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Original Research Article

The clinical and radiological outcome of uncemented primary total hip arthroplasty in case of AVN of femoral head in middle age group

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ABSTRACT

Background: The appropriate treatment of avascular necrosis (AVN) of the femoral head has become a serious problem around the world, particularly in adult instances. Objective was to evaluate the clinical and radiological outcome of uncemented primary total hip arthroplasty in case of AVN of femoral head in terms of pain relief, functional capacity, range of motion, absence of deformity, radiological assessment and comparing pre-operative and post-operative functional status.
Methods: This was a prospective observational study of 44 hips of 37 patients at the National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, Bangladesh.
Results: Here, majority (70%) belong to 30-35 years age group, and 75% were male. The affected site of arthroplasty among patients where highest (51.35%) patients had been affected on right side and right side number of hip was (43.18%). Among all, 30 patients underwent unilateral total hip replacement (THR), 7 patients who were affected bilaterally underwent staged bilateral THR at an interval of 6-12 weeks. According to the position of the acetabular component, anteverted in 70% patients, retroverted in 0% patients, neutral in 25% patient, <35º inclined in 0% patients, 35º-50º inclined in 65% patients, and >50º inclined in 20% patients at follow-up cases. Based on modified Harris hip score (HHS), 92% cases rated this treatment as excellent.
Conclusions: Uncemented total hip arthroplasty in individuals, who have arthritis of the hip joint secondary to AVN, provides satisfactory clinical and radiographic outcome. Though the procedure is not free of complications, the overall functional and clinical outcome had shown excellent result.

Keywords: Arthroplasty, Femoral, Necrosis, Uncemented

INTRODUCTION

The hip is the second largest weight-bearing joint in the human body after the knee joint. It is a ball-and-socket type of synovial joint. The rounded head of the femur forms the ball, which fits into the acetabulum (socket in the pelvis). The bony surfaces are covered by articular cartilage and smooth tissue, which cushions the ends of the bones and promotes joint motion.[1-5]

Various conditions have been attributed to aetiological factor for avascular necrosis for femoral head. These include steroid therapy, autoimmune disease, hemoglobinopathies, hyper coagulopathies, hyper-lipidemia, Gaucher's disease, alcoholism, particularly trauma, and dislocation of hip. All have a significant impact on the joint and cause pain and dysfunction. The treatment of femoral head avascular necrosis ranges from conservative to invasive. In the early stages, conservative therapies such as restricted weight bearing, physical

therapy, termination of steroid therapy, and anti-inflammatory drugs are indicated.[6-8] Several pharmacological treatments, including bisphosphonates and statins, have demonstrated therapeutic efficacy in the early stages of avascular necrosis. The surgical treatment can be divided into two categories: those that preserve the femoral head (core decompression, osteotomy, non-vascularized and vascularized bone grafting, and autologous bone grating) and those that partially or completely replace the femoral head (hemiarthroplasty and total hip arthroplasty).[9-12] The porous HA coated prosthesis used in uncemented total hip arthroplasty promotes healing which allows bone to grow into or onto the prosthesis has led to improved implant survival rate and supports their growing use. It was created to give an alternative to the poor results associated with early cemented total hip replacements. The early outcomes for cementless total hip replacements were unsatisfactory because the smooth surface of the cementless prosthesis inhibited good adhesion to the bone, resulting in aseptic loosening a few years after surgery.[12] The discovery of porous-coated materials in the 1980s permitted bone in growth on the surface of prostheses, resulting in enhanced adhesion and improved prognosis.[13] Preliminary data suggest that non cemented total hip arthroplasties have relatively low revision rate and excellent prosthetic durability. Evaluation of long-term outcomes of a procedure like total hip replacement is important to determine its durability. It provides a means of comparison of the results of different clinical interventions that may lead to changes in operative technique and implant design over time.

Objective

To evaluate the clinical and radiological outcome of uncemented 47 hips arthroplasty in case of AVN of femoral head in 30 to 45 years' age group.

METHODS

This was a prospective observational study.

Place and period of study

The study conducted in National Institute of Traumatology and Orthopaedic Rehabilitation from July 2016 to December 2021 total 5 years 5 month study period with follow-up.

Study population

All the adult patients of avascular necrosis of femoral head regardless of age, sex group of 30 to 45 years.

Sampling method

Purposive non-randomized sampling according to availability of the patients and strictly considering the inclusion and exclusion criteria.

Sample size

Uncemented 44 hips arthroplasty in case of AVN of femoral head of 37 patients was included in the study.

