

## Reference List: CoP

1. **Dahl J, S+Åderlund P, Nivbrant B, Nordsletten L, R+Åhrl S Less wear with aluminium-oxide heads than cobalt-chrome heads with ultra high molecular weight cemented polyethylene cups: A ten-year follow-up with radiostereometry. *International Orthopaedics* 2011;online August 2011:1-6.**

Abstract: Purpose Wear is a major contributor to osteolysis and aseptic loosening of total hip replacements (THR). Both alumina (Al<sub>2</sub>O<sub>3</sub>) and cobalt-chrome (CoCr) femoral heads are commonly used. We investigated wear comparing alumina heads to cobalt-chrome heads against conventional cemented polyethylene (PE) cups for up to ten years. Methods Linear wear was measured with radiostereometry (RSA). Our material was derived from two prospective randomised trials that investigated fixation of femoral stems, not wear, and was evaluated retrospectively (Level III). Results The mean (95% CI) proximal head penetration was 0.96 mm (0.68-1.23) in the cobalt-chrome group and 0.42 mm (0.30-0.53) in the alumina group at ten years (P = 0.001). The mean (95% CI) 3D penetration was 1.07 mm (0.79-1.35) and 0.53 mm (0.38-0.63), respectively, at ten years (P = 0.001). Conclusion Alumina heads performed better than cobalt-chrome heads in this study after ten-year follow-up

2. **Descamps S Comparative study of polyethylene wear in THR: 28 mm diameter ceramic versus metallic head: a fifteen years result. In: 10th EFORT Congress, Vienna 3-6 June 2009, 2009.**

Abstract:

### INTRODUCTION

The aim of this prospective, randomized, monocentric study was to compare wear of polyethylene when using a 28 mm diameter ceramic head versus a metallic head.

### MATERIAL AND METHOD

226 THR performed between 1988 and 1990 were evaluated in 2005. 111 patients had died, 28 were lost of follow up and in 17 cases radiological assessment was not possible. 74 arthroplasties have been analyzed. In all cases, a straight femoral stem in protasul 10 (Zimmer), and a polyethylene cup sterilized under gamma radiation were used. In 37 cases the bearing surface used a metal head and in 37 cases a ceramic head. Radiolucent lines were analysed on AP x-rays. Aseptic loosening was defined according to Hodgkinson and Harris criteria. The penetration of the femoral head was measured with a special software (M.P.H. Wear) on digitalised x-rays.

### RESULTS

The two groups were statistically comparable (p = 0.0857). For metallic heads, linear wear was 0,102 mm / year (62.8 mm<sup>3</sup>/year volumetric wear). For ceramic heads, linear wear was 0,058 mm / year (volumetric wear 35.7 mm<sup>3</sup>/year. It represents a significant reduction (p = 0.0004) 44% of penetration. There was a penetration higher than 0.1 mm per year in thirteen cases of metal heads and in only one case of ceramic head. It was noted four aseptic loosening. In these four cases penetration was greater than 0.2 mm per year. In three cases, it was a metal head and in one case, a ceramic head.

### DISCUSSION

Our results are comparable to those found in the literature when the follow up is more than ten years as reported by Schuller, Oonichi and Hernigou. For authors with follow up shortest than ten years, it is reported identical outcomes between ceramic head and metal head (as reported Jenni, Devane and Sychterz).

### CONCLUSION

This is the first randomized prospective study with two identical populations, showing a statistical significant difference of wear of polyethylene between ceramic and metallic prosthesis head.

3. **Ihle M, Mai S, Siebert W Ceramic Versus Metal Femoral Heads in Combination With Polyethylene Cups: Long-Term Wear Analysis at 20 Years. *Semin Arthroplasty* 2011;22:218-24.**

Abstract: Bearing surfaces are an important implant-related factor in the process of wear and resulting osteolysis. Especially, polyethylene (PE) wear is known to be a major reason for aseptic loosening of the acetabular and femoral components in total hip replacement (THR). In the past, several studies showed the advantages of ceramic femoral ball heads compared with metal ball heads with respect to the resulting PE wear. In this framework, we posed the question whether ceramic and metal ball heads still resulted in similar clinical outcome regarding PE wear after 20-year follow-up. Additionally, we investigated whether wear and osteolysis were correlated within these groups and compared our findings with results from appropriate publications. In this prospective study, 93 nonselected, consecutive uncemented hip arthroplasties were performed in 80 patients with use of the titanium-coated Robert Mathys (RM) cup and the cementless Spotorno stem. Eighty ceramic and 13 metal femoral heads with a diameter of 32 mm were used. The mean age of the patients was 52 years. The average follow-up was 19.3 years. No patient was lost for follow-up. The metal group showed a mean wear rate of 0.190 mm/year, whereas the ceramic group had 0.107 mm/year ( $P = 0.025$ ). The rate of revision cases was clearly higher within the CoCrMo group showing 6 revisions in 13 cases (46.2%) compared with 11 in 80 cases (13.8%) within the ceramic group. Wear rates were positively correlated to femoral head material ( $P = 0.025$ ), stem osteolysis ( $P = 0.003$ ), cup osteolysis ( $P = 0.011$ ), cup revision ( $P = 0.041$ ), and cup inclination ( $P = 0.012$ ). This long-term study shows that during a period of 20 years, ceramic ball heads generate less linear PE wear compared with metal ball heads, thus causing significantly less osteolysis and revisions of either component

