



Early Functional Outcome of Ceramic on Ceramic Total Hip Replacement Using a 36 mm Diameter Femoral Head

Authors

Dr Sonu Mehta¹, Dr Deepak Aher², Dr Shoaib Sheikh³, Dr Devendra Patkar⁴

¹Senior Resident, Gandhi Medical College, Bhopal

²Senior Resident, Gandhi Medical College, Bhopal

Email: Deepakaher07@gmail.com

³Registrar, Fortis Hospital, Mulund

Email: shoaibsk.7@gmail.com

⁴Resident, Gandhi Medical College, Bhopal

Email: Deva.Patkar89@gmail.com

Corresponding Author

Dr Sonu Mehta

7/2 Race Course Road, Silver Stud Building, Indore, M.P. 452003, India

Email: Sonu_mehta1987@yahoo.com, Ph- 9926899887

Abstract

30 patients with diseased hips were treated with uncemented total hip replacement with a 36 mm femur head using a ceramic on ceramic bearing at a tertiary care hospital.

Patients aged 30 years and above were included in the study with the oldest patient being 75 years. The most common indication for surgery was secondary osteoarthritis of the hip joint due to avascular necrosis of the femur head (21 patients). Other causes were primary osteoarthritis of the hip (3 patients), intermediate stage of avascular necrosis of femur head which had not progressed to the stage of osteoarthritis (2 patients), osteoarthritis post old history of trauma (2 patients), osteoarthritis post healed tuberculosis of the hip (1 patient), and ankylosing spondylitis (1 patient).

A thorough clinical and radiological examination was performed. All the patients were advised to do isometric quadriceps exercise 8 hours after surgery. Patients were made to sit up on 1st post-operative day and advised knee bending exercises. Patients were made to stand up and walk on 1st post-operative day non weight bearing or partial weight bearing as tolerated. Sutures were removed on 12th post operative day. Average duration of stay in hospital was 5 days. The duration of follow up was till 18 months. Patients were assessed by the modified Harris Hip Score and WOMAC score after 12 and 18 months post op. All the patients were followed up regularly, no patients were lost for follow up. There was no complication during the period of study.

The mean Modified Harris Hip Score increased significantly from 26.6 pre operatively to 89.3 post operatively at 12 months and 90.0 at 18 months.

The mean WOMAC score has decreased significantly from 70.5 pre operatively to 14.8 post operatively at 12 months and 14.2 at 18 months.

This proves that uncemented total hip arthroplasty done with a 36 mm femur head and a ceramic on ceramic bearing gives excellent results.

Introduction

Total hip arthroplasty is a reconstructive procedure that has improved the management of chronic disabling conditions of the hip such as osteoarthritis. Replacement of damaged cartilage surfaces with artificial bearing materials has enabled surgeons to improve function and relieve pain in vast majority of patients.¹

Evaluation of outcomes of an operative procedure is important to determine if the procedure is of value. Patient derived outcome scales have become increasingly important to surgeons and clinical researchers for measuring improvement in function after surgery.

Hard-on-soft combinations consist of a head made of stainless steel, cobalt-chromium (Co-Cr) alloy or alumina and a cup made of ultra-high molecular weight polyethylene. Association between high volumetric wear, polyethylene particulate debris, osteolysis, and loosening in total hip replacement (THR) in young patients is well recognized and understood complications of these prosthesis.

Alternative bearing materials in THR have been developed to reduce the incidence of osteolysis. Hard on hard bearing with less wear particle debris is a move in this direction. Currently, ceramic on ceramic is a popular hard on hard bearing option. The ceramic material has undergone modifications, and a third-generation ceramic, released in the mid 1990s, is believed to have better wear properties².

Currently available ceramic components show high survivorship and low bearing wear at midterm follow up. Although these alternative materials such as ceramic are stronger and have more wear resistance, they are also relatively brittle and have somewhat poor tolerance to variation in the cup (socket) placement. They also have their special complications including fracture of the ceramic and rarely, squeaking. Recently, a new alumina matrix composite material (Delta ceramic) with improved material properties was developed to address these concerns.

During the initial development of hip replacement, the surgeons tried to make the implants which mimic the size of the natural femoral head. However, it was soon realised that when a large metal ball articulates with a plastic cup, the plastic part gets worn out quickly due to increased "volumetric wear". To decrease the "wear" of the plastic, Sir John Charnley (who was one of the pioneers in the development of modern hip replacements), opted for a smaller 22 mm metal head (which is much smaller than the natural femoral head) in the design of Charnley hip replacement. However, a high dislocation rate following hip replacement has been quoted with smaller "ball size" in multicentre studies³.

