and upper body while allowing the entire lower limb to move in three planes of motion.

One of the main factors impairing human locomotion is pain in the hip joint. There are numerous approaches to treating this incapacitating hip pain.

Hemiarthroplasty is a procedure to repair the muscles, ligaments, and other soft tissue structures that control a joint's motion, stability, and function. The replacement of the broken femoral stem with an artificial one had such a deep social influence and such a spectacular early success.

If reliable union is to occur, reduction, compression, and firm internal fixation are necessary for displaced femoral neck fractures. In senior ambulatory patients, primary prosthetic replacement is usually advised by surgeons as an alternative to internal treatment of displaced femoral neck fractures due to the high incidence of nonunion and osteonecrosis.

Prosthetic replacement allows immediate weight bearing to return elderly patients to activity and help avoid complications of recumbency and inactivity. When the concept of prosthetic replacement was first introduced, this perhaps was the most important advantage. As a primary procedure, prosthetic replacement eliminates osteonecrosis and nonunion as complications of femoral neck fractures.[37]

The complications of persistent pain and protrusioacetabuli with unipolar hemiarthroplasties have led many surgeons to choose a bipolar system. Studies suggest that the current generation of bipolar hemiarthroplasties have a lower incidence of protrusioacetabuli than do earlier designs. Some authors have found, however, that the motion of the inner bearing surface may not last, and that all bipolar hips functionally become unipolar implants.

The decision to perform hemiarthroplasty using a unipolar or bipolar prosthesis remains controversial, with proponents on either side. Advantages of the unipolar prosthesis include lower cost and no risk of polyethylene wear debris. Proposed advantages of the bipolar prosthesis include less acetabular wear and potentially less hip/groin pain.[38]

So in view of these varied opinions we desire to compare the efficiency of these two prosthesis unipolar and bipolar prosthesis for the management of intracapsular fractures of neck of femur in elderly people.

II. MATERIALS AND METHODS

Study Design: Comparative study

Study Settings: Orthopaedicsdepartment in alluriseetaramaraju academy of medical sciences.
Duration of the Study: 18 months (December 2020 to April 2022)
Total number of groups: 2
Detailed description of the study groups:

- First group - Unipolar Hemiarthroplasty
- Second group - Undergoing Bipolar Hemiarthroplasty.

SAMPLING

a. Sample size of each group: 20

b. Total sample size of the study: 40

C.Scientific basis of sample size used in the study

Sample size (n) = $Z_1\sqrt{2\,p(1-p)}+Z_2\sqrt{[p_1(1-p_1)+p_2(1-p_2)}^{\,2}$ **Z_1= Z value associated with set of alpha = 1.64 [fixed]**

P_1= probability of outcome in unipolar = 79.79
P_2= probability of outcome in bipolar = 86.18
P= P1+P2/2 = 0.82
Sample size =19.5 = 20
So, sample size for unipolar =20 and Sample size for bipolar =20
d. Sampling technique: Convenient sampling

Inclusion criteria:

1.Displaced intracapsular fracture of the neck of the femur with adequate calcar.
2. Male and female patients of age 60 years and above
3. Neglected intracapsular fractures of the neck of the neck femur more than 3-4 weeks old in elderly patients.
4. Non-union of intracapsular fractures of the neck of femur in elderly patients.
5. Unilateral fracture neck of femur.

Exclusion criteria:

1. Fracture of the neck of the femur in younger patients.
2. Extra capsular fractures of the neck of femur
3. Patient with neurological disorders
4. Any other, patients associated with any other ipsilateral or contralateral fracture of upper and lower extremities
5. Pathological fracture neck of femur.
6. Fracture neck of femur with shaft of femur fracture.
7. Bilateral fracture neck of femur.

Table1. Comparison between Unipolar and bipolar prosthesis

	Unipolar	**Bipolar**
Total No. of Patients	20	20
Total No. of Hips	20	20
Age	64 to 82 years (mean 69.45 years)	65 to 88 years (mean 74.6 years)
Cemented / Uncemented	Cemented = 10 Un cemented = 10	Cemented = 10 Un cemented = 10
Right/Left	Left =11 Right =9	Left =12 Right =8
Approach	Posterior	Posterior
Unilateral / Bilateral	20/0	20/0
Study	Retrospective and Prospective	Retrospective and Prospective
Follow up	12 to 85 months (Mean follow up – 48.2 months)	12 to 84 months (Mean follow up – 46.2 months)

PREOPERATIVE EVALUATION

Clinical

Preoperatively the patients were evaluated using the Harris hip score. This score takes into account pain, function, absence of deformity and range of motions. The general condition of the patient including his physical and mental status, general medical condition and ability to withstand surgery is considered. Physical status should include both upper and lower extremities including opposite hip, both knees, feet and spine. Any fixed deformities and limb length discrepancy was noted. Trendelenberg test to access the abductor Osseomuscular mechanism was noted.

