

Outcomes of Ceramic-on-Ceramic Total Hip Arthroplasties After Ten Years at Cork University Hospital Ireland

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Abstract

Objectives: We conducted a retrospective observational study to investigate the patients' reported outcomes and survival of ceramic-on-ceramic total hip arthroplasty.

Patients and Methods: 238 patients underwent ceramic on ceramic hip arthroplasties between January, 2010 and October 2012. Out of these, 205 patients (86.1%) had uncemented fixations and 33 patients (13.9%) had cemented fixations with THA using a CoC femoral head and liner. For each patient, WOMAC and SF-12 scores were measured at six weeks, six months, two years, and five years. Radiological follow up to 10 years. The patients who received revision surgery were identified in the database.

Results: The mean preoperative WOMAC and SF-12 scores were 39.83 ± 12.29 and 30.07 ± 2.18 , respectively. At 5 years, the mean WOMAC score had improved from 39.83 ± 12.29 to 90.40 ± 5.30 ($p < 0.01$), Wilcoxon signed-rank test; the mean SF-12 score had improved from 30.07 ± 2.18 to 34.40 ± 2.22 ($p < 0.01$, Wilcoxon signed-rank test). Four patients (1.68%) got revision within 10 years postoperatively.

Conclusion: The CoC THA showed statistically significant clinical improvement in WOMAC score and functional score of SF-12 after 5 years follow-up with satisfactory survival after 10 years.

Keywords: Ceramic-on-ceramic, Total Hip Arthroplasty, SF-12, Functional Score, WOMAC, Survivorship

Introduction

It is stated that Ceramic on Ceramic (CoC) bearing surface has the lowest rate of wear among all other bearing substitutes in Total Hip Arthroplasty (THA) [1], [2]. The third generation alumina ceramic had some reported drawbacks such as fracture [3] and squeaking which was reported in 14.6% of patients with CoC bearing surface [4]. At the beginning of this century, the 4th generation (Delta) was introduced to the market to decrease these drawbacks. It is composed of 82% alumina and 17% zirconia. Its grain size ($0.6 \mu\text{m}$) is 1/3 the size of third generation ceramic [5], [6]. Consequently, the Delta ceramic is more resistant to crack propagation and fracture, which allows the use of larger head size and thinner liner.

This increases the range of movement and decreases the dislocation rate [6]. Another advantage of the CoC bearing surface is less wear debris, which makes it an attractive bearing surface option for the younger population [7], [8]. Moreover, the CoC bearing couple is hard (more scratch resistant) with a low coefficient of friction which makes it closer to the native hip joint. On top of that, it is also wettable which aids in lubrication [9]. Some authors measured the amount of skeletal muscle fat atrophy after THA with different articulating couples using CT scan. They claimed that the CoC bearing surface has the least amount of muscle atrophy [10]. A recent Randomised Control Trial (RCT) compared the CoC with the Metal on Polyethylene (MoP). The results were in favour of the CoC at 20 years follow-up [11]. We aimed in this study to investigate the mid-term survival and patient reported outcome measures (PROMs) of CoC THA.

Material and Method

This study was approved by the local ethical review board before starting data extraction. The study was conducted on prospective data collected between 2011 and 2012. This is the first study to use the Irish National Orthopaedic Register (INOR). A total of 238 patients who got primary CoC bearing surfaces for THA were recruited in this study. All surgical procedures were performed by two orthopaedic consultants in two orthopaedic centres (Cork University Hospital and South Infirmity Victoria University Hospital). Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) [12] and 12-Item Short Form Health Survey (SF-12) scores [13] were collected at six weeks, six months, two years, and five years. Radiological follow up was documented after ten years. Additionally, we asked each patient if they heard any noise from their hip. The noises were defined as any clicking, snapping, grinding, or squeaking [14].

113 patients (47.5%) underwent lateral hip approach and 125 patients (52.5%) had posterior hip approach. 205 patients (86.1%) had a titanium stem (Summit; DePuy) and hemispherical hydroxyapatite-coated titanium acetabular cup (Pinnacle; DePuy). Thirty-three THAs (13.9%) had cemented stems (Exeter; Stryker) and uncemented cups (Trident, Stryker). All cases were done using a BIOLOX delta ceramic-on-ceramic bearing. All cases were done by preparing the acetabulum first, followed by the femur. Confounder and effect modifiers like preoperative functional score, age, gender, implant type, surgical approach and type of fixation were noted.

Statistical analysis

SPSS version 23 was used for data analysis [15]. Mean and SD was calculated for numerical data like age and functional score. Frequency and percentages were calculated for categorical variables like gender, implant type, and surgical approach. Test of significance was applied and p value ≤ 0.05 was taken as significant.

Results

Two hundred and thirty-eight patients were enrolled in our study. The average age of the patients was 52.13 ± 10.12 years with the majority (67.2%) between 31-60 years of age. The male to female ratio was 1.73. About 47.5% of patients had a lateral approach of surgery and 52.5% of patients had a posterior approach. 86.1% of patients had uncemented fixation and 13.9% had cemented fixation. Four hips (1.7%) were revised within 5 years postoperatively (Table. I).

Table 1: Demographic data of the study groups.

Variable	Mean \pm SD	N (%)
Age (years)	52.13 \pm 10.12	
16-30 years		34 (14.3)
31-60 years		160 (67.2)
61-74 years		44 (18.5)
Gender		
Male		151 (63.4)
Female		87 (36.6)

Surgical Approach	
Lateral	113 (47.5)
Posterior	125 (52.5)
Fixation	
Hybrid	33 (13.9)
Uncemented	205 (86.1)
Implant Mode	
Summit, Pinnacle	205 (86.1)
Exeter, Trident	33 (13.9)

Clinical outcomes: 10 years after THA, the mean WOMAC score had improved from 39.83 ± 12.29 to 90.40 ± 5.30 ($p < 0.01$), Wilcoxon signed-rank test. The mean SF-12 score had improved from 30.07 ± 2.18 to 34.40 ± 2.22 ($p < 0.01$, Wilcoxon signed-rank test), (Table. 2) .

