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Veitch, Stephen W. and Whitehouse, Sarah L. and Howell, Jonathan R. and Hubble, Matthew J. W. and Gie, Graham A. and Timperley, A. John (2010) *The concentric all-polyethylene Exeter acetabular component in primary total hip replacement*. *Journal of Bone and Joint Surgery: British Volume*, 92-B(10). pp. 1351-1355.

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The concentric all-polyethylene Exeter acetabular component in primary total hip replacement

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Veitch SW, Whitehouse SL, Howell JR, Hubble MJW, Gie GA, Timperley AJ. The concentric all-polyethylene Exeter acetabular component in primary total hip replacement. *J Bone Joint Surg [Br]* 2010;92(10):1351-5

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Abstract

We report the long term outcome of the flangeless, cemented all polyethylene Exeter cup at a mean of 14.6 years (range 10-17) after operation. Of the 263 hips in 243 patients, 122 hips are still in situ, 112 patients (119 hips) have died, eighteen hips were revised, and three patients (four hips) had moved abroad and were lost to follow-up (1.5%). Radiographs demonstrated two sockets had migrated and six more had radiolucent lines in all three zones. The Kaplan Meier survivorship at 15 years with endpoint revision for all causes is 89.9% (95% CI 84.6 to 95.2%) and for aseptic cup loosening or lysis 91.7% (CI 86.6 to 96.8%). In 210 hips with a diagnosis of primary osteoarthritis survivorship for all causes is 93.2% (95% CI 88.1 to 98.3%), and for aseptic cup loosening 95.0% (CI 90.3 to 99.7%).

The cemented all polyethylene Exeter cup has an excellent long-term survivorship.

Introduction

A combination of cemented metal-backed polyethylene cups and larger diameter all polyethylene cups were used at our institution from 1984 up to 1991. Metal-backed cups were abandoned when it became apparent that the metal-back was responsible for an increased generation of polyethylene and cement debris(1). Despite this a review of the first 325 Exeter Universal hips, of which 94% had metal-backed cups, described good survivorship with endpoint revision for aseptic loosening of the acetabular component of 96.9% (CI 93.1 to 98.9) at 12 years(2) and 90.4% (95% CI 83.1 to 94.7%) at 17 years(3). Since 1991, all polyethylene cemented cups have been implanted; the long term performance of these has not previously been fully established. Two designs of all polythene cups were used, with different polyethylene thickness at the dome, described as low or high profile. We report the survivorship and the clinical and radiographic outcomes of these Exeter all polyethylene cups. The cups have a skirt on the external face designed to reduce the possibility of dislocation and is cemented with no added flange (figure1).

A consecutive group of patients operated on by locally-based Consultants who underwent primary total hip replacement using the Exeter all polyethylene cups and Exeter Universal stems (Stryker Inc., Newbury, UK) between March 1991 and December 1993 was reviewed. Patients who had previously undergone previous hip surgery were excluded. Surgery was performed at a single centre by multiple surgeons of widely differing experience. Clinical data was prospectively acquired and stored on our unit's database.

Patients and Methods

Between March 1991 and December 1993, 263 primary hip arthroplasties in 243 patients were carried out using the Exeter Universal stem and Exeter all polyethylene cup (Stryker Howmedica Osteonics). There were 107 arthroplasties in men and 156 in women. The mean age of patients at the time of operation was 66.3 years (range 18-89); 25 were under the age of 50 years. Consultant orthopaedic surgeons carried out 64% of the operations, registrars and fellows 36%. There were 210 cases (80%) with an initial diagnosis of osteoarthritis (Table 1).

Clinical evaluation was by the grading system of Merle d'Aubigné and Postel as modified by Charnley(4)(surgeon-derived), and at review both the Harris (5) (in part patient derived), and Oxford(6) (patient derived) hip scores were also recorded. The latter used the transformed 0 to 48 worst-to-best score as recommended by Murray et al.(7). The Charnley categories (A, B or C) (8) and the pre-operative status of the patients are summarised in table 2. Patients were reviewed in clinic every 5 years following surgery.

Survivorship analysis was performed using the Kaplan-Meier method (9-11) for the entire cohort as well as for the subset of patients with an initial diagnosis of osteoarthritis with 4 different end points; failure defined as re-operation for any reason; revision for aseptic loosening or lysis of the cup, revision for aseptic loosening of the stem and worst case scenario (12,13) with at least 40 cases remaining at risk (14,15). Radiographs taken before and after operation and at final review were examined jointly by two surgeons (...) for evidence of failure of the socket or stem, socket migration, the site and extent of lucent lines at the cement-bone, cement-cup and cement-stem interfaces, the presence of localised lysis, and measurements of linear wear using the Livermore technique (16).