Investigations

The complete blood count, ASO, ESR, CRP, urine analysis, chest x- ray and multi channel ECG were done as a routine.

Preoperative radiographic assessment

- X ray Pelvis with both hips AP view
- X ray of affected hip AP and Lateral view

Preoperative planning includes templating the x-rays. Goals of preoperative planning are

1. To determine the correct site, size and implant (uncemented/ cemented).
2. To restore the anatomic and biomechanical center of rotation of the hip joint.
3. To restore any limb length discrepancy
4. To restore appropriate muscle relationships.

OUR SURGICAL PROCEDURE

Preparation of Patient

On the day of surgery, skin is prepared using povidone-iodine solution and covered with sterile drapes and brought to the theatre where a final preparation is done. Prophylactic antibiotic is given on the table. We prefer third generation cephalosporin in the dose of 1 gm given IV along with an Aminoglycoside for 72 hours.

Operation theatre:

Though many hemiarthroplasties are being done in theatres with laminar flow, using body exhaust systems to reduce exogenous bacterial contamination even now, it is possible to achieve a comparable rate of infection in a conventional operating theatre if adequate precautions are taken to maintain asepsis such as thorough fumigation, air-conditioning, limiting the flow of traffic through the theatre to essential personnel only, use of prophylactic antibiotics, maximal operative speed and minimal conversation.

Fig 1. Instruments used for Hemiarthroplasty

Fig 2: Thompson Unipolar Prostheses

FIG:3 Cemented Bipolar Prostheses

Fig4:Austin Moore

Fig5:Uncementedbipolar

POSTOPERATIVE CARE AND REHABILITATION

Antibiotics

The patient is given fifth generation intravenous cephalosporin for the first 5 days.

Post operative care

The patient is nursed in absolute aseptic conditions in the postoperative ward with the limb protected by an abduction pillow placed between the legs and a small pad beneath the knee to maintain it in slight flexion. Drains are removed at the end of 48 hrs. Drain tips are sent for microbiological examination.

Rehabilitation protocol

This actually begins preoperatively where the exercises to be practiced are taught by the physiotherapist. These exercises i.e. ankle dorsiflexion and plantar flexion, Quadriceps and gluteal exercises are started as soon as pain subsides. Upper limb and breathing exercises are also done. Patients are allowed to sit in bed in the first post op day. After drain removal patient is made to stand and walk. Sutures are removed on 10th day and patient is advised 6 weeks of bed reset.

Adduction is dangerous and coupled with flexion and internal rotation, is ever more so. The patient is instructed to avoid these positions. The patient is instructed not to squat, sit cross legged and is to adapt a table and chair life style.

After the surgery clinical evaluation with Harris hip score(Modified) (Campbell) and radiological evaluation with plain x-ray pelvis both hips and proximal femur - AP view was done for all patients at regular intervals.

FOLLOW UP

Prospective patients were reviewed regularly at 6 weeks, 6 months, 1 year and then yearly follow up.
Retrospective study patients were reviewed every yearly.
Patients wereassessed radiologically and assessed clinically using Harris Hip score.

III. RESULTS

The 20 hips each unipolar and bipolar clinically and radiologically. Clinical evaluation was done using Harris hip score which reveals the following results