Although lab studies and some clinical studies also support the concept that the larger sized balls decrease the dislocation^{3,4}, we do not have much studies that specifically measure the functional outcome of ceramic on ceramic hip replacement using a 36mm head. Hence, this study is intended to determine the functional outcome of the surgery using ceramic on ceramic prosthesis with 36mm diameter head.

All the total hip arthroplasties were uncemented arthroplasties at our institution, performed by the same surgeon, using the same technique. Implants used belonged to the same system in all patients, Aesculap THR implant system.

Aims and Objectives

To study the functional outcome of Ceramic on Ceramic Total Hip Replacement using a 36 mm diameter femoral head with the help of the following scores - Harris Hip Scoring (Modified) and WOMAC Score

Methodology

In this study 30 patients, aged between 30 and 75 years, with diseased and destroyed hips were treated with uncemented total hip replacement using ceramic on ceramic bearing with a 36mm femoral head prosthesis at a tertiary care institute. The patients were followed up till 18 months.

Inclusion Criteria

- 1) Patients with hip pathology indicated for total hip replacement
- 2) SEX –Male and Female.
- 3) No signs of infection
- 4) Patients giving consent for surgery
- 5) Patients in age group 20 to 80

Exclusion Criteria

- 1) Active infection.
- 2) Patients medically unfit for surgery.
- 3) Patients not willing for surgery.
- 4) Patients who have undergone previous total hip replacement surgeries
- 5) Patients having deformities and pathologies of other joints of the lower limbs with are likely to have an effect on the functional outcome of the hip arthroplasty.
- 6) Patients having a recent history of trauma causing a fracture of the acetabulum or femur which is the main indication for a total hip arthroplasty in this case.

On admission to the ward, a detailed history of the patient was taken. This included age, sex, occupation, complaints, associated medical illness. Following this, they were subjected to a thorough clinical examination and general condition was assessed and accordingly corrective measures were taken to correct the general wellbeing of the patients.

Routine blood investigations were done for all the patients. Special attention was paid to CRP and ESR and if these were abnormal, surgery was deferred. Standard anteroposterior and lateral X-rays were taken including pelvis with both hips. Analgesics, antibiotics, tetanus toxoid and blood transfusions were given as needed.

Aspirin, anticoagulants and other anti-inflammatory drugs were stopped 7 to 10 days before surgery.

Preoperative Assessment

The patients were evaluated according to the Modified Harris Hip Scoring system⁵ and the

Western Ontario & McMaster Universities Osteoarthritis index⁶. The more the WOMAC score, the more pain, stiffness and functional disability is present. The scores taken into account were of pain, function, range of motion, and deformities. Also a mention of the limb length discrepancy and flexion contracture is made.

The physical fitness of the patient undergoing a major surgery was assessed. Physical examination included examination of spine and both lower extremities including opposite hip, both knees and foot.

Trendelenburg test to assess the abductor musculature mechanism was done. Neurovascular status of affected extremity was evaluated. Any occult infections like skin lesions, dental caries and urinary tract infections were identified and treated preoperatively.

Implants

All the cases done at our institute used AESCULAP implants and instrumentation for the total hip arthroplasty. Acetabular size and Femur stem size varied according to the patients. This study includes only those cases in which a femur head prosthesis of 36 mm diameter has been used. Uncemented Total Hip replacement was done in all cases using a ceramic on ceramic bearing, that is, a ceramic liner was used with the ceramic head. All surgeries were done by the same surgeon using the same approach.

Postoperative Management

-Limb is kept in abduction with pillow in between the 2 lower limbs.

-Vitals are monitored carefully for 48 hours.

-IV antibiotics are continued for 24 hours.

-Check X-ray performed.

Physiotherapy

Day of surgery: Static quadriceps exercises, ankle dorsiflexion and plantar flexion and spirometry were done approximately 8 hours after surgery.

Post op Day1: Patient was made to sit bedside, then mobilized with the help of a foldable walker and assistance. Weight bearing was usually partial as tolerated by the patient .Static exercises were continued. Spirometry was continued.

Post op Day 2: Mobilization was continued along with other exercises

Post op day 3: Commode training was given.

Post op day 4: Exercise protocol was intensified. Mobilization distance was increased.

