

# Functional outcome following a large head total hip arthroplasty

## A retrospective analysis of mid term results

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### ABSTRACT

**Background:** One of the reasons that hip resurfacing and large head metal on metal (MOM) total hip arthroplasty (THA) became popular in Asia was the possible increased range of movement and thereby improved function of the hip joint. Due to concerns of MOM articulation an alternative bearing was sought. Hence, a shift from large head MOM to large head ceramic on ceramic (COC) was made. The aim of this study was to compare the functional outcome including range of motion (ROM) and dislocation rates following large head MOM and large head COC THA.

**Materials and Methods:** Retrospectively, 39 primary THA with large head MOM with a mean age of 56 years (range 36-72 years) and average followup of 54 months (range 38-70 months) were compared with 23 primary THA with large head COC bearing with a mean age of 48 years (range 36-68 years) and an average followup of 18 months (range 12-26 months). Functional outcome was assessed using the Modified Harris Hip Score. Dislocation rate and ROM were compared.

**Results:** Global ROM averaged 248 degrees with MOM group and 252 degrees with the COC group. One patient with metal bearing had dislocation at an average 3 year followup which required revision THA while there were no complications in the COC group. MHHS averaged 89 points in MOM and 94 in COC THR.

**Conclusion:** This study has shown that large head ceramic on ceramic THA is a good alternative to large head metal on metal THA with comparable dislocation rates and range of movements and without complications of metallosis in Asian patients.

**Key words:** Ceramic bearing, large head, metal bearing, total hip arthroplasty

**MeSH terms:** Arthroplasty, replacement, hip, prosthesis design

### INTRODUCTION

Approximately four billion people reside in African and Asian continent<sup>1</sup> which constitutes almost half of the world population. There is also a significant immigrant population from these continents in the Western world. This is a significant of people mass which requires activities such as kneeling, cross-legged sitting, sitting on the floor, and Asian style squatting for cultural and religious

purposes. The currently used joint replacement implants designed and developed in the West are based on Western needs and lifestyle.<sup>2</sup> When patients in the Asian and the African sub-continent suffer from joint disease, there are postoperative restrictions as conventional designs do not allow their physiological high range of motion (ROM).

Various studies have shown that hip resurfacing and large head metal on metal (MOM) total hip arthroplasty (THA) has better postoperative activity level compared to conventional THA.<sup>3,4,5</sup> This is most likely due to increased ROM.<sup>6,7</sup> For this reason we adopted MOM THA so our patients could perform their activities of daily living (ADLs) with minimal risk of dislocation. However, certain MOM THA have led to metallosis, tissue reactions to metal debris, ALVAL (Aseptic Lymphocytic Vasculitis Associated Lesions), periprosthetic osteolysis, and aseptic loosening.<sup>8-10</sup> Hence, a decision to use large head, fourth generation ceramic on ceramic (COC) THA in place of MOM to maintain the benefit of large heads. Various studies have shown that large diameter femoral heads reduce impingement, improve range of motion (ROM) and have a lower dislocation rate.<sup>11-16</sup>

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The aim of this study was to compare the functional outcome including range of movement and complications between large head COC THA and MOM THA. Our hypothesis was: (1) whether the large-diameter ceramic-on-ceramic (COC) bearing articulation had similar ROM and Harris Hip Score (HHS) as compared with the large MOM THA, (2) whether this new material had equal or lower intra and postoperative complication and revision rates.

## MATERIALS AND METHODS

Retrospective analysis of prospective data of all patients of Asian origin from January 2008 to December 2012 who underwent. In the initial phase of the study patients, the choice of implant was with MOM bearing. However, with the recognition of MOM issues the senior author moved to the COC bearing with large size femoral heads. MOM group consisted of 36 patients (39 hips) with at least 3 year followup and the COC group consisted of 23 patients (23 hips) done in last 2.5 years with a minimum 1 year followup. Both the groups were compared. Patients requiring THA for osteoarthritis, avascular necrosis or inflammatory arthropathy were included in the study. Patients who underwent THA for fracture neck femur were excluded.

All surgeries were performed by a single surgeon using the modified Hardinge approach (anterior one third of the gluteus medius is elevated from the greater trochanter) except in very obese and previously operated patients where the posterior approach was used. In MOM THA, acetabular cup used was articular surface replacement (ASR) cup with unipolar metal head and corail femoral stem (Depuy Orthopedics, Warsaw). The minimum femoral head size in ASR was 39 mm and the maximum was 63 mm. In COC THA, Deltamotion cup (Biolog Delta; CeramTec AG, Plochingen, Germany) and Corail femoral stem (Depuy Orthopedics, Warsaw) with large ( $\geq 36$  mm) ceramic femoral head was used. The minimum head size in this system is 36 mm and the maximum is 44 mm.