Table 2. Unipolar Hemiarthroplasty – Functional Results

Excellent	3	15%
Good	12	60%
Fair	3	15%
Poor	2	10%

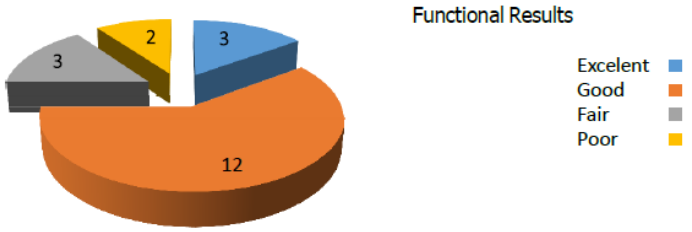


Fig .6 Unipolar Hemiarthroplasty – Functional Results

Table3.Bipolar Hemiarthroplasty–Functional Results

Excellent	7	35%
Good	9	45%
Fair	3	15%
Poor	1	5%

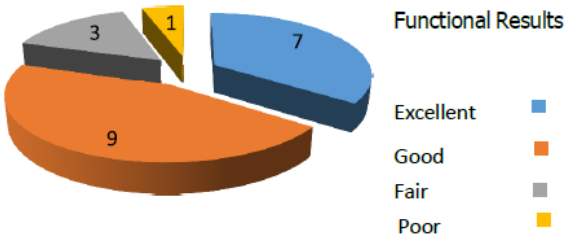


Fig 7. Bipolar Hemiarthroplasty – Functional Results

COMPARISON OF UNCEMENTED UNIPOLAR AND UNCEMENTED BIPOLAR HEMIARTHROPLASTY- FUNCTIONAL RESULTS

Table 4. Uncemented Unipolar Hemiarthroplasty - Functional Results

Excellent	3	30%
Good	3	30%
Fair	2	20%
Poor	2	20%

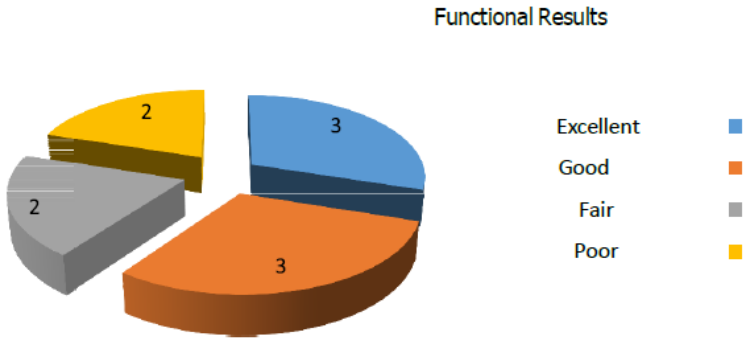


Fig 8. Bipolar Hemiarthroplasty – Functional Results

Table 5. Uncemented Bipolar Hemiarthroplasty - Functional Results

Excellent	5	50%
Good	3	30%
Fair	2	20%
Poor	0	0%

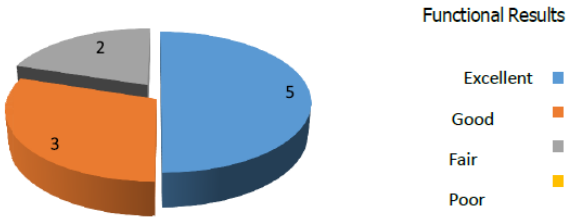


Fig 9. Bipolar Hemiarthroplasty – Functional Results

COMPARISON OF CEMENTED UNIPOLAR AND CEMENTED BIPOLARHEMIARTHROPLASTY-FUNCTIONALRESULTS

Table 6. Cemented Unipolar Hemiarthroplasty - Functional Results

Excellent	0	0%
Good	9	90%
Fair	1	10%
Poor	0	0%

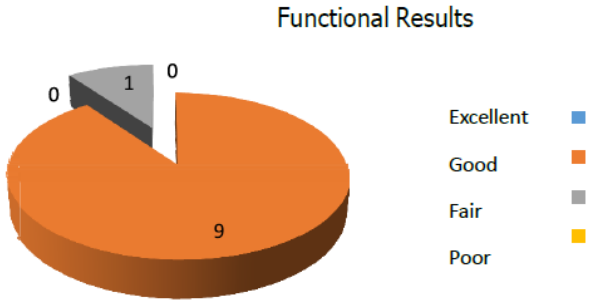
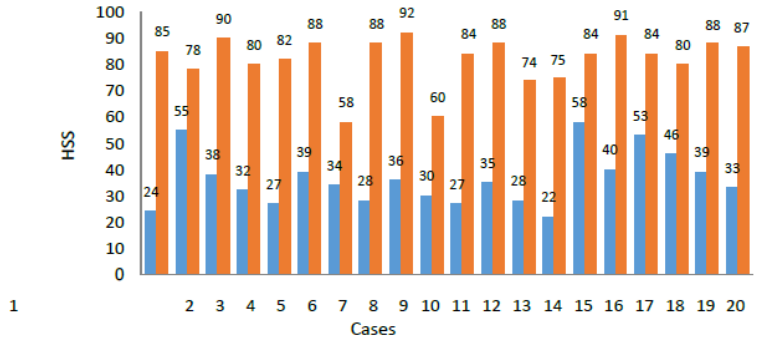