4. **Kim YH, Yoowang C, Jun-Shik K Cementless Total Hip Arthroplasty With Alumina-on-Highly Cross-Linked Polyethylene Bearing in Young Patients With Femoral Head Osteonecrosis. *J Arthroplasty* 2010.**

Abstract: Abstract: Abstract: We asked whether total hip arthroplasties (THAs) using alumina-on-highly cross-linked polyethylene bearing would improve functional activity and reduce aseptic loosening, polyethylene wear, and osteolysis. Consecutive primary THAs were performed in 71 patients (73 hips) who were younger than 50 years (mean age, 45.5 years) with femoral head osteonecrosis. There were 48 men (50 hips) and 23 women (23 hips). Osteolysis was evaluated using radiographs and computed tomographic scanning. The average follow-up was 8.5 years (range, 7-9 years). The mean preoperative Harris hip score was 50.6 points, which improved to 96 points at the final follow-up. Preoperative functional activity was improved significantly at the latest follow-up. The mean polyethylene linear penetration was  $0.05 \pm 0.02$  mm/y and no hip had aseptic loosening or osteolysis. Keywords: femoral head osteonecrosis, total hip arthroplasty, alumina-on-highly cross-linked polyethylene, osteolysis.

5. **Lewis PM, Al-Belooshi A, Olsen M, Schemitch EH, Waddell JP Prospective randomized trial comparing alumina ceramic-on-ceramic with ceramic-on-conventional polyethylene bearings in total hip arthroplasty. *J Arthroplasty* 2010;25:392-7.**

Abstract: This prospective randomized study aims to compare the outcome between an alumina ceramic-on-ceramic (CC) articulation with a ceramic on ultra-high-molecular-weight polyethylene articulation (CP). Fifty-six hips in 55 patients with mean age 42.2 (range, 19-56) each received uncemented components, a 28-mm alumina head with randomization of acetabular liner. Mean St Michael's outcome score for each group with up to 10 years follow-up (median, 8 years; range, 1-10) was 22.8 and 22.9, respectively ( $P = .819$ ). Wear was identified in all but 1 CP replacement, but only 12 of the 23 CC. Mean wear in the CP group was 0.11 mm/y and 0.02 mm/yr in the CC group ( $P < .001$ ). Other than significantly greater wear in the polyethylene group, there was no significant difference in midterm outcome between the 2 groups

6. **Meftah M, Ebrahimpour PB, He C, Ranawat AS, Ranawat CS Preliminary clinical and radiographic results of large ceramic heads on highly cross-linked polyethylene. *Orthopedics* 2011;34:e133-e137.**

Abstract: Data are limited regarding large ceramic femoral heads with highly cross-linked polyethylene. We hypothesized that large ceramic head articulation with highly cross-linked polyethylene is safe with a low wear rate, comparable to metal-on-highly cross-linked polyethylene. The study group comprised 63 patients (72 hips) who had undergone total hip replacement (THR) with ceramic-on-highly cross-linked polyethylene between April 2006 and March 2007 with a minimum 2-year follow-up. Postoperative Western Ontario and Mc-Master Universities Arthritis Index (WOMAC) and Hospital for Special Surgery (HSS) scores were used for clinical assessment. Six-week and 2-year radiographs were analyzed by 2 independent observers using Roman 1.70 software. Twenty-six patients (29 hips) had 32-mm and 37 patients (43 hips) had 36-mm Biolox delta ceramic femoral heads (Ceramatec, Plochingen, Germany). Mean patient age was 60.9±8.9 years, and mean follow-up was 2.9±0.5 years. Mean postoperative WOMAC and HSS hip scores were 30.4 and 36.6, respectively. Mean wear at 1 and 2 years postoperatively was 0.06±0.28 and 0.006±0.12 mm/yr for all hips, respectively. Mean wear at 1 and 2 years postoperatively for the 32-mm femoral head was 0.063±0.278 and 0.007±0.126 mm/yr, respectively, and for the 36-mm femoral head was 0.057±0.292 and 0.006±0.118 mm/yr, respectively. No patient had any clinical complications, such as reoperation, infection, fractures, or radiographic evidence of osteolysis or loosening. The early results of THR with large ceramic heads demonstrate high safety and efficacy. Our data with 2-year follow-up show low wear rates, similar to published data for metal-on-highly cross-linked polyethylene

7. **Rajaratnam SS, Jack C, Tavakkolizadeh A, George MD, Fletcher RJ, Hankins M, Shepperd JA Long-term results of a hydroxyapatite-coated femoral component in total hip replacement: a 15- to 21-year follow-up study. *J Bone Joint Surg Br* 2008;90:27-30.**