Inclusion criteria

30 to 45 years age group, sex, any side, the patients who were mentally and physically fit (ASA-group 1-3), AVN of femoral head with secondary osteoarthritis of the hip joint irrespective of cause.

Exclusion criteria

Below the age 30 years and above the age of 45 years, history of previous replacement surgery in the involved hip due to any cause, unstable medical illness that would significantly increase the risk of morbidity and mortality, active infection of the hip or any other region, insufficiency of abductor musculature, rapidly progressive neurological disease, malignant tumor of femoral head or acetabulum with very few little life expectancies.

Post-operative management

Limb was kept in abduction with pillow between two lower limbs. Intravenous antibiotics were given for 3 days. Oral antibiotics started from 4th postoperative day and continued for another 15 days.

On 1 post-operative day

Check x-rays were taken, drain was removed. Static quadriceps exercise, knee and ankle mobilization was done. Walking with walker with tolerable weight bearing patient was discharged from hospital after 1 week. Stapler removal done on 14th post op day.

Advice at discharge

Not to squat. Not to sit cross-legged. Not to cross the lower limb across the midline. Use high commode.

Statistical analysis

After collection, all data were reviewed and edited during the analysis. Using window-based computer software built with statistical packages for social sciences (SPSS 24), the data were then entered into the database, and statistical analysis of the results was obtained. The findings were presented in figures and tables.

Ethical approval

The appropriate ethical approval for the study was taken from the ethical review committee of National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, Bangladesh.

Study procedure

A data collection form was prepared by the researcher considering the key variables like age, sex, presenting symptoms, clinical findings, associated medical conditions, investigations, preoperative findings and outcome of surgery. Data were collected by the researcher himself. Aims and objectives, procedure, risks and benefits of the study were explained to the selected patients. They were also assured about the secrecy of information and records. Then written informed consent was taken from each patient.

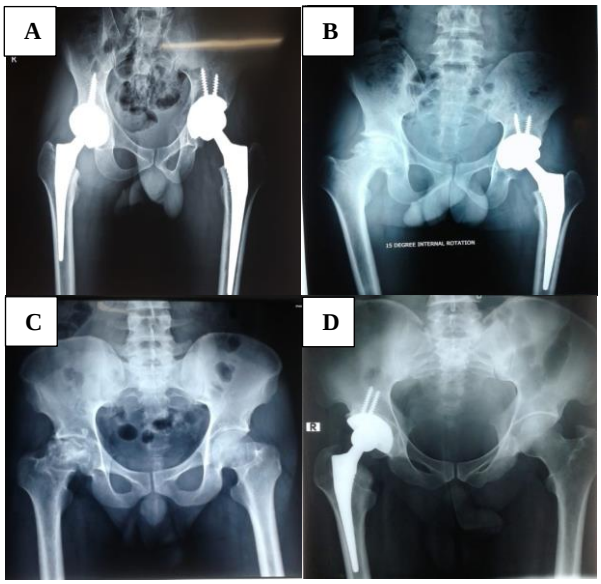

Figure 1: X-ray of AVN of femoral head; A) bilateral THR; B) postoperative x-ray (left side); C) preoperative x-ray AVN of right sided femoral head; D) post operative x-ray.

RESULTS

Study subjects belonged to an age range of 30 to 45 years of both gender, male and female. Among the 37 study groups, majority belonged to age group of 35-35 years.

Table 1 shows the demographic status of the patients where majority belong to 30-35 years age group, 70% and 75% were male. The following table is given below in detail.

Table-1: Demographic status of the patients (n=37).

Demographic	Percentage
Age group (in years)	
30-35	70
36-40	17
41-45	13
Gender	
Male	75
Female	25

Table 2: Distribution of the patients according to site affected status of arthroplasty (n=37).

Site of arthroplasty	No. of patients (N)	Percentage	No. of hip	Percentage
Left side	11	29.72	11	25.00
Right side	19	51.35	19	43.18
Bilateral	07	18.91	14	31.82
Total	37	100	44	100

Table 2 indicates the frequency distribution of affected site of arthroplasty patients, where highest (51.35%) patients had been affected on right side and right-side number of hip was (43.18%). Among all of the patients, 30 patients underwent unilateral THR, 7 patients who were affected bilaterally underwent staged bilateral THR at an interval of 6-12 weeks.