Fig 10. Cemented Unipolar Hemiarthroplasty - Functional Results

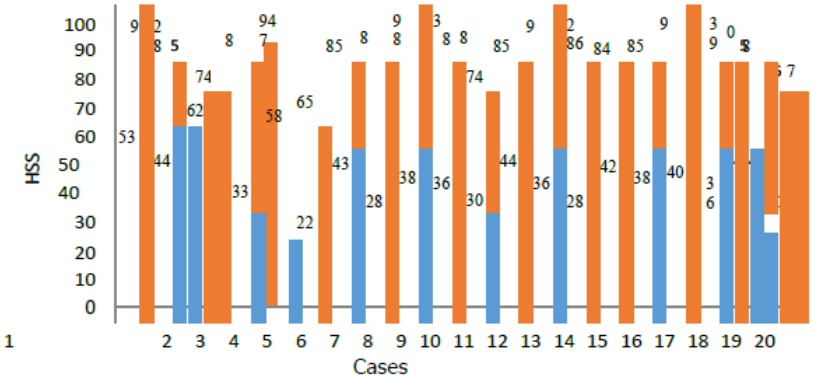
Table 8. Comparison of Pre-op and latest Harris hip score of Unipolar and Bipolar Hemiarthroplasty

	Mean pre-opHHS	Mean latest HHS	Mean Difference in HHS
Unipolar	36.2	81.8	45.6
Bipolar	39.1	85.05	45.95



Average latest HHS 81.8

Fig 12. Comparison of Pre-op and latest Harris hip score of Unipolar Hemiarthroplasty



Average latest HHS 85.05

Fig 13. Comparison of Pre-op and latest Harris hip score of Unipolar Hemiarthroplasty

COMPLICATIONS OF UNIPOLAR HEMIARTHROPLASTY:

- Heterotopic Ossifications → 1 (5%)
- Limb Length discrepancy → 2 (10%)
- Sciatic nerve palsy → 1 (5%)
- Periprosthetic fracture → 1 (5%)
- Acetabular erosion → 2 (10%)

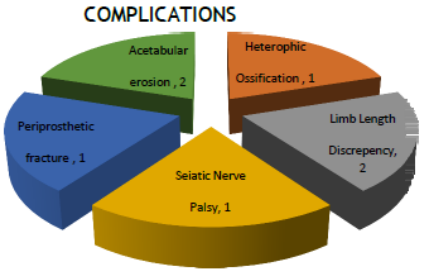


Fig 14. Complications of Unipolar Hemiarthroplasty

COMPLICATIONS OF BIPOLAR HEMIARTHROPLASTY:

- Heterotopic Ossifications → 1 (5%)
- Limb Length discrepancy → 1 (5%)
- Sciatic nerve palsy → 1 (5%)
- Periprosthetic fracture → 1 (5%)
- Acetabular erosion → 1 (1%)

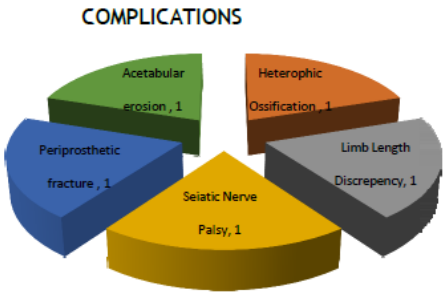


Fig 15. Complications of Bipolar Hemiarthroplasty

UNIPOLAR HEMIARTHROPLASTY:

Table 09. Radiological evaluation -Stem position in Unipolar cases

Stem Position	No.	Percentage
Neutral	13	65%
Valgus	2	10%
Varus	5	25%

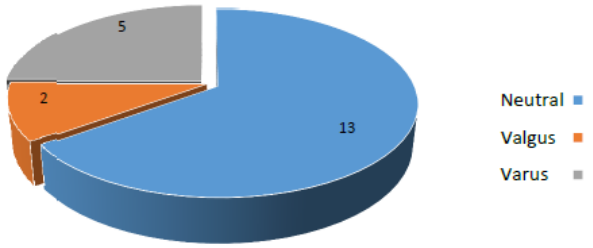


Fig 16. Radiological evaluation - Stem position in Bipolar cases

BIPOLAR HEMIARTHROPLASTY:

