The Exeter Contemporary flanged cemented acetabular component in primary total hip arthroplasty


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Aims
We report on the outcome of the Exeter Contemporary flanged cemented all-polyethylene acetabular component with a mean follow-up of 12 years (10 to 13.9). This study reviewed 203 hips in 194 patients. 129 hips in 122 patients are still in situ; 66 hips in 64 patients were in patients who died before ten years, and eight hips (eight patients) were revised. Clinical outcome scores were available for 108 hips (104 patients) and radiographs for 103 hips (100 patients).

Patients and Methods
A retrospective review was undertaken of a consecutive series of 203 routine primary cemented total hip arthroplasties (THA) in 194 patients.

Results
There were no acetabular component revisions for aseptic loosening. Acetabular revision was undertaken in eight hips. In four hips revision was necessitated by periprosthetic femoral fractures, in two hips by recurrent dislocation, in one hip for infection and in one hip for unexplained ongoing pain.

Oxford and Harris hip scores demonstrated significant clinical improvement (all p < 0.001). Radiolucent lines were present in 37 (36%) of the 103 acetabular components available for radiological evaluation. In 27 of these, the line was confined to zone 1. No component had migrated.

Conclusion
Kaplan–Meier survivorship, with revision for aseptic loosening as the endpoint, was 100% at 12.5 years and for all causes was 97.8% (95% confidence interval 95.6 to 100) when 40 components remained at risk.

The Exeter Contemporary flanged cemented acetabular component demonstrates excellent survivorship at 12.5 years.

Take home message: The Exeter Contemporary flanged cemented acetabular component has excellent clinical outcomes and survivorship when used with the Exeter stem in total hip arthroplasty.

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Since its introduction in 1970, the cemented acetabular component of the Exeter Hip system (Stryker Orthopaedics, Mahwah, New Jersey) has undergone numerous modifications. The original acetabular component was all polyethylene. It was eccentric, with a posterior skirt following the radius of the inner diameter. In 1984 a metal back was added. In 1988 the eccentricity was abandoned and the skirt design was changed. The metal back was abandoned in 1990, and in 1991 the concentric all-polyethylene Exeter acetabular component was introduced. This has shown to have excellent long-term survivorship. The Exeter Contemporary flanged all-polyethylene acetabular component was introduced in 1998. This incorporates a flange on the rim that serves to contain the cement and pressurise it into trabecular bone.

We report the first clinical and radiological outcomes of the Exeter Contemporary flanged acetabular component at a mean of 12.0 years (10.0 to 13.9) follow-up.

Patients and Methods
A retrospective review was undertaken of a consecutive series of 203 routine primary cemented total hip arthroplasties (THA) in 194 patients.


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patients. The operations were performed between February 2000 and June 2002. An Exeter Contemporary flanged acetabular component and Exeter femoral component were used (Stryker Orthopaedics). Clinical and radiological data were prospectively recorded.

The mean patient age at the time of operation was 70.5 years (standard deviation (SD) 9.4, 46 to 93). In total 112 (55.2%) hips were performed in women and 91 (44.8%) in men. There were 110 (54.2%) right hips and 93 (45.8%) left hips.

The indication for surgery was primary osteoarthritis in 189 hips, arthritis secondary to idiopathic avascular necrosis in 13 hips and arthritis secondary to infantile coxa vara in one hip.

Operations were performed by consultant surgeons in 66 hips, hip fellows in 119 hips and by registrars or senior house officers under supervision in 18 hips. The posterior approach was used in all cases and all implants were cemented. The internal diameter of all acetabular components was 26 mm, while the outer diameter ranged from 46 mm to 58 mm.

Acetabular preparation involved removal of the labrum and surrounding osteophytes and decortication of the acetabulum. Acetabular reamings, without cartilage, were squeezed in the hand and then placed in a long-handled circular spoon, 1.5 cm in diameter. The graft was then squeezed again with the thumb to make it level with the rim of the spoon. The graft was moved from the spoon onto the medial wall of the acetabulum and pushed firmly with the convex side of the spoon onto the medial wall and under the transverse ligament. The spoon was held in position while the socket was lavaged, to protect the graft. Milled bone from the acetabular reamers was routinely placed on the medial wall with the aim of enhancing fixation once the bone had incorporated and to help prevent cement extrusion below the transverse acetabular ligament.3 Where cysts were present these were decorticated, curetted and filled with milled bone graft. Multiple drill holes (seven to ten 6 mm drill holes, one each in the ischium and pubis, and five to eight in the ilium, depending on the size of the acetabulum) were made to maximise cement fixation into host bone. The flange of the acetabular component was trimmed by the surgeon to fit just within the rim of the acetabulum with 40° to 45° of inclination and 20° to 25° of anteversion to the anatomical plane. The acetabulum was then pressure washed with saline and packed with gauze swab soaked in 1.5% hydrogen peroxide solution (3% hydrogen peroxide diluted in equal volume of normal saline) in order to create a dry surface for cementing. Cement (Antibiotic Simplex, Stryker Orthopaedics) was introduced and pressurised using a proprietary pressuriser until the cement viscosity was optimal for implantation. The acetabular component was then introduced in the pre-rehearsed position.

The Exeter femoral stem was cemented in 15° to 20° anteversion (to achieve a combined anteversion of 35° to 40°).

