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Evaluation of Clinical and Functional Outcome of Bipolar Hemiarthroplasty in Avascular Necrosis of Femoral Head in Adults

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Abstract: ***Aim:*** *Evaluation of clinical and functional outcome of bipolar hemiarthroplasty in avascular necrosis of femoral head in adults.* ***Materials and methods:*** *In this prospective study 30 cases of avascular necrosis of femoral head were included and were treated with bipolar hemiarthroplasty and were mobilized on day 3 post operatively. Patients were followed up till 9 months post operatively at intervals of 1 month, 3 months, 6 months and 9 months.* ***Results:*** *The mean follow up was for 9 months. In our study, mean age of patients was 46.67 years (range 20- 80 years). In Present study total Harris hip score at the end of 6 months ranged from 46 to 95. Nine (30.0%) hemiarthroplasties had hip scores from 91 to 100 (excellent). Eleven (36.7%) had hip scores 81 to 90 (good).Seven hips (23.3%) were rated 71 to 80 (Fair) and Two (06.7%) were rated 24 to 69 (poor). Thus 90% of the hips were classified as having a fair to excellent results.* ***Conclusion:*** *Avascular necrosis of the hip joint predominantly affects a young to middle aged population. Given this epidemiological perspective arthroplasty is not the first choice treatment but young patients having healthy acetabulum and extensive collapse of femoral head, with joint subluxation, make it a viable primary alternative. Bipolar arthroplasty is a simple, reliable, viable and a cost effective procedure as a primary surgical treatment modality in the patients with avascular necrosis of the hip joint.*

Keywords: Hip joint, bipolar, hemiarthroplasty, avascvular necrosis of femoral head, hip pain

1. Introduction

Hip joint being the most stable ball and socket joint in the body, it still maintains an extraordinary range of movements. Osteonecrosis (ON) of hip is a disorder resulting from a temporary or permanent loss of blood supply to the head of femur bone. When the blood supply is disrupted, the bone tissues begin to break down (necrosis). This can weaken the bone and eventually result in its collapse. If this occurs near a joint, it can lead to the collapse of the joint surface, resulting in pain and inflammation (arthritis). Osteonecrosis is also referred to as avascular necrosis or "AVN", "aseptic necrosis", and "ischemicbone necrosis"[1].

Avascular necrosis of the femoral head can be either primary (idopathic) or secondary (traumatic or nontraumatic), Trauma, alcohol consumption, smoking and corticosteroid therapy are frequently incriminated in the development of this disease, as secondary causes. There have been a variety of traumatic and atraumatic factors that have been identified as risk factors for osteonecrosis, but the pathogenesis still remains unclear[2]

Nowadays, there are more than 16 different classification systems used to classify and describe avascular necrosis of the femoral head, from which the classification system introduced by Ficat is the most commonly used. The Ficat classification system consists of five stages (0 to IV): the first three describe the events that occur before the collapse of the femoral head and the last two stages describe the post-collapse changes[3].

Surgical management of femur's head avascular necrosis include various treatment options like core decompression, bone grafting both vascular and avascular, osteotomies, hip resurfacing, hemiarthroplasty and total hip arthroplasty[4-6]. Total hip arthroplasty is indicated amongst young subjects in avascular necrosis with acetabular involvement; however, its action is not clear amongst cases without involvement of acetabulam[7]. Bipolar hip arthroplasty was initially restricted to hip osteoarthritis, non-united fractures and acute femur fractures[8-9]. It was **Bateman[10]** and **Giliberty[11]** who first performed bipolar hip arthroplasty in Ficat Stage III type of avascular necrosis on basis of the hypothesis that "acetabular floor has a regenerative property, that regenerates bone in the area of subchondrum, if weight bearing stimulation is given by an accurately fitted cup" and gave the theory that preferential motion at inner side will decrease the erosion of cartilage erosion.

Not all the patients have the extensive deformities of both the femoral head and acetabulum, for which a dual-assembly total hip prosthesis is required. In some patients, then, it would appear appropriate to make use of system that embraces the low friction principle, but yet does not require removing or distorting the acetabulum, which, in nearly all the instance does not need to be replaced. The combination of these requirements led to the development of "a single assembly" or "endoprosthesis" or "universal prosthesis" or "bipolar" type of hip replacement, the credit for which goes to **James E. Bateman[10]**

Harkess (1998)[12] suggested modular hip systems provide not only for selection of various head sizes and neck lengths but now also allow independent sizing of various portions of the stem. This single assembly type of unit is well tolerated within the body, and clinical progress has been most encouraging. Patients walk early and without pain. A high degree of stability has been maintained.