Table 10. Radiological evaluation: Stem position in Bipolar cases

Stem Position	No.	Percentage
Neutral	16	80%
Valgus	1	5%
Varus	3	15%

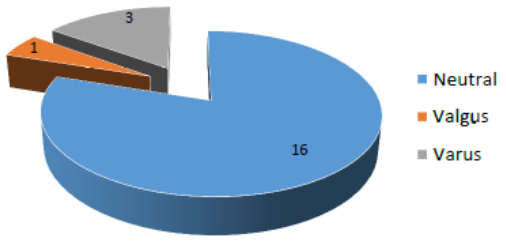


Fig 17. Radiological evaluation - Stem position in Bipolar cases

COMPARISON OF UNCEMENTED UNIPOLAR AND UNCEMENTED BIPOLAR HEMIARTHROPLASTY- RADIOLOGICAL RESULTS

Table 11. Uncemented Unipolar Hemiarthroplasty - Radiological Results

Centre	6	60%
Varus	2	20%
Valgus	2	20%

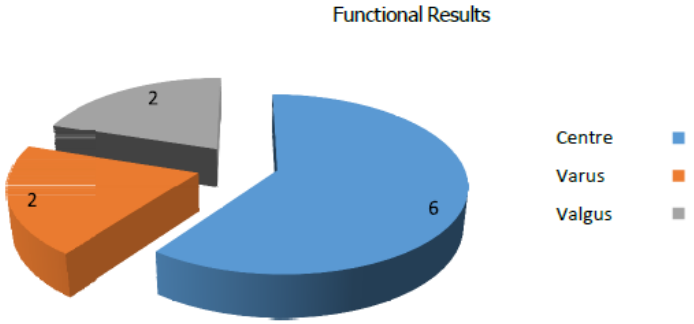


Fig 18. Uncemented Unipolar Hemiarthroplasty - Radiological Results

Table 12. Uncemented Bipolar Hemiarthroplasty - Radiological Results

Centre	8	80%
Varus	2	20%
Valgus	0	0%

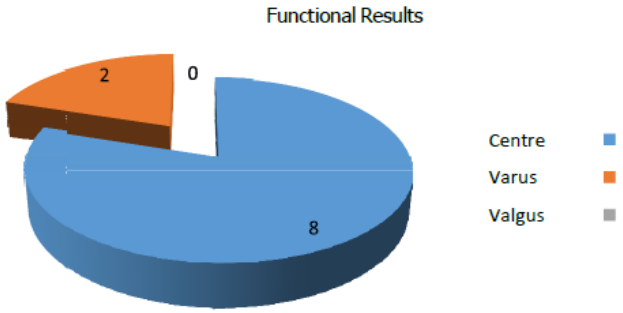


Fig 19. Uncemented Bipolar Hemiarthroplasty - Radiological Results

COMPARISON OF CEMENTED UNIPOLAR AND CEMENTED BIPOLAR HEMIARTHROPLASTY- RADIOLOGICAL RESULTS

Table 13. Cemented Unipolar Hemiarthroplasty - Radiological Results

Centre	7	70%
Varus	3	30%
Valgus	0	0%

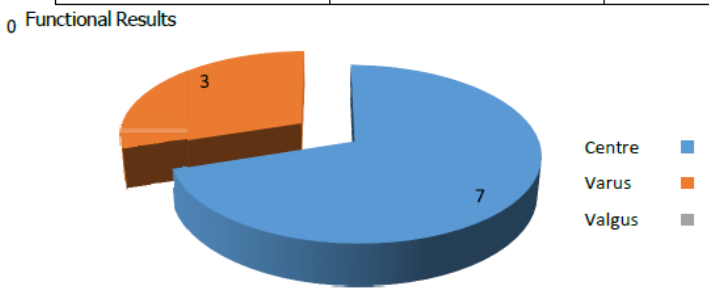


Fig 20. Cemented Unipolar Hemiarthroplasty - Radiological Results

Table 14. Cemented Bipolar Hemiarthroplasty - Radiological Results

Centre	8	80%
Varus	1	10%
Valgus	1	10%

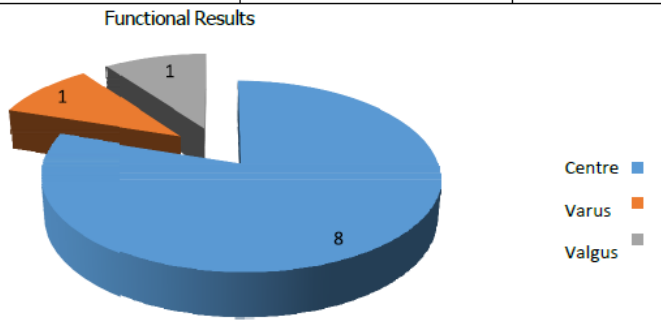


Fig 21. Cemented Bipolar Hemiarthroplasty - Radiological Result

IV. Discussion

Hemiarthroplasty, as an effective technique for femoral neck fractures, could help early ambulation and satisfied function recovery and is increasingly performed by the surgeons.20-22 However, controversy has persisted for a long time regarding the use of bipolar versus unipolar prosthesis. This study suggests that (1) Bipolar hemiarthroplasty is associated with similar or better improvement in hip functionality, hip pain, and quality of life compared with Unipolar hemiarthroplasty while with a higher cost and that (2) there are no significant differences between Bipolar hemiarthroplasty and Unipolar hemiarthroplasty with regard to operation time, blood loss, blood transfusion, hospital stay, mortality, reoperation, dislocation, and complications, and that (3) Bipolar hemiarthroplasty could not decrease acetabular erosion rate in the long term. Compared with Unipolar hemiarthroplasty, bipolar prosthesis with an additional inner articulation has the theoretical advantages of less acetabular erosion and less dislocation.23-24

This study demonstrates that the incidence of acetabular erosion in Bipolar hemiarthroplasty is less than that in the Unipolar hemiarthroplasty group at the follow-ups. However, statistical difference was only noted at 1 year follow-up and the acetabular erosion rate increased at the later follow- ups. This may be because the bipolar articulation loses mobility with time and functions as a Unipolar hemiarthroplasty.19 Regarding to dislocation, it is not proved to be less comparing Bipolar hemiarthroplasty with Unipolar hemiarthroplasty in this study.