Postoperative protocol was same for all patients in both the groups. Postoperatively, patients received two doses of intravenous antibiotic. DVT prophylaxis and lower-extremity venous pumps were used to prevent thromboembolic incidents. Patients were instructed on hip movements and strengthening exercises and all therapy was supervised and started on the first postoperative day. Patients were mobilized partial weight bearing with a walker and then progressed to a stick within limits of comfort. All patients were able to achieve stair climbing before discharge. Hip precautions were advised for 6 weeks.

All patients were followed up clinically and radiologically at 6 weeks, 3 and 6 months, and thereafter annually.

Patients were evaluated by trained senior orthopedic fellows independently who were blinded to the type of THA. At each followup, patients completed questionnaires regarding pain severity, satisfaction and possible complications. Evaluators completed the Modified Harris Hip Score (MHHS) forms and documented ROM (global movements including flexion, extension, abduction, adduction, and rotations). The movements were measured with a long goniometer. Standard plain anteroposterior radiographs of the pelvis and lateral radiographs of the hip were taken at these followup visits. All MOM THA patients were evaluated every 6 months for metallosis by measuring their chromium and cobalt levels in blood and were screened for pseudotumour formation. In addition, any wound complications, including hematomas, superficial wound infections and deep infections requiring a return to the operating theatre, within 30 days of the procedure were recorded.

We applied ANOVA and independent *t*-test for evaluating the difference in ROM and MHHS. Chi-square test was applied for comparing the dislocation rates between the two groups. A *P* value of  $< 0.05$  was defined as statistically significant.

## RESULTS

Both the MOM and the COC groups had similar demographics except that the patients in the COC group were younger by eight years. There was no difference in the preoperative and postoperative MHHS scores between the two groups [Tables 1 and 2]. There was no statistical difference in the global ROM between the two groups. There was no evidence of any component loosening or osteolysis in both the groups at the last followup.

One male patient operated for secondary arthritis in the MOM group who presented with pseudotumor formation had dislocation 1.5 years after the primary surgery which needed revision with a metal on polyethylene articulation. Patient was doing well after the revision surgery with no further episodes of dislocation. Three patients with metal bearing were found to have raised cobalt and chromium ion levels in blood at the 3 year followup. These patients are under review for further investigations and need for revision surgery. There were no complications of fracture or squeaking in the COC group. There was no statistical difference for wound complications and dislocation rates between the two groups [Table 2].

## DISCUSSION

Most of the hip and knee implants are designed and developed to enable Western patients to perform ADLs like sit at the table to eat, climb stairs, and use western

**Table 1: Demographics: MOM and COC group**

	MOM group	COC group	P value
Total no of hips	39	23	
Male:Female	26:10	15:8	
Mean age (years) (SD) (range)	56.3 (7.8) (36-72)	48.4 (9.2) (36-68)	P<0.01
Mean followup (months) (SD) (range)	54.7 (7.3) (38-70)	18.1 (3.5) (12-26)	P<0.001
Diagnosis	RA 4 OA 32	RA 3 OA 20	
Approach	P 3 AL 33	P 3 AL 20	

MOM=Metal on metal, COC=Ceramic on ceramic, P=Posterior, AL=Anterolateral, RA=Rheumatoid arthritis, OA=Osteoarthritis, SD= Standard deviation

**Table 2: Comparative analysis of vital parameters - MOM vs COC group**

	Group	Mean	Std dev	P value
Preop MHHS	MOM	50	7.8	P=0.2619*
	COC	51.5	10.4	
Postop MHHS	MOM	90	4.2	P=0.05218*
	COC	91.7	4.8	
Range of movement	MOM	248.5	11	P=0.07*
	COC	253.9	7.3	

\*No significant difference was found, values are comparable between two groups, MOM=Metal on metal, COC=Ceramic on ceramic, MHHS = Modified harris hip score

commode toilet and shower independently.<sup>2</sup> However, it is questionable whether it serves the required needs of the Asian and African patients who constitute almost half of the world population. Most Asian patients undergoing THA would like to squat and sit cross legged on the floor or bed. This was possible with large head MOM THA for our patients till 3 years ago. The main reason for using MOM THA was that it provided the option of using large femoral head and thereby the potential for restoring normal hip movements.<sup>3,7</sup> Due to the concerns of MOM articulation an alternative bearing was sought. Hence, a shift from large head MOM to large head COC with the goal of providing improved ROM thereby ability to provide normal hip function for our patients. Our study shows that the functional outcome in the COC group is comparable to the MOM group at early to medium-term followup without an increased risk of complications like metallosis, squeaking, and ceramic liner fracture.

