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Functional and radiological outcome in primary ceramic-on-ceramic total hip arthroplasty

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Abstract

Background: Traditionally, total hip arthroplasty (THA) was done using cobalt-chrome into a polyethylene socket. However, because of wearing properties of these implants, implant loosening and loss of bone stock, particularly in younger and more active patients, was seen with greater frequency. This led to the development of ceramic implants having better wear characteristics.

Material and Methods: Present study was carried out as prospective study, on 30 patients undergoing primary ceramic on ceramic THA with minimum of 6 months of follow up. For clinical evaluation, Harris Hip score and Modified Merle d'Aubigné and Postel score were calculated pre-operatively and post-operatively. For radiological evaluation, post-operative radiographs were checked for alignment of femoral stem, loosening of stem or acetabular component, osteolysis and presence of heterotopic ossification, at predefined regular intervals.

Results: The mean Harris hip score, in our study, increased from 35 pre-operatively to 88.4 post-operatively, and mean Modified Merle d'Aubigné and Postel score increased from 9.3 pre-operatively to 16.2 post-operatively, with 90% hips having good to excellent results. This improvement was statistically significant ($p < 0.005$). On evaluation of alignment of femoral stems, 28 stems were central (93.3%) and 2 stems were in valgus (6.67%), having no significant clinical outcome. Not a single case of focal osteolysis, stem loosening or heterotopic ossification was seen.

Conclusion: We found excellent results of primary ceramic on ceramic THA comparable to available literature, with no serious complication found in any patient. The limitations of our study include the lack of a control group undergoing THA with alternate bearing surfaces, and longer follow up.

Keywords: Functional outcome, radiological outcome, ceramic-on-ceramic, total hip arthroplasty

Introduction

Total hip arthroplasty (THA) is one of the most successful and cost-effective surgical procedures and remains the treatment of choice for long-term pain relief and restoration of function for patients with diseased or damaged hips [1]. The first generation of cementless femoral stems and subsequent generations of uncemented femoral stems have been developed to address the complications like osteolysis and the volume of micro particles, which are released from implant surfaces by friction during normal joint function [2].

Since the first total hip replacements performed by Charnley in the 1960s, many different types of prostheses have been used [3]. The traditional method of fixation of an implant to bone involved the use of cement. However, in the 1980s, implant loosening and loss of bone stock, particularly in younger and more active patients, was seen with greater frequency [4]. The uncemented THA was developed to avoid these problems. The development of uncemented stems with hydroxyapatite (HA) coating may decrease the incidence of loosening, distal migration and may enhance integration and prosthetic stability.

Changes in bearing technology have typically focused on increasing implant survival by decreasing wear, resulting osteolysis and reducing dislocation rate. Alternative bearing surfaces are of two types: low wear metal on polyethylene articulations and bearing surfaces using couples such as ceramic on ceramic.

Early reports on ceramic-on-ceramic total hip arthroplasty have demonstrated excellent clinical and radiological results. The theoretical advantages of ceramic-on-ceramic are represented by its remarkable sliding characteristics and its very low wear debris generation.

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The goal of our study was to evaluate the functional and radiological outcome in patients who underwent primary total hip arthroplasty using ceramic bearings.

Materials and Methods

Present prospective study was carried out on 30 patients, who underwent primary uncement ceramic-on-ceramic THA, in the Department of Orthopaedics, ESI-PGIMS, Basaidarapur, New Delhi, between October 2014 to September 2015 with a minimum of 6 months of follow-up. The patients had to be mentally clear and ambulatory. For clinical evaluation, Harris hip score [5] and Modified Merle d'Aubigné and Postel [6, 7] scores were measured pre-operatively and post-operatively. Radiographic evaluation included pre-operative antero-posterior and lateral views of the hip joint along with pelvis. Post-operative radiographs were checked for alignment of femoral stem, loosening of stem, presence of heterotopic ossification, loosening of acetabular component at predefined regular intervals of 6 weeks, 3 months, 6 months, and then annually. Patients above the age of 65 years were not included in the study. At the end of the study, the data was analysed statistically. A *p* value of <0.05 was considered as significant.

Results

The mean age of patients in our study at the time of surgery was 40.9 years. Age varied from lowest of 21 years to highest of 64 years. Maximum number of patients i.e. 9 belonged to the age group of 31-40 years. In our study of 30 patients, 5 (16.67%) were females and 25 (83.33%) were males, with male: female ratio of 5:1. The clinical outcome, determined by Harris Hip Score and Modified Merle d'Aubigné and Postel Score [5-7], was not affected by different age groups, or the sex of the patients.

Pre-operatively, the mean Harris Hip Score was 35.03 (Range from 20 to 44), which increased to a mean of 88.43 (Range from 74 to 95) post-operatively. 90% of hips had good to excellent results at latest follow up. Pre-operatively, the mean Modified Merle d'Aubigné and Postel Score was 9.33 (Range from 6 to 12), which increased to a mean of 16.17 (Range from 13 to 18) post-operatively. 90% of hips had good to excellent results at latest follow up. This improvement in post-operative Harris Hip Score and Modified Merle d'Aubigné and Postel Score, is statistically significant (*p* value < 0.0005).

On radiographic evaluation, stem alignment was central in 93.33% of cases (28 cases) and valgus in 6.67% cases (2 cases). On comparison between alignment of stem and clinical outcome (based on Harris Hip Score and Modified Merle d'Aubigné and Postel Score), no significant association was found i.e. clinical outcome was not affected by the alignment of stem.