Coventry (1991)[13] said that bipolar arthroplasty as used today has rather specific indications. A younger patient with an avascular head is considered the best candidate. And, the patient with a failed total hip arthroplasty due to loosening of the Acetabular component and bone resorption may have a bipolar prosthesis combined with bone grafting of the acetabulum.

2. Materials and Methods

Study Design:
This Prospective study was done under the guidelines of ethical committee of the hospital.

Study Approval:
This study was approved by Institutional Medical Ethical committee. Written informed, valid consent was obtained from all the patients participating in the study.

Study Population:
Thirty patients of either sex between age group 20-80 years of age came for the treatment at government medical college and hospital setup was studied.

Sample size:
Sample size for present study was calculated by conducting pilot study, the pilot study was conducted on 5 patients of avascular necrosis of hip. The mean Harris hip score at 3 Months in Bipolar Arthroplasty group was 108, 97.16 with SD of 9.2 and 9.14. In this present study 30 patients were enrolled.

Inclusion Criteria
1) Age group adults (20 to 80 years),
2) Co-operative and compliant patients,
3) Radiologically diagnosed avascular necrosis in head of femur,
4) Consent to participate in the study.

Exclusion Criteria
1) Acetabular involvement,
2) Bony ankyloses,
3) Age <20 & >80 years,
4) Refusal to provide informed consent,
5) Medically unfit for surgery,
6) Patient who are not willing for surgical intervention.

3. Operative Procedure

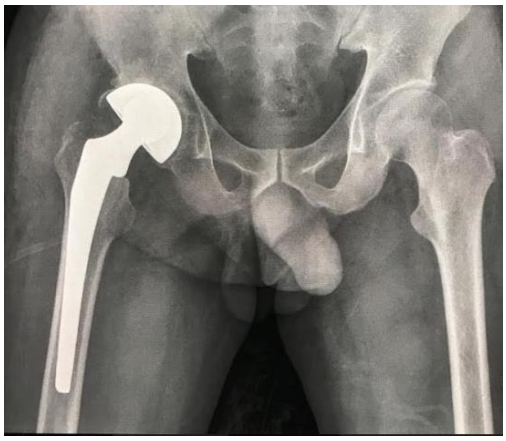
Patients positioned laterally and using the southern approach, Incision was 10-15 cm curved centered over greater trochanter and continued along the shaft of femur. There is no internervous plane. Gluteus maximus is split and short external rotators detached close to insertion and reflected along with sciatic nerve. Upper part of quadratus femoris divided and posterior joint capsule incised and hip is dislocated by internal rotation. This was followed by prosthesis insertion and cementing. Movements of the limb at the hip joint are then checked for any loosening at the head- acetabular interface and shaft-stem interface. After achieving hemostasis, the wound is closed in layers over a negative suction drain and dressed opening the drain.

Post-Operative Protocol
Patient is advised to rest in supine position with both limbs in abduction, keeping a pillow between the limbs. Patient is kept fasting for four hours, parenteral antibiotics for 10 days & parenteral analgesics for 48 hours are started postoperatively. The primary operative site is checked 48 to 72 hours after surgery and drain removed, the patient is ambulated using standard walking frame. Static quadriceps exercises, ankle and toe mobilization, pelvic lift exercises and bowel-bladder-back care is given. Patients were discharged on the 5th day post operatively. Follow up was taken at 1 month, 3 months, 6 months and 9 months after the surgery. The patients were assessed functionally on the basis of Harris hip score and radiologically in form of anteroposterior X- rays of operated hip.