Patient was adviced to continue physiotherapy at home after the discharge, and come for stitch removal on the 12 post-operative day.

every 6 months thereafter. At the follow-up a detailed clinical examination was done and patient was assessed subjectively for symptoms like pain, swelling and restriction of joint motion.

-Modified Harris hip scoring system and WOMAC score was used for evaluation at 12 months and at the last follow up which was at 18 months.

-On clinical examination, examination for tenderness, range of movements of the joint and limb length discrepancy was noted.

-Check X-rays were taken to study for any signs of complications of the procedure

Follow-up

In our study, patients on discharge were advised to report after 1st month, 3rd month, 6th month and

Radiological Photographs

Case 1 : Secondary OA Left Hip



Pre-Operative X-Ray



Immediate Post Operative X Ray

Results**Age Distribution****Table No.1:** Graphical Representation for Age Distribution

Age (In Years)	No. of Patients	Distribution
30-39	9	30.0%
40-49	5	16.7%
50-59	8	26.7%
60-69	6	20.0%
70-79	2	6.7%
Total	30	100.0%

Sex Distribution**Table No.2:** Graphical Representation for Sex Distribution

Sex	No. of Patients	Distribution
Male	26	86.7%
Female	4	13.3%
Total	30	100.0%

Side Affected**Table No.3:** Graphical Representation for Side Operated

Side Operated	No. of Patients	Distribution
RIGHT	18	60.0%
LEFT	12	40.0%
Total	30	100.0%

Indications for Surgery**Table No.4:** Graphical Representation for Indications

Diagnosis	No. of Patients	Distribution
OA sec to AVN	21	70.0%
OA Post Traumatic	2	6.7%
ANKYLOSING SPONDYLITIS	1	3.3%
AVN	2	6.7%
OA Post Tb Hip	1	3.3%
OA Primary	3	10.0%
Total	30	100.0%

Stem Sizes Used**Table No.5:** Graphical Representation for Stem Size

Stem Size	No. of hips
8	8
9	5
10	3
11	2
12	6
13	4
14	2
Total	30

Cup Sizes Used**Table No.6:** Graphical Representation for Cup Size (in mm)

Size of Cup(in mm)	No. of hips	Distribution
48	4	13.3%
50	5	16.7%
52	5	16.7%
54	5	16.7%
56	4	13.3%
58	3	10.0%
60	4	13.3%
Total	30	100.0%

Table No.7: Cup Size respective to size above or below 54 .

Cup Size (in mm)	No. of Hips	Distribution
< 54	14	46.7%
54-60	16	53.3%
Total	30	100.0%

Incidence of Complications**Table No.8:** Graphical Representation for Complications

Complications	No. of Patients	Distribution
No	30	100.0%
Yes	0	0.0%
Total	30	100.0%

Harris Hip Scores**Table No.9:** Graphical Representation for Harris Hip Score (Modified)

Harris Hip Score (Modified)	No. of hips	Distribution
Exc	17	56.7%
Good	13	43.3%
Fair	0	0.0%
Poor	0	0.0%

Table No.10: Statistical Representation for Harris Hip Score (Modified)

HHS	Mean	S.D	Min	Max
Pre-op HHS	26.6	11.3	11	52
Post-op HHS at 12 months	89.3	4.1	82	97
Post-op HHS at 18 months	90.0	3.8	82	97

WOMAC Scores**Table No.11:** Statistical Representation for WOMAC Score

WOMAC	Mean	S.D	Min	Max
Pre-Op WOMAC Score	70.5	8.6	48	85
Post-op WOMAC Score at 12 months	14.8	6.0	4	29
Post-op WOMAC Score at 18 months	14.2	5.9	4	29

Conclusion

- Using Paired T Test, P value is 0.000 ($P < 0.05$) i.e. there is a significant difference between Pre-op WOMAC and Post-op WOMAC at 12 months.
- Using Paired T Test, P value is 0.000 ($P < 0.05$) i.e. there is a significant difference between Pre-op WOMAC and Post-op WOMAC at 18 months.

Discussion

Large head THA essentially increases the stability by increasing the jump distance and allows greater range of movement (ROM).^{6,7,8} Bearing surfaces also changed from metal on polyethylene to metal on metal (MOM) and ceramic on ceramic (COC). All these changes have increased the stability and longevity of the prosthesis which can offer near normal ROM. As increasing young population is undergoing THA, the need for bearing surfaces which have a low wear rate like ceramic is growing.^{9,10}

In our study, we found that the mean age of the patients undergoing the total hip arthroplasty was 50.36.