Table 2: Clinical outcomes.

		WOMAC		SF-12		P-value
		N	Mean \pm S.D	N	Mean \pm S.D	
Pre-Operation		238	39.83 \pm 12.29	238	30.07 \pm 2.18	< 0.05
Post-Operation	6 weeks	238	79.13 \pm 9.81	238	29.66 \pm 3.22	< 0.05
	6 months	236	84.97 \pm 9.95	236	32.18 \pm 1.84	< 0.05
	2 years	215	89.53 \pm 5.42	215	33.67 \pm 3.91	< 0.05
	5 years	215	90.33 \pm 5.79	215	34.31 \pm 2.32	< 0.05
	10 years	215	90.40 \pm 5.30	215	34.40 \pm 2.22	< 0.05

Complications: Two cases (0.8%) got postoperative infections. One was treated by Debridement and Antibiotic Implant Retention (DAIR) procedure and the other one was treated by 2 stage revision THA. No evidence of recurrent infection was recorded at final follow-ups. Two patients (0.8%) sustained a periprosthetic fracture of the proximal femur after a fall 12 and 18 months post-operatively. They were treated by open reduction and internal fixation using proximal femoral locking plates with cable wires. Eight patients (3.4%) complained of noise during walking and other activities, but their symptoms were not bad enough to warrant further surgical intervention (Table 3).

Table 3: Loss of follow up and complication.

Loss of Follow-up	N (percentage)
6 weeks	0 (0%)
6 months	2 (0.8%)
2 years	10 (4.2%)
5 years	23 (9.7%)
10 years	23 (9.7%)
Revisions after 10 years	4 (1.68%)

Discussion

The most important finding in this study is the relatively low complication rate for the Delta CoC THA. There was a 1.4% revision rate after 10 years (98.6 % survival rate). We didn't report any case of revision for ceramic fracture or aseptic loosening. We reported postoperative squeaking in only 3.4 % of the patients. They complained of very little noise, which didn't require any surgical intervention. The average time for presentation of squeaking in our study was 2 ± 0.5 year for all patients. However, other authors reported 3.9 ± 2.40 years [16], which was slightly delayed compared to ours. Moreover, a nearly similar onset of squeaking to our study was reported by Restrepo et al. which was 19.7 months ± 24 in six percent of patients in a study including 1284 patients [17]. Lim et al. mentioned that most of the patients presented with noise after 6 months postoperatively and the percentage of squeaking was 3.8 % [18]. The difference between the studies regarding the time of presentation of hip noises after CoC was due to the multifactorial reason for squeaking, which was affected by the type of component and impingement of the prosthesis [16]. The improvement in the clinical outcomes was satisfactory and significant for both WOMAC and SF-12 scores. Hamilton et al, [19] published the first study about the Delta CoC THA. They reported 2.8% ceramic liner fracture with 97.6 % survival rate after 2.5 years follow-up. Five years later the same authors claimed their 5.3 years follow-up, with 0.9 % fracture rate of the ceramic liner and 7.5 % of squeaking [5]. Other authors reported no fracture or squeaking rate after 5-6 years follow-up [20]–[22]. The data in the Australian Joint Registry records a 3.1% revision rate after 5 years. Of this, 0.6 % was due to fracture of the ceramic liner [2]. The postoperative joint squeaking mostly stems from edge loading as a consequence of excessive abduction angle of the acetabular cup [23], [24]. Some authors compared the outcomes between the CoC and Ceramic on Polyethylene (CoP). They argued that there was no significant difference between both bearing articulations [25]. The Dutch joint registry reported lower revision and dislocation rates for the CoC than CoP THA [26]. Ceramic is a stiff material, but brittle, which increases the risk of ceramic fracture in theory. However, in our study we didn't report any case with ceramic fracture. Some authors reported that the fracture usually happens in the liner more than the head [27]. Aggressive violence during application of the Ceramic is not the main cause of Ceramic fracture. However, the main reason is Liner or cup malalignment [28], [29]. Thus, extra care regarding the cup and liner insertion is advised.

Conclusion

The CoC THA showed statistically significant clinical improvement in WOMAC score and functional score of SF-12 on follow-up after 10 years with satisfactory survival after 10 years.

Strengths & Limitations

Some of the strengths of the study are that it is the first study to use the Irish National Orthopaedic Register (INOR). It clearly demonstrates the potential implications of the National Joint Registry database in Ireland. Once fully formed, INOR will generate high-yield information from its annual reports. The limitation in this study was that the mean age of the patients was <60 years and the documentation of the Body Mass Index was missed in the INOR. Both factors are major contributors to the results of any joint arthroplasty. Secondly, there was a lack of PROMs on follow-up after ten years. Thirdly, 23 of our patients were lost on follow-up after 5 and 10 years.

Conflict of Interest

The authors declare that they have no relevant financial or non-financial interests to report”.

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Ethical approval

This study was approved by the local ethical review board at Cork University Hospital, Cork, Ireland.

Informed Consent

Written informed consent was obtained from all patients and/or families”.

Author contributions

MIA and HE are the main authors of this study. They planned the work design, data, analysis/interpretation and writing for the manuscript. MIY also contributed in selecting the included studies during the process of screening. He was also involved in study design and statistical analysis. AA was involved in proof reading and writing of manuscript. RG and JH played an essential role in this study. They provided necessary guidance and mentorship.

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