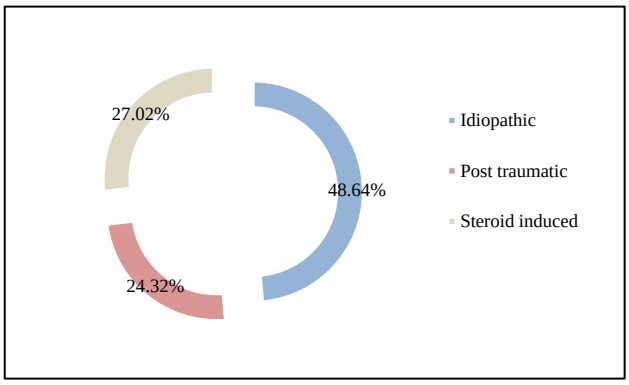

Figure 2: The etiology status of the patients (n=37).

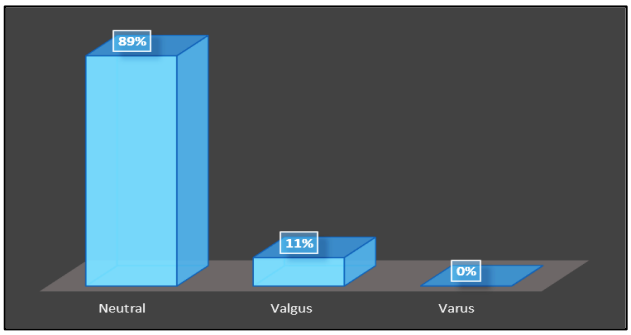

Figure 3: The position of the femoral component on radiography at follow-up.

The etiology number of the patients where idiopathic found the highest amount which is 18 (48.64%), steroid induced showed 10 (27.02%) and the post-traumatic exposed only 9 (24.32%) (Figure 2). The position of the femoral component on radiography at follow-up. Neutral position was found maximum which is 89%, valgus in 11%, and varus in none of the patients at follow-up (Figure 3).

Table 3 demonstrates the position of the acetabular component on radiography was found to be anteverted in

70% cases, retroverted in 0%, neutral in 25% cases, <35o inclined in 0% cases, 35º-50º inclined in 65% cases, and >50º inclined in 20% patients at follow-up. The following Table is given below in detail:

Table 3: The position of the acetabular component on radiography at follow-up (n=37).

Acetabular component position	Percentage
Anteverted	70
<35º inclined	0
35º-50º inclined	65
>50o inclined	20
Neutral	25
Retroverted	0

*Multiple responses were observed

Table 4 describes the distribution of pre-operative and post-operative pain status of all patients where maximum changes of post-operative pain severity found in slight cases and the frequency is 25 (67.57%). On the contrary, moderate pain found highest in pre-operative cases, which is 22 (59.46%). The following Table is given below in detail.

Table 4: Distribution of patients by pre-operative and post-operative pain status (n=37).

Severity of pain	Pre-operatively	Post-operatively
	Frequency (%)	**Frequency (%)**
No pain	0 (0)	2 (5.41)
Slight	0 (0)	25 (67.57)
Mild	3 (8.11)	10 (27.02)
Moderate	22 (59.46)	0 (0)
Severe	12 (32.43)	0 (0)

Table 5: Distribution of patients by their pre and post-operative limping condition (n=37).

Limping	Pre-operatively	Post-operatively
	Frequency (%)	**Frequency (%)**
None	1 (2.70)	24 (64.86)
Mild	8 (21.62)	13 (35.14)
Moderate	22 (59.46)	0 (0)
Severe	6 (16.22)	0 (0)

Table 5 demonstrates the distribution of pre-operative and post-operative limping condition of all patients.

Considering limping of the patients, 1 patient (2.70%) had no limping gait, 8 patients (21.62%) had mild limping gait, 22 patients (59.46%) had moderate limping gait and 6 patients (16.22%) had severe limping gait. On the other hand, following operation, 24 patients (66.86%) with no limping gait and 13 patients (35.14%) among them carried mild limping.

Table 6 represents the distribution of patient by support function. Prior to surgical intervention 2 patients (5.41%) were not able to walk and 35 patients (94.59%) used crutch or cane for support to walk. After operation 28 patients (75.68%) could walk without support. The following table is given below in detail.

Table 6: Distribution of patient by support function (n=37).

Support function	Pre-operatively	Post-operatively
	Frequency (%)	**Frequency (%)**
None	0 (0)	28 (75.68)
Cane for long walk	4 (10.81)	9 (24.32)
Cane most of the time	9 (24.32)	0 (0)
One crutch	13 (35.14)	0 (0)
Two canes	9 (24.32)	0 (0)
Not able to walk	2 (5.41)	0 (0)

Table 7: Distribution of patients by pre and post-operative use of stairs (n=37).