Abstract: Between 1986 and 1991 we implanted 331 consecutive Furlong hydroxyapatite-coated femoral components of a total hip replacement in 291 patients. A cemented acetabular prosthesis was used in 217 hips and a hydroxyapatite-coated component in 114. We describe the long-term clinical and radiological survival of the femoral component at a mean follow-up of 17.5 years (15 to 21). Only two patients (0.68%) were lost to follow-up. With revision of the femoral component for any reason as the endpoint, the survival at a mean of 17 years was 97.4% (95% confidence interval 94.1 to 99.5), and with revision for aseptic loosening as the endpoint it was 100%. The survival at a maximum of 21 years with revision of the femoral component for any reason as the endpoint was 97.4% (95% confidence interval 81.0 or 99.5). These results compare favourably with the best long-term results of cemented or uncemented femoral components used in total hip replacement

8. **Suckel A, Friedrich G, Lothar K, Nikolaus W, Manfred G Long-term Results for the Uncemented Zweymuller/Alloclassic Hip Endoprosthesis: A 15-Year Minimum Follow-Up of 320 Hip Operations. *J Arthroplasty* 2009;24:846-53.**

Abstract: A follow-up study of 15 (15-17) years of 320 consecutive Zweymuller total hip arthroplasties is presented. Age at surgery was 67 (29-99) years. A total of 164 (51.3%) patients had died. Clinical and radiological examinations were available for 97 (30.3%), phone interviews and radiological examinations for 4 (1.3%) hips, and phone follow-ups for 49 (15.3%). There were 6 (1.9%) patients who were lost to follow-up. The Harris Hip Score results in a median value of 88. According to the Kaplan-Meier method, a survival rate of the cup/inlay of 98% (95% confidence interval, 95%-99%) after 17 years was achieved. For the stem/head, the survival rate was 98% (95% confidence interval, 94%-99%). In 95.2% of patients, no operative revision was required. The rate of aseptic loosening was 2% for the acetabular and 1% for the femoral component.

9. **Urban JA, Garvin KL, Boese CK, Bryson L, Pedersen DR, Callaghan JJ, Miller RK Ceramic-on-polyethylene bearing surfaces in total hip arthroplasty. Seventeen to twenty-one-year results. *J Bone Joint Surg Am* 2001;83-A:1688-94.**

Abstract: **BACKGROUND:** Polyethylene wear debris, and the resulting inflammatory response leading to osteolysis and loosening, is the primary mode of failure limiting the longevity of total hip replacements. Alternative bearing surfaces, including ceramic-on-polyethylene, have been investigated in an effort to decrease the amount of polyethylene wear debris. The purpose of this study was to evaluate the seventeen to twenty-one-year results of the use of ceramic-on-polyethylene total hip prostheses. **METHODS:** Sixty-four total hip prostheses were implanted with cement, by one surgeon, in fifty-six patients from 1978 to 1981. The average age at the index arthroplasty was sixty-nine years (range, fifty-one to eighty-four years). The components consisted of a cemented Charnley-Muller stem with a 32-mm modular alumina femoral head and a cemented all-polyethylene acetabular component. All patients who retained the index prosthesis were assessed clinically with use of Harris hip scores and were evaluated radiographically at the time of the latest follow-up. **RESULTS:** At the time of this latest follow-up, of the original sixty-four implants, eighteen (28%) were still in place and five (8%) had been revised. The remaining forty-one implants were in patients who had died and were functioning well until the patient's death. No patient was lost to follow-up. Of the eighteen hips with an intact prosthesis in the surviving patients, seven had an excellent clinical result; nine, a good result; and two, a fair result. One asymptomatic hip had definite radiographic evidence of femoral loosening. No hip had definite signs of acetabular loosening or evidence of osteolysis. Survivorship analysis revealed that the probability of survival of the prostheses without revision was 95% at five years, 95% at ten years, 89% at fifteen years, and 79% at twenty years. The mean linear and volumetric polyethylene wear rates were 0.034 mm/yr and 28 mm<sup>3</sup>/yr, respectively. There were no fractures of the ceramic heads. **CONCLUSIONS:** Outstanding long-term clinical and radiographic results were attained despite the use of what are now considered substandard techniques (an inferior stem design, a 32-mm head, and first-generation cementing techniques). The wear rates in this study are lower than previously reported metal-on-polyethylene wear rates and are consistent with the lowest reported in vivo ceramic-on-polyethylene wear rates. These findings support the consideration of ceramic-on-polyethylene bearing surfaces in total hip arthroplasty

10. **Willmann G, Brodbeck A, Effenberger H, Mauch CH, Nagel J, Dalla Pria P Investigation of 87 Retrieved Ceramic Femoral Heads. In: Puhl W, ed. *Bioceramics in Orthopaedics - New Applications*: Ferdinand Enke Verlag, 1998:13-8.**