DISCUSSION OF CLINICAL OUTCOME

Discussion of clinical outcome includes the following

1. Pain
2. Limp
3. Support
4. Walking distance
5. Range of movements
6. Limb length discrepancy

1. Pain:

Pain in the thigh is generally associated with the use of femoral stems that were designed for ingrowth of bone than cemented ones. In all of our patients, the pain decreased with time and were pain free at 6 months post surgery.

In our study, all the patients had good pain relief after 6 months of post surgery in their hips. In our study, patients who had poor outcome also had good pain relief in hip, but the patient's ipsilateral knees were diagnosed to have osteoarthritis.

2. Limp:

In our study, postoperatively none of our patients had limp. All our cases were done through posterior approach. Hardinge25 believed that limp

occurred less frequently when a posterior approach is used.(jbjs 64 b 17-19 1982).

3. Support (walking aids):

In our study, all patients are walking without any support except patients with poor outcome, uses walker support for mobilization. These patients with poor outcome had ipsilateral osteoarthritis knee joint, hence these patients walk with walker support.

4. Walking Distance:

Preoperatively none of the patients were unable to walk for unlimited distance. Post operatively patients with excellent and good results were able to walk for 6 blocks, patients with fair result were able to walk 2-4 blocks and patients with poor results were able to walk indoor only with walker support.

5. Range of motion:

After surgery other than poor results patients rest had fairly good range of movements.

6. Limb length discrepancy:

Equalization of leg length with a hemiarthroplasty remains a challenge. Frequently the procedure is completely successful except for an unexpected leg length inequality. Foot wear correction was given to the above patients Discrepancies of 1 cm generally are well tolerated, and perception of the discrepancy tends to diminish with time. Apparent leg length inequality and pelvic obliquity caused by residual soft tissue contracture usually responds to physical therapy with stretching and improve with time.15 In our study we had 2 patients' with limb length discrepancy i.e. lengthening - 1 cm and 1.5 cm respectively in unipolar and 2 patients in bipolar with one case shortening of about 0.5cm and 1 case lengthening of 0.5 cm respectively.