Use of stairs	Pre-operatively	Post-operatively
	Frequency (%)	**Frequency (%)**
Unable	17 (45.95)	0 (0)
In any manner	17 (45.95)	0 (0)
Normally with railing	3 (8.10)	2 (5.41)
Normally without using a railing	0 (0)	35 (94.59)

Table 7 indicates the distribution of patients by pre-operative and post-operative use of stairs. It was evident that 17 patients (45.95%) were unable to use stairs, 17 patients (45.95%) were able to use stairs in any manner and 3 patients (8.10%) were able to use stairs normally with railing pre-operatively. Following operation, 35 patients (94.59%) were able to use stairs without using railing, and only 2 patients (5.41%) had to use stairs with railing.

Table 8: Distribution of patients by pre and post-operative capacity to sit on and by using transport.

Parameters	Pre-operatively	Post-operatively
	Frequency (%)	**Frequency (%)**
Capacity to sit on		
Unable	26 (70.27)	0 (0)
High chair	11 (29.73)	0 (0)
Comfortable	0 (0%)	37 (100)
Capacity to sit on		
Unable	37 (100)	0 (0)
Able to use	0 (0)	37 (100)

Table 8 shows the distribution of patients by pre and post-operative capacity to sit on and by using transport. According to the study analysis, 26 patients (70.27%)

were unable to sit comfortably and 11 patients (29.73%) were using high chair to sit on. The post-operative capacity to sit on chair increased significantly 100% patients could sit comfortably following operation. On the other hand, before operation all patients (100%) were unable to use public transport whereas all patients were able to use public transport after operation.

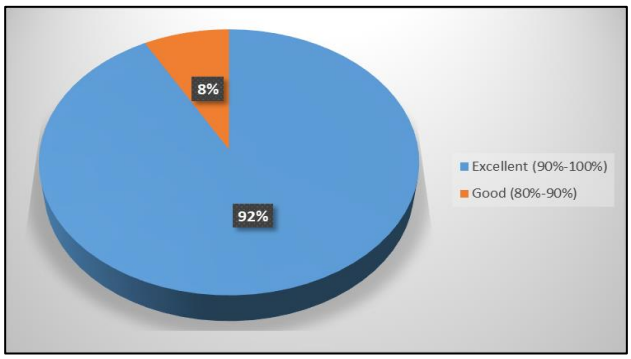

Figure 4: Modified Harris hip score (HHS).

Figure 4 exemplifies modified Harris hip score (HHS) where 92% cases rated this treatment as excellent where as 8% cases were good.

Table 9 represents distribution of restricted range of movement preoperatively and postoperatively where there were no cases of restriction in the range of movement postoperatively found. The following table is given below in detail:

Table 9: Distribution of restricted range of movement preoperatively and postoperatively.

Description	Preoperatively (%)	Postoperatively
Internal rotation	92	None
External rotation	78	None
Abduction	20	None
Adduction	50	None
Flexion	70	None

DISCUSSION

Avascular necrosis, in addition to secondary osteoarthritis, is a severe illness that frequently leads in the collapse of the femoral head. Development of porous-coated devices intended for biologic fixation by bone ingrowth. Total hip arthroplasty is the preferred therapy for advanced stages of avascular necrosis of femoral head. In our study, 75% patients were male and 25% patients were female. The majority number of the patients (70%) were between 30-35 years and the lowest (13%) were between 41-45 years, whereas Reddy et al, found the opposite ratio of gender distribution and there were 23.33% males and 76.67% females. The overall male to female ratio was 4:1. In our study affected site of arthroplasty among patients where highest (51.35%) patients had been affected on right side and right-side number of hip was (40.42%). Among all of the patients, 30 patients underwent unilateral THR, 7 patients who were affected bilaterally underwent staged bilateral THR at an interval of 6-12 weeks.

Majority of patients (43.33%) were between 21-40 years and the lowest years (23.33%) were between 41-50 years, which had similar distribution of age groups like our study.[14] This resemblance is because avascular necrosis is a disease that affects people in their early years and the main indication for surgery in our study was secondary osteoarthritis of hip joint due to AVN. Prakashappa et al, shows that most of the patients were affected on the right side (46.7%), left side (40%), and a few were affected bilateral (13.3%).[15] Similarly, in our study, most of the patients had been affected on right side (51.35%).