Operative Technique

The posterior approach was used in 259 hips and the transgluteal (direct lateral) in 4 hips. All implants were cemented. Most of the femoral components had heads of 26mm (80%) and the remainder had 30mm heads. Acetabular preparation involved removal of the surrounding osteophytes and decortication of the acetabular walls and roof wherever this was possible. Thirty-five hips (13%) required augmentation of the socket, in the form of bone blocks and/or chips, in order to address bone defects in deficient acetabula. Four hips (2%) needed block autografts, 31 hips (12%) impaction grafting, and 5 hips (2%) both block and impaction grafting. Thirteen hips (5%) had fixation in the form of plates or screws to support the graft. Multiple drill holes were made for cement fixation into host bone. Surgeons had a choice of implanting a low and a high profile cup, the difference being in the thickness of the dome. The high profile cup allows more lateralisation of the centre of the femoral head. The majority of cups were low profile (232 hips (88%)), the remaining (31 hips (12%)) were high profile. Simplex cement (Stryker Corporation) was used in 204 (78%), and Palacos cement (Heraeus Medical, Germany) in 59 (22%). Prophylactic intravenous antibiotics were given in the form of cefuroxime (1.5g) on induction of anaesthesia, and two subsequent doses of 750mg at intervals of eight hours. Prophylaxis for deep vein thrombosis included early mobilisation, the wearing of elasticated stockings, and elevation of the foot in bed in all patients.

Results

At the time of review 112 patients (119 hips) had died at a mean 7.8 yrs (range 0.1-16) following surgery. None of these cases had undergone a revision of their hip arthroplasty. One patient died three days following surgery due to a large cerebral vascular bleed. Three patients (four hips) had moved abroad and were lost to follow-up. Of the remaining 128 patients (140 hips), 17 patients (18 hips) underwent revision at a mean time following initial surgery of 11.0 years (range 3.2-15.9). Eleven hips were revised for aseptic loosening of the cup, two for lysis around a well fixed implant, three for recurrent dislocation and two for deep infection. All 13 hips revised for aseptic cup loosening or lysis were symptomatic. According to Paprosky's classification of acetabular defects(17) one was type 1, seven were type 2A, three were type 2B, one a type 3A and one a type 3B. Five were revised to cemented cups, and 8 to uncemented cups. Only two of the revisions required acetabular augmentation with rim mesh and impaction grafting.

Of the 13 cases revised for aseptic cup loosening, five underwent acetabular bone grafting (2 block graft) at the time of initial surgery, one was a Paprosky type 1 acetabular defect, three were type 2A, and one was type 3B.

There were no cases of aseptic loosening of the femoral stem.

Kaplan-Meier survivorship curves (figure 2) have been constructed for different endpoints; failure defined as re-operation for any reason; revision for aseptic loosening or lysis of the cup, revision for aseptic loosening of the stem and worst case scenario.

The Kaplan-Meier survivorship (and 95% confidence intervals (CI)) at 15 years (with 61 cases remaining at risk) with endpoint revision for all causes is 89.9% (95% CI 84.6 to 95.2%) and for aseptic cup loosening or lysis 91.7% (CI 86.6 to 96.8%).

Worst case survival at 15 years was 88.4% (95% CI 83.0 to 93.8) (figure 2). There were no revisions for aseptic loosening of the femoral component. In hips with a diagnosis of primary osteoarthritis (208 hips) survivorship with endpoint revision for all causes is 93.2% (95% CI 88.1 to 98.3%) and for aseptic cup loosening 95.0% (CI 90.3 to 99.7%) (figure 3).

113 patients (122) hips still have their prostheses in situ underwent review at a mean 14.6 years (range 10-17) following surgery. The clinical status of the patients at their last follow-up is shown in table 1, using the Charnley modification of the Merle d'Aubigne and Postel hip score. The mean Oxford Hip score was 39 (range 7-48), and the mean Harris hip score was 75 (range 21-91). Sixteen patients were unable to attend clinic due to ill health, frailty, or because they live in another part of the country. For these patients, the clinical review was performed by telephone and x-rays were requested for those patients who lived in other parts of the country. Three patients (4 hips) were considered lost to follow up as they had left the country and were not contactable and were included as failures in the worst case curve.

Complications were as follows; three patients had deep vein thrombosis, one had a pulmonary embolism, one, a femoral nerve injury, and five hips dislocated (four late dislocations and one at six weeks post-operatively following a fall). One patient sustained a cortical perforation at the tip of the stem during surgery. This did not affect the outcome. One patient sustained a periprosthetic fracture at the tip of the stem following a fall three years post-operatively. This was treated with open reduction and internal fixation of the fracture using plate and cables. The stem was not changed.