DISCUSSION OF RADIOLOGICAL OUTCOME

Discussion of the radiological outcome includes the following

1. Implant loosening
2. Acetabular erosion
3. Femoral stem position
4. Subsidence and migration
5. Dislocation
6. Heterotopic ossification

1. Implant loosening:

In our study, mean follow up is 48.2 months in unipolar and 46.2 months in bipolar hemiarthroplasty respectively, we did not have any case of implant loosening during our period of follow-up. In our study, we have one case of 84 months of follow up but that patients did not have any implant loosening. However, long-term follow-up if necessary.

2. Acetabular erosion:

In our study, of unipolar hemiarthroplasty with a mean followup of 48.2 months we had 2 cases of acetabular erosion and in bipolar hemiarthroplasty with mean followup of 46.2 months we had one acetabular erosion.

3. Femoral stem position:

The ideal femoral stem position is central. In our study, we had 16 stems out of 20 in neutral position (80%) one in valgus (5%) 3 in varus in bipolar hemiarthroplasty. In unipolar, hemiarthroplasty, we had 13(65%) stems out of 20 in neutral position, 2(10%) in valgus and 5(25%) in varus.

4. Subsidence and migration:

In our study, we had no subsidence or migration in unipolar and bipolar hemiarthroplasty.

5. Dislocation:

The incidence of dislocation rate were highest during the immediate post op period but remain elevated throughout the first three post operative months. In our series, we have no cases of dislocation in both unipolar and bipolar hemiarthroplasty.

6. Heterotopic ossification:

Heterotopic ossification is a relatively common complication after hemiarthroplasty. It usually first becomes visible on radiographs three to four

weeks after surgery and matures by three to six months.26,27,28 The incidence of heterotopic ossification ranges from 5% to 90% in various literatures.29,30

In our series of bipolar hemiarthroplasty the incidence of heterotopic ossification was 1 out of 20 (5%) and in unipolar hemiarthroplasty the incidence of heterotopic ossification was also 1 out of 20 (5%). The particulate bone debris and the escape of femoral bone marrow elements, which are normally sealed off by bone cement in a cemented femoral component may be increased when an uncemented implant is used.

V. **Conclusion**

We have done a short term follow up of functional and radiological outcome of unipolar and bipolar hemiarthroplasty in intracapsular neck of femur fracture.

From our study, we have arrived at the following conclusion:

➢ Hemiarthroplasty is a challenging surgery due to general condition of those elderly patients and due to the surgical techniques used to pass the operation safely. Otherwise it may lead to several complications.

➢ Harris hip score is an excellent scoring system for assessing the functional outcome of unipolar and bipolar hemiarthroplasty. We have 15% of Excellent results in unipolar hemiarthroplasty and 35% Excellent results in bipolar hemiarthroplasty respectively. We have 60% good results in unipolar hemiarthroplasty and 45% in bipolar hemiarthroplasty respectively and we have 15% fair result in each unipolar and bipolar hemiarthroplasty respectively.

➢ The results of our study also shows that uncemented bipolar hemiarthroplasty gave better results when compared with uncemented unipolar hemiarthroplasty.

➢ Our results also shows that, cemented bipolar hemiarthroplasty gave better results when compared with cemented unipolar hemiarthroplasty clinically and radiologically.

➢ The results of our study are rewarding in term of improving patient's quality of life as evidenced by pre-op and post-op Harris hip score.

➢ Hemiarthroplasty is an Excellent treatment strategy for intracapsular neck of femur fracture in terms of pain relief and restoration of function and mobility as near as possible to the pre injury level.

➢ The bipolar hemiarthroplasty done for intracapsular neck of femur fracture gave better functional and radiological results in our study in comparison to the unipolar hemiarthroplasty done for intracapsular neck of femur fracture.

➢ Acetabular erosion is the most commonly encountered complication in unipolar hemiarthroplasty than the bipolar hemiarthroplasty which had less complication comparatively.

➢ Our overall mean Harris hip score pre-operatively for unipolar hemi arthroplasty was 36.2 and bipolar hemiarthroplasty was 39.1 which increased to 81.8 for unipolar and 85.05 for bipolar hemiarthroplasty respectively, with the p-value of <0.561.

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