In a study done by Sanjay Agarwala et.al¹¹, mean age was found to be 56 for the group which underwent ceramic on ceramic total hip arthroplasty, and mean age of 48 for the second group that underwent metal on metal total hip arthroplasty. This in accordance with our study. In another study by Ahmed Rizle et.al¹², 15 patients underwent ceramic on ceramic total hip replacement mean age of the patients was found to be 34 years that is much less than what we observed in our study.

In the results of sex distribution of our study, 26 out of 30 patients were males, i.e., 86.7 % were males in our study that was more than the study done by Sanjay Agarwala et.al¹¹, where 72.22 % of patients who underwent a ceramic on ceramic hip replacement were males. Whereas, in the study by Ahmed Rizle et.al¹², only 20% of the

patients who underwent total hip replacement with a ceramic on ceramic bearing, were males.

In our study, the most common indication for surgery was osteoarthritis [70%] secondary to avascular necrosis of femoral head that was similar to the study done by Sanjayagarwala et.al¹¹.

In the study done by Ahmed Rizle et.al¹², the most common indication for surgery was avascular necrosis of femoral head. This is different from our results. The reason for this difference could be the delay in presentation of patients to us when the osteoarthritis sets in. In our study the mean modified Harris hip score was 26.6 which is poor ,pre- operatively , and at 18 months it increased to 90 i.e., excellent. In a study done by Sanjay Agarwala et.al¹¹, who studied 36 patients who underwent a ceramic on ceramic with large head total hip replacement, with a follow up period of 18 months, modified Harris hip score increased from pre operative value of 50 to post operative value of 89 . This result is in accordance with our study .Also in a study by Ahmed Rizle et.al¹², the mean Harris hip score increased from a pre operative value of 37.6 to 91.8.

There are large number of studies which show a strong relationship between larger femoral heads and better functional outcomes and lower dislocation rates^{7,8,9}. However, V T Veysi¹³ in his study found functional levels achieved following hip replacement are not influenced by the size of bearing.

In our study, we had no incidence of post operative dislocation using the 36mm diameter head in 30 patients followed up for a period of 18 months. In a study done by Somesh et.al¹⁴ compared hip arthroplasties done using a 36 mm femoral head and 28mm femoral head and found that dislocations with a 36 mm femoral head were lower than those for a 28 mm smaller femoral head. Also, Gagala et al¹⁵ studied 50 hips with an average follow up of 40 months and showed a decreased risk of postoperative dislocation with

36 mm head. These results are in accordance with our study.

Although our study period was short, but there were no incidence of loosening or osteolysis. Sugano et al.⁹ in their 11 to 14-year follow up results of THA using a third-generation alumina ceramic-on-ceramic bearing showed 14-year survivorship as the end point of revision of 97.9% for the acetabular cup, 97.8% for the femoral stem, and 95.7% for the overall implants. Porat et al.¹⁶ compared ceramic on ceramic (COC) large head THA with metal on metal (MOM) THA and found 26% of the revision in MOM group and 13% in the COC group were bearing related.

Total hip replacement is a permanent method of relieving pain in the hip due to various conditions. The aim of the surgery is to relieve pain, at the same time to preserve motion and stability of the joint. An uncemented ceramic on ceramic bearing with a large diameter head, 36 mm as in our case, gives excellent functional outcomes with reduced rate of complications. The strength of this study is that all hips were primary arthroplasties, all were done using a uniform technique, done by same surgeon and no patient lost for follow-up. The limitation of the study is that the sample size is less and the follow-up duration is not very long so as to demonstrate the long term complications of this procedure.

Conclusion

Based on our experience and results, we conclude that total hip replacement with a ceramic on ceramic bearing using a 36 mm diameter femoral head, is an excellent procedure in the management of diseased and destroyed hips with chronic and incapacitating pain in elderly patients.

□ Secondary osteoarthritis of the hip due to avascular necrosis of the femoral head was the most common cause of chronic hip pathology in our study.

□ The assessment of clinical results of uncemented total hip replacement with 36 mm

head and ceramic on ceramic bearing, has shown that there is definitive improvement with regard to pain, function and range of motion post-operatively.

□ With proper patient selection, adequate planning, armamentarium, meticulous surgical technique, we have achieved good results.

□ Long term studies are necessary to study the late complications and to prove the efficacy of these implants and procedure

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