The causes of avascular necrosis of femoral head, idiopathic was majority that was more than 48%. The next major cause was use of steroid 27.02%. Celebi et al showed etiology of avascular necrosis was idiopathic 48%, use of steroid is 36%, which was similar to our study.[16] Johannson et al also reported most commonly associated factors in patients operated idiopathic 35%and it is also nearly similar to my study.[17] Use of high dose steroids is the one of the major causes of avascular necrosis (NIAMS. 2015).[18]

Kantor et al shows that maximum post-operative acetabular cup angle was 40º-45º (41.17%).[19] Our study also shows similar results, 65% acetabular component position was 35º-50º inclined. In this study, there were 2 subsidence and 1 migration cases were found. Andrew Whaley and Daniel et al, radiological assessment of acetabular components in uncemented acetabulum is done and defined loosening when migration of >2 mm in horizontal or vertical direction, rotation of implant, screw breakage or more than 1mm radiolucent line in all zones.[9] Acetabular cup inclination was measured by AP radiograph by 2 lines, one is trans ischial line and other line parallel to opening of acetabular component, and grouped in to normal (30-40º), vertical (>45º) and horizontal cup (<30º) alignment.[11]

Femoral stem position is determined as Varus, valgus or central based on angle made by the lines drawn from mid points of transverse diameter of shaft of femur and the stem of the femoral component at 1 cm, 3 cm and 5 cm from the tip of femoral stem. On our study, 89% of the cases had central positions and 11% in valgus positions. Bhowmik et alin their study also indicates that femoral stem positions were central in 82 hips, valgus in 15 hips and varus in 13 hips.[20]

Pain is a subjective sensation and its sensitivity varies from person to person. There is no definite method available to measure pain. The location of pain was recorded in the groin, the buttocks, the lateral or trochanteric area, the anterior aspect of thigh or diffuse.

The pain status among patients indicated that the pain significantly decreased following operation. The statistics shows that patients had moderate pain 22 patients (59.46%), severe pain 12 patients (32.43%) and mild pain 3 patients (8.11%) before surgical approach. After operation, no pain was observed in 2 patients (5.41%), 25 (67.57%) patients had slight pain and 10 (27.02%) patients had mild pain and no patients had severe pain. McLaughlin et al showed that 22% had only slight pain, 6% had mild pain, 4% had moderate pain and no patients had severe pain which is similar to our study.[21]

Considering pre-operative limping of the patients, 1 patient (2.70%) had no limping gait, 8 patients (21.62%) had mild limping gait, 22 patients (59.46%) had moderate limping gait and 6 patients (16.22%) had severe limping gait. Following operation, 24 patients (64.86%) with no limping gait and 13 patients (35.14%) had mild limping gait. This indicate that following operation limping feature of the patients significantly decreased. Limp and dependency on walking aids by the patients decreased substantially after the arthroplasty.[22]

Prior to surgical intervention 2 patients (5.41%) were not able to walk and 35 patients (94.59%) used crutch or cane for support to walk. After operation 28 patients (75.68%) could walk without support. McLaughlin 2000, also showed his study no support was required in 87% hips, 9% hips required cane for long walks and 1% required a cane for full time which was also similar to this study.[21]

In our study 17 patients (45.95%) were unable to use stairs and 17 patient (45.95%) able to use stairs in any manner and 3 patients (8.10%) were able to use stairs normally with railing preoperatively. Following operation, 35 patients (94.59%) were able to use stairs normally without using railing, and only 2 patient (5.41%) use stairs with railing. According to the study analysis, 26 patients (70.27%) were unable to sit and 11 patients (29.37%) were using high chair to sit on. The post-operative capacity to sit on chair increased significantly ($p<0.05$), 100% patients could sit comfortably following operation. Before operation 30 patients (100%) were unable to use public transport whereas 37 patients were able to use public transport after operation which is statistically significant.

In a study by Gaikwad et al, mentioned that post-operatively, excellent score was seen in 15 (50%) patients; good in 12 (40%) patients; fair in 2 (6.67%) patients and poor in 1 (3.33%) patient.[23] Other study shows excellent results in 25 hips (83.33%), good results in 3 hips (10%) and fair results in 2 hips (6.67%).[24] Whereas, in our study positive improvements were noticed where no cases of restriction in the range of movement postoperatively found and according to modified Harris hip score (HHS) 92% cases rated this treatment as excellent where as 8% cases were good.

The main limitation of the study was small sample size. The study is recommended to be done in large population for more accurate results.

CONCLUSION

Cementless total hip arthroplasty has shown promising outcomes in individual adults who have avascular necrosis of femoral hip and no other hip disease. It has excellent functional results and is not connected with any substantial early or late problems. Patients seldom feel discomfort, limping, trouble walking, difficulty climbing stairs, difficulty using public transportation, or difficulties sitting. They can wear shoes and socks with ease, have no physical deformities, and achieve normal limb length. They do not acquire any restrictions in their range of motion. As a result, patient satisfaction is excellent following cementless total hip arthroplasty for hip avascular necrosis.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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