Initial post-operative antero-posterior and lateral radiographs were available for review in 101 hips and final follow-up radiographs in 110 hips (out of 122 surviving

hips). A radiolucent line was defined as described by Kobayashi et al (18) as being a linear radiolucency adjacent to a sclerotic line. In the sockets radiolucent lines were seen in 22 hips (22%) on the initial post-operative radiograph, sixteen in DeLee and Charnley zone 1, one in zone 2, two in zone 3, one in zone 1 and 3, and two in all three zones (19). Progression of radiolucent lines was seen in only one of these hips. At latest follow-up, radiolucent lines were seen in the socket of 54 hips (49%), 39 in zone 1, two in zone 2, two in zone 3, three in zones 1 and 2, two in zones 1 and 3, and 6 (5%) in all three zones. Five hips (5%) had a focal area of pelvic osteolysis, four occurring in zone 1 and one in both zones 1 and 2. Two of the cups had migrated but as the patients were pain free neither cup has been revised. Both of these cups had radiolucencies but not all zones were affected. Using Hodgkinson's definition of radiological loosening (20) 8 hips (7%) were loose. Localised femoral osteolysis was seen in one hip in Gruen zone 5 (21) and was not progressing. The mean linear wear of the polyethylene measured using the Livermore technique was 0.11mm/year (0.0-0.4). No significant difference was found in the linear wear in those sockets with no radiolucent lines compared to those with one or more radiolucent lines (student t test; $p=0.22$).

Discussion

The aim of this study was to perform a review of Exeter hip replacements where a cemented all polyethylene Exeter cup was used and a survivorship study of the all polyethylene Exeter cup.

The survivorship at 15 years with endpoint revision for all causes is 89.9% (95% CI 84.6 to 95.2%) and in those with a diagnosis of primary OA 93.2% (95% CI 88.1 to 98.3%). These results are comparable to those found in the Swedish hip registry where the 10 year survivorship with endpoint revision for all causes in 6374 cemented Exeter hips was 92.6% (CI +/- 0.8%)(22). During this time uncemented cups had poorer results in both the Swedish and Norwegian registries(22,23).

The results of the all polyethylene cup are similar to the cemented metal-backed polyethylene cups previously reported from our unit(2,3).

Radiolucent lines in the acetabulum were seen in at least one DeLee and Charnley zone in 22% of hips at the initial post-operative radiograph. The cup used in this series did not have an outward facing flange at the periphery, a design which has been shown to aid pressurisation of cement (24,25), and to reduce the incidence of radiological demarcation at the cement bone interface (26). Progression of radiolucent lines was only seen in one of these cups. The two cups with radiolucencies seen in all three zones on the initial radiographs have not migrated on subsequent radiographs and the patients remain asymptomatic. It was reassuring to see that the rate of radiolucent lines in two or more zones at final review (11 hips, 10%) remained low as did the number revised for aseptic cup loosening (13 hips). According to Hodgkinson's et al (20) definition of radiological loosening of an acetabular component 8 hips in our series (7%) had either a greater than 1mm of radiolucency in

all three DeLee and Charnley zones and/or had migrated. These cups have not been revised as the patients remain asymptomatic.

Limitations of this study include difficulty in reviewing those patients who were unable to return to clinic in view of frailty and general ill health. Also a number of patients have moved to other parts of the country and abroad making regular review much harder. Another difficulty we encountered was with regard to missing radiographs which had been destroyed by the health authority.

We used the Livermore technique to measure linear wear(16). The technique is limited by the variable quality of the radiographs and the fact that measurements are necessarily made in two dimensions. The mean linear wear of polyethylene measured was 0.11mm/year (0.0-0.4) which is lower than the polyethylene wear observed with uncemented cups. In a randomised prospective study comparing a cementless acetabular component with a cemented all-polyethylene cup when the same femoral component was used(27), the mean wear rate observed with cementless cups was 0.15mm per year compared with 0.07mm per year with the cemented design. The difference in wear was significant ($p<0.0001$).

Of the 18 cases revised 3 cups were high profile (in this series 31(12%) of cups were high profile) and 15 low profile (232 (88%) of all cups). No significant difference was found in the profile of the cup with regards to revision for aseptic cup loosening at our institution. Of the 13 sockets revised for aseptic cup loosening and lysis the majority (8/13) had Paprosky type 1 and 2A defects which allowed for a relatively straightforward revision procedure. Only two of the 13 sockets revised required acetabular augments at revision.

Despite good results achieved with the use of the all polyethylene concentric Exeter cup, we no longer use this design due to the improved radiological findings and

survivorship reported with a cemented flanged cup which allows sustained high cement pressurisation at the time of implantation(26).