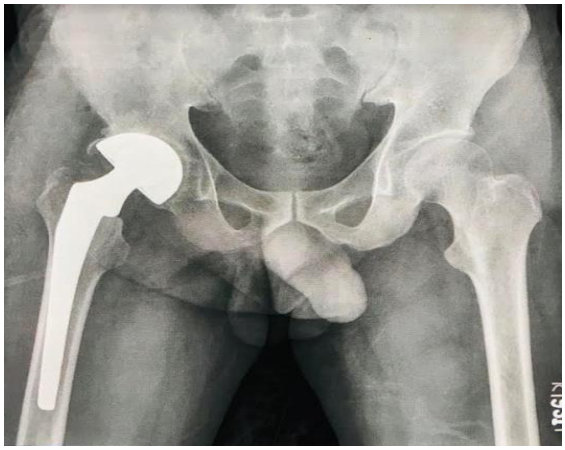
Intra Operative pictures

Pre-Operative X-Ray

Immediate post-Operative



3 Months Follow- Up X-Ray



6 Months Follow- Up X-Ray

4. Observations & Results

Study was carried out between the period March 2021 to June 2022 in our hospital on the patients of age group 20-80 years who were admitted for the management of painful hip and restrictions of movement of hip after getting the approval from the ethical committee of the hospital. Aim of the study was to evaluate clinical and functional outcome of bipolar hemiarthroplasty in avascular necrosis of hip in adult patients. We studied 30 cases of avascular necrosis of hip with valid consent and full knowledge of the study to the patients. Following observations are made.

Age Incidence:

Table VII: Age Incidence of Patients

Sr. No.	Age group (in years)	No. of patients	Percentage	Mean ± SD
1.	20-30	02	6.66%	46.67±10.06
2.	31-40	07	23.33%	
3.	41-50	11	36.66%	
4.	51-60	07	23.33%	
5.	61-70	03	10%	
6.	71-80	00	-	
TOTAL		30	100.00%	

The maximum age of the patient included in the study was 60 years and the minimum was 19 years. The mean age was 46.67 years.

In our study population included was between age group of 20 to 80 years of age with maximum population of age group of 41-50 years (36.66%). Mean age of the patients is 46.67±10.06 years. Youngest patient of the age 28years and oldest patient was the age of 65 years.

Table X: Presenting Symptomatology

Sr. No.	Chief complaint	No. of patients	Percentage
1.	Painful hip	25	83.3%
2.	Painful hip + Restrictions of movement	12	40.0%
3.	Deformity	05	16.7%

In this study painful hip and restrictions of movement were the most common presenting complaint. 05 (16.7%) patients had some kind of deformity.

Size of bipolar prosthesis used:

Table XV: Size of Bipolar Prosthesis Used

Sr. No	Size of Bipolar prosthesis (In mm.)	No. of Patients	Percentage
1.	41	06	20.0%
2.	43	08	26.6%
3.	45	10	33.3%
4.	47	04	13.3%
5.	49	02	6.6%
Total		30	100.00

The most common prosthesis sizes used in males was 45 - 49 mm; with the commonest one being 45 mm, in 09 hips and in females was 41 - 45mm; with the commonest one used being

41 and 43 mm, in 3 hips each. In our study, the commonest prosthesis size used was number 45 mm in 10 (33.3 %) hips, largest size used was 49 mm in 02 (6.6 %) hips and the smallest size used was 41 mm one in 6 (20.0 %) hips.

Comparison of HARRIS hip score over time:

Table XVII: Comparison of HARRIS Hip Score Over Time

S. No.	Follow-Up Time	Mean ± SD	Std. Error	P- Value
1.	PRE-OP	25.63 ± 8.42	1.53	< 0.0001 S
2.	1 MONTH	43.27 ± 8.08	1.47	< 0.0001 S
3.	3 MONTH	62.17 ± 10.85	1.98	< 0.0001 S
4.	6 MONTH	81.63 ± 10.50	1.91	< 0.0001 S

The Harris Hip score was used to evaluate the patient outcome in our study at the intervals of 1 month, 3 months and 6 months post operatively. The score was found to be higher at 6-months post operatively.

Complications in patients:

Table XX: Complications in patients

S. No.	Complications		No. of Patients	Percentage
1.	Intra- Operative Complications	Calcar fracture	02	6.6%
		Calcar fracture + Subtrochanteric	01	3.3%
2.	Early Complications	Anteversion	01	3.3%
		Dislocation	01	3.3%
		Limb Length Descripency >1.5mm	01	3.3%
		Superficial Infection	02	6.6%
3.	Late Complications	Deep Infection	01	3.3%
		Settling + Poor	01	3.3%

In our study of 30 patients, superficial infection and calcar fracture was the most common complications seen in the patients. There was superficial infection and calcar fracture in 02 patients. Complications like calcar fracture plus subtrochanteric, anteversion, dislocation, limb-length discrepancy, deep infection and settling plus poor were present in 01 patient.

5. Discussion

Avascular necrosis of the hip joint predominantly affects a young to middle aged population. Given this epidemiological perspective arthroplasty was not the first choice treatment but young patients had healthy acetabulum, extensive bone necrosis, severe collapse of femoral head, and joint subluxation, make bipolar replacement surgery; a viable primary treatment modality.