None of the patients showed heterotopic ossification, osteolysis, or stem loosening. Squeaking was not found in any of our patient. There were no major complications observed in any of our patient.

Discussion

Ceramic bearings are widely used in Total Hip Arthroplasty along with metal and polyethylene bearings. There were several studies in past few years accessing the advantage of one over the other. The aim of our study was to evaluate the functional and radiological outcome of primary total hip arthroplasty with ceramic bearings. The study was conducted in Department of Orthopaedics in ESI-PGIMS, Basaidarapur, New Delhi. A total of 30 patients undergoing

total hip arthroplasty with ceramic-on-ceramic bearings were included.

The mean age of patients in our study was 40.09 with age ranging from 21 to 64 years; majority of them being from age group 31-40 years. A case study was reported by Capello and Feinberg (2009) [8] where ceramic-on-ceramic joints were implanted in a 13-year-old child with bilateral end-stage arthritis of the hip. Seven and eight years post-operatively the patient had no pain, no limp, and was able to walk long distances. The radiographs showed no implant loosening, osteolysis or wear. This is a very encouraging Result, however, it was stated that the patient is still very young (20 years of age at the time of report) and, therefore, the need for revision surgery will be more than likely. Other studies on younger patients have not had as good results as those reported by Capello though. Nizard et al. (2008) [9] reported on ceramic-on-ceramic hips that had been implanted in a group of 101 patients (132 hips), younger than 30 years old (mean age: 23.4 years, range: 13-30 years). In our study, age was not associated with any significant difference in the clinical outcome, as suggested by age distributed mean Harris Hip scores and Modified Merle d'Aubigné and Postel scores [5-7].

In our study out of 30 hips, 5 were that of females with male: female ratio of 5:1. A study conducted by Reuven et al. [10] included 10 males and 40 females. No significant statistical differences were seen comparing pre and post-operative Harris hip scores. We too did not find any correlation between the sex of the patient and clinical outcome. This increased male to female ratio in our study could be due to the fact that in Indian context, males are more exposed to trauma due to increased outdoor activity level, and also to avascular necrosis due to smoking and consumption of alcohol.

The mean period of follow up in our study was 14.63 months. (ranging from maximum of 21 months to minimum of 8 months). This follow up is small due to limited time frame we had but we intend to continue the study for longer period. Lins et al. [11] reported 81% of femoral components and 97% of acetabular components were stable at mean follow-up of 60 months following uncemented fixation, while Mont et al. [12] reported good to excellent results in 94% of patients at short-term follow-up.

We evaluated the clinical outcomes based on Harris hip score and Modified Merle d'Aubigné and Postel score as has been done by various authors. The mean Harris hip score in our study increased from 35.03 pre-operatively to 88.43 post operatively at the latest follow up with 90% hips having good to excellent results. The Modified Merle d'Aubigné and Postel score in our study increased from 9.33 pre-operatively to 16.17 post-operatively with 90% hips having good to excellent results. This improvement was statistically significant (*p* < 0.005). Our results are comparable to a study done by Reuven et al. [10] in which pre and post-op Harris Hip scores were 45 and 88 respectively with 80% patients having good or excellent results. Another study was done by Millar et al. [13] in which pre and post operative Harris hip scores were 29.4 and 85.7 respectively at minimum of 24 months of follow up.

On evaluation of alignment of femoral stem 28 stems were central (93.33%) and 2 stems in Valgus (6.67%) and none in varus position. There was no significant correlation between stem alignment and clinical outcome based on Harris hip score or Modified Merle d'Aubigné and Postel score. Long term follow up is needed to show exact result of this.

No cases of focal osteolysis or heterotopic ossification were

seen in our study. This is in contrast with study of Simon et al¹⁴ where osteolysis was seen in 6 out of 34 hips, 3 being grade 1, 2 grade 2 and 1 grade 3. Various other authors have reported osteolysis ranging from 7% to 78% (Christie et al. Tanzer et al, Bono et al.)^[15, 16, 17]. This could be due to shorter duration of follow up in our study and small number of study population.

Stem loosening was not seen in any patient till recent follow up. This is in accordance with study of Simon et al¹⁴ where osteolysis was seen in only 1 out of 34 cases with long follow up without clinical signs of loosening.

Squeaking was not seen in any patient in our follow up. Jarrett et al. (2009)^[18] described a group of 131 patients from which 14 (10.7%) suffered an audible “squeak” during normal activities (however, only 4 of these patients were able to reproduce the “squeak” during the clinical review session). After 10 years of follow-up Chevillotte et al. (2012)^[19] discussed the performance of 100, third generation ceramic-on-ceramic joints. By use of a questionnaire, 5% of these patients reported the occurrence of “squeaking”. All of these patients were active, sporty and heavy men.

None of the major threatening complication was noticed during evaluation of our cases. A study was done by Aoude et al. (2015)^[20], in which outcome of 133 total hip arthroplasties with ceramic on ceramic bearings was analysed. In this study, one hip underwent two staged revision for infection and another underwent revision for dislocation.

In our study, we have achieved excellent clinical outcome and fixation by bony ingrowth comparable to available literature. Osteolysis and heterotopic ossification were not seen in any of the patients as reported in literature, which could be due to short period of follow-up. No major threatening complication was seen in our study. The limitation of our study includes the lack of a control group with alternate bearing surfaces, and lack of longer term follow up.

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