The concentric all polythene Exeter cup and Exeter Universal stem show excellent long term results. Survival rates for uncemented sockets are often defined as revision of the acetabular metal shell and operations for liner exchange and grafting behind well fixed shells do not tend to be counted as implant failures. When failure of the device is defined as acetabular revision for any reason the survivorship at 15 years with endpoint revision for all causes of 89.9% in this series of cemented cups is superior to reported series of uncemented implants over a similar time period (28-32).

Acknowledgements

The authors would like to acknowledge the hard work and dedication of the Exeter Hip Research Team in organising patients' appointments, chasing up x-rays and outcome scores, and putting together the database.

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Tables

Table 1. Pre-operative primary diagnosis.

Primary Diagnosis	Number (%)
Osteoarthritis	210 (80)
Dysplasia	13 (5)
Rheumatoid arthritis	12 (5)
Other inflammatory arthritis	6 (2)
Avascular necrosis	8 (3)
Post-traumatic osteoarthritis	3 (1)
Perthes	3 (1)
Other	8 (3)

Table 2. Pre-operative (all cases) and review (surviving cases) clinical scores using the Charnley modification of the Merle d'Aubigné and Postel scoring system (0-6 worst to best).

Charnley category	Number of arthroplasties	Pain	Function	Movement
Preoperative				
A	100	2.3	2.8	3.4
B	99	2.3	2.7	3.2
C	64	1.8	2.1	3
At review				
A	29	5.6	5.6	5.6
B	57	5.5	5.0	5.4
C	36	5.5	3.7	5.6

Figure 1. Low profile a) and high profile b) Exeter all-polyethylene acetabular component



Fig 1a



Fig 1b

Figure 2. Kaplan Meier survival curves of the Exeter cup (95% confidence intervals) for all cases

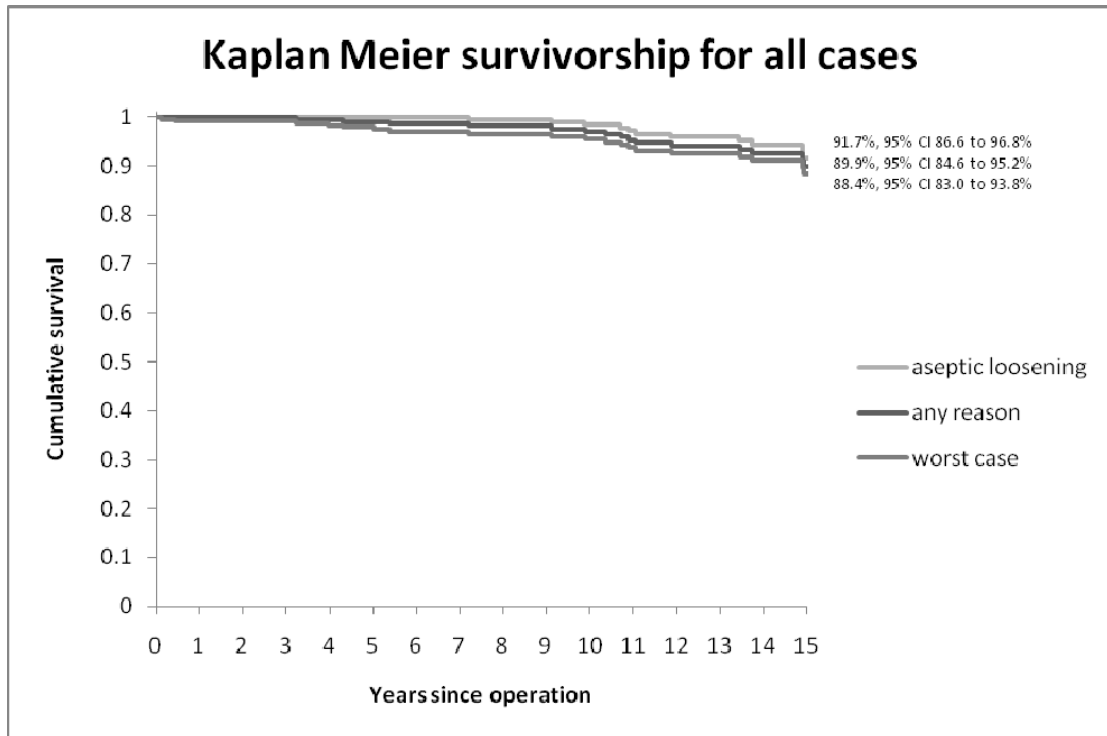


Figure 3. Kaplan Meier survival curves of the Exeter cup (95% confidence intervals) for OA