Age Distribution

Yadav S. (2017)[17] in his study, the mean age of the study subjects was ± 78 years. **In the present study**, mean age of patients was 46.67 years (range 20-80 years). It is evident that, relatively younger patients were treated by bipolar prosthesis.

Clinical Functional Results:
Clinical functional results analyzed by using Harris Hip Score.

Singh J et al. (2018)[18] in his study, 20 hips underwent bipolar arthroplasty for the treatment of avascular necrosis of hip and results were analyzed using the Harris hip scores (HHS). Out of 20 hips in 13 patients showed excellent results in(65 %) hips, good in 05 (25 %), fair in 01 (5 %) and poor in 01 (5 %).

In the present study, the results were analyzed using the Harris hip scores (HHS), 30 hips in 30 patients underwent bipolar arthroplasty for the treatment of avascular necrosis of hip. Out of 30 hips in 09 patients showed excellent results in (30%) hips, good in 11 (36.66 %), fair in 07 (23.33 %) and poor in 02 (6.66 %). We had gratifying results, 20 (66.66 %) hips had good to excellent results. We attribute these satisfactory results to; proper patient selection (good pre-operative muscle power, absence or intra-operative release of soft tissue contractures), early post-operative ambulation coupled with aggressive, active flexion/ abduction exercises within the limits of pain, asking the patients not to squat/ sit cross-legged and a well-motivated patient willing to accept the limitations of the new joint.

6. Complications

No surgical procedure in history is without any set of complications. The same holds true in case of bipolar arthroplasty. **Bowman et al. (1985)**[19] reported one deep wound infection and no dislocation of prosthesis in their study on 75 hips in 73 patients/

In present study, Early onset superficial infection in 02 (6.66%) hips out of 30 hips. Deep infection in 01 (3.33%) hips out of 30 hips. Infection controlled with curettage of sinus tract and intravenous antibiotics in the ward. One hip (3.33%) dislocated immediately in post-operative which required open reduction. Two patients (6.66%) patients intra-operative calcar fracture was seen. In one patient, it was associated with fracture of sub-trochanteric fracture. Nothing was done for calcar fracture and calcar was replaced as such. Regarding fracture of sub-trochanter encirclage wiring was done followed by delayed weight bearing. Two patients (6.66%) had limb length discrepancy of 0.5 cm was seen most likely it was due to slight varus alignment of stem of prosthesis in 01 case and varus with inappropriate resection of neck in remaining 01 cases.

One (3.33%) patient showed in toeing gait at the time of walking meaning thereby increased anteversion at the time of introduction of prosthesis. Settling down of prosthesis is seen in 02 (6.66%) patients. Heterotopic ossification as a

complication was not seen in any patient. There were no prosthetic failures/ loosening, peri-prosthetic fractures or revision surgeries, sciatic nerve palsies, and protrusion. None of our patients hadpulmonary embolism or deep vein thrombosis.

7. Conclusion

This study was carried out in 30 patients to observe the efficiency of bipolar arthroplasty in management of avascular necrosis of femoral head. Avascular necrosis of the hip joint predominantly affects a young to middle aged population. Given this epidemiological perspective arthroplasty is not the first choice treatment but young patients having healthy acetabulum and extensive collapse of femoral head, with joint subluxation, make it a viable primary alternative. Bipolar arthroplasty is a simple, reliable, viable and a cost effective procedure as a primary surgical treatment modality in the patients with avascular necrosis of the hip joint. Bipolar could stand on its own to suit the Indian conditions including cost- effectiveness, not requiring a specialized set-up or operating theater, not requiring specialized training and was altering the basic life style of our patients. Bipolar arthroplasty has advantage of less post-operative hospital stay early mobilization and walking without support so it reduces family burden. Bipolar arthroplasty having advantage that it get easily converted into Total Hip Arthroplasty (THA) whenever it is required. Bipolar Hemiarthroplasty using tight fitting cup for avascular necrosis of femoral head has a low incidence of groin pain and erosion of acetabulum. After surgery, patients must be advised to avoid squatting, sitting cross- legged, doing heavy manual work in order to increase the longevity of the prosthesis. Post-operatively, active exercises must be instituted early to strengthen the extensors and abductors of the hip joint, so as to minimize the chances of prosthesis loosening and dislocation. The patient must adhere to strict rehabilitation program for an excellent outcome. The patient must be explained regarding the limitations and longevity of the prosthesis and must have realistic and restricted expectations from the joint so as to have a good, problem free hip joint for a long period of time.

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