Large head THA essentially increases the stability by increasing the jump distance and allows greater range of movement (ROM).<sup>12,13,14</sup> Bearing surfaces also changed from metal on polyethylene to MOM and 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.<sup>17,18</sup>

With respect to ROM, Bartz *et al.*<sup>19</sup> reported only very small gains in movement before impingement when the head size increased from 22 to 28 mm and no significant increase between 28 and 32 mm heads. However, Amstutz *et al.*<sup>20</sup> reported an improvement in ROM with 32 mm diameter head compared to 22 mm diameter design due to greater head neck ratio (1.98 vs 1.74). Similarly, Chandler *et al.*<sup>21</sup> reported that delayed contact between the femoral neck and acetabular component with large femoral head sizes allowed greater ROM. This is the first study comparing the ROM of large head COC and MOM THA. Our study has shown that there is no statistical difference in the ROM between the two groups.

Long term results of large head ceramic on ceramic are published and are encouraging. Gaglia *et al.*<sup>22</sup> studied 50 hips with an average followup of 40 months. They showed a decreased risk of postoperative dislocation with 36 mm head and decreased incidence of osteolysis in primary alumina-alumina and XSPE-alumina THA. Sugano *et al.*<sup>17</sup> in their 11 to 14-year followup results of cementless 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. They concluded that cementless THA with the third-generation COC hip bearing provided an excellent survivorship and eliminated periprosthetic osteolysis for 11 to 14 years. Porat *et al.*<sup>23</sup> looked at the failure of the hard bearing surface THA in around 3000 THAs. They found that the most common etiology for failure in the short to medium term was loosening of the components. Comparing MOM versus COC bearing, they found 26% of the revision in MOM group and 13% in the COC group were bearing related. Recently, few studies have looked at another bearing option of ceramic on metal (COM). Schouten *et al.*<sup>24</sup> did a double-blinded randomized controlled trial comparing COM and MOM bearings. At 6 and 12 months followup they found elevated mean serum cobalt and chromium levels increased in both groups. The outcomes from our study for the COC group are comparable to that from the literature with no evidence of loosening at short to medium term.

In the past it was thought that dislocation following THA was influenced by the diameter of the femoral head but there are contradictory findings in the literature. There are large number of studies which show a strong relationship between larger femoral heads and lower dislocation rates<sup>12-14,17,19,25,26</sup> but the high number of variables weakens the statistical power of the large historical studies.<sup>16,27</sup> Berry *et al.*<sup>26</sup> examined 21,000 primary THAs in which 22, 24, or 32 mm diameter femoral heads were used and regardless of the approach, dislocation rates were reduced when a larger size was used.<sup>14</sup> The posterior approach

was associated with higher dislocation rates compared to other approaches. Norwegian arthroplasty registry also found that dislocation rates were lower with 32 mm heads than with 28 mm heads.<sup>28</sup> This registry also showed that 22 and 28 mm heads performed equally well. The lower rates of dislocation with larger heads can be explained by the “suction fit” which is an additional restraining force apart from static and dynamic restraining forces due to the soft tissue envelope. Other factors which increase the force required to separate the bearing surfaces are—stiffness of the material, a thin fluid film (due to small diametric bearing clearance), a large contact area, and viscous lubricating fluid. In our study we had one case of dislocation in the MOM group and no dislocation in the COC group though this was not statistically significant.

Although 2-year followup is insufficient to document the long term success of the implant, improvements in hip function and motion came to plateau by 1 year after THA. The study duration was therefore adequate to address the safety and efficacy of prosthesis for the short to medium term. Another limitation of our study is that it is a retrospective analysis of the data. However, the parameters studied in our study do give us valuable data to comment on the functional outcome for the two groups.

To conclude, this study has shown that large head COC THA is a good alternative to large head metal on metal THA with comparable low dislocation rate in spite of physiological normal range of movement and without complications like metallosis in Asian and African patients.

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