All patients received prophylactic antibiotics at induction and at eight and 16 hours post-operatively. Patients received thromboprophylaxis in the form of foot pumps and low molecular weight heparin (LMWH) during the inpatient stay. This was followed by 28 days of aspirin, in those patients with no contra-indications to this regimen.

Patients were reviewed at eight weeks, six months, two years and five years post-operatively and thereafter every five years, or for this review. Patients who had moved away were telephoned and, where possible, hip scores were recorded. The radiographic follow-up for this group was arranged with local hospitals and radiographs were electronically transferred to us for assessment.

Clinical assessment for all patients, both pre- and post-operatively, was recorded using the grading systems of Merle d’Aubigne and Postel as modified by Charnley, Harris hip scores (HHS), Oxford hip scores (OHS)7 (modified 0 to 48, worst to best scale, as recommended by Murray et al8) and Euroquol EQ-5D.9

Radiographic assessment was carried out on standard anteroposterior (AP) radiographs using webPACS (Southampton, Hampshire, United Kingdom). An orthopaedic registrar and an Extended Scope Physiotherapy Practitioner, independently evaluated the presence and extent of radiolucent lines (RLLs)10 at the cement-bone interface. A RLL was defined as the roentgenographic appearance of a radiolucent gap at the bone-cement junction in THA. If a RLL was noted its maximum thickness, the DeLee and Charnley zone, or zones, involved, and the proportion of interface affected, were recorded. Where there was disagreement regarding the presence or extent of a RLL, a line was recorded as present and the greater of the two assessments was accepted.

All hips found to have RLLs wider than 1 mm at any point, or of any thickness in more than one zone, were assessed for a change in position. The abduction angle was measured on immediate post-operative AP pelvic radiographs and on most recent radiographs. One line was drawn along the lower border of the obturator foramina. A second line was drawn to bisect the upper and lower corners of the marker wire in the acetabular component, and then extended to intersect the first line. The angle formed between these two lines was the abduction angle (Fig. 1). This assessment was undertaken separately, by the two assessors and the greater of their measurements was accepted. A change in abduction angle of > 5° was taken to represent evidence of acetabular component migration and, thus, loosening.10

Statistical analysis. This was performed using SPSS for Windows (version 21, IBM Corp, Armonk, New York). It was undertaken using Wilcoxon signed rank test for non-parametric data. Kaplan–Meier13 survivorship curves and 95% confidence intervals (CI) were generated with the endpoints of acetabular revision for aseptic loosening and acetabular revision for acetabular failure of all causes, including infection. Rates of survival at 12.5 years are given.
when at least 40 hips remained at risk. As there was no loss to follow-up, construction of a worst-case curve was not warranted.

**Results**

A total of eight hips (eight patients) underwent some form of revision procedure, 66 hips (64 patients) were in patients who died before their ten-year review, leaving 129 hips (122 patients) in situ at a minimum of ten years. Of these 129 hips, clinical scores were available for 108 hips (104 patients) and radiographs were available for 103 hips (100 patients) (Fig. 2). A total of 15 hips (15 patients) had neither scores nor radiographs available beyond ten years; these were all followed up with telephone calls or letters to the patient, their next of kin or their GP, and it was confirmed that the prostheses remained in situ.

**Revisions.** Three acetabular components (three patients) were revised, along with the femoral component, for a periprosthetic fracture of the femoral shaft. In all these, the acetabular cement mantles were found to be pristine, and a cement-in-cement revision of the acetabular component was performed. A fourth patient also suffered a periprosthetic fracture of the femoral shaft. This was initially treated with revision of only the femoral component. Three years later however, the femoral component fractured and a second revision was undertaken of both the stem and the acetabular component. Again the acetabular cement mantle was found to be pristine and a cement-in-cement acetabular revision was performed.

Two acetabular components (two patients) were revised for recurrent dislocation. The acetabular cement mantles were well fixed and a cement-in-cement revision was undertaken. One was revised to a Trident all-polyethylene constrained acetabular component (Stryker Orthopaedics) and the other to an Exeter all-polyethylene extra-cover acetabular component (Stryker Orthopaedics). One acetabular component was revised as a two-stage procedure for infection. One hip was revised for ongoing pain for which infection was suspected but later excluded as a cause. There was no sign of loosening or infection. The cancellous bone was
very soft. An uncemented ABG cup was reinforced with four screws which much improved the pain but there is long-term discomfort. No hips were revised for aseptic loosening.

Clinical outcomes. Hip scores were available for 108 of 129 hips at greater than ten years. Mean time to review was 12.2 years, (10.0 to 13.9, SD 0.79). OHS, HHS and Euroqol scores are detailed in Table I. Three patients had low clinical scores at recent review. In each case disease processes unrelated to their hip arthroplasty contributed to lack of mobility and low scoring.

Radiographic outcomes. Of the 103 radiographs of hips (100 patients) at minimum ten years follow-up available for analysis, 37 hips (36 patients, 36%) demonstrated RLLs, 66 hips (64 patients, 64%) had no lucent lines, 27 of the 37 hips had lucent lines in zone one only. The distribution of radiolucent lines in our cohort is recorded in Table II and examples are shown in Figure 3. Only 13 hips (13 patients, 13%) had RLLs of greater than 1 mm thickness at any point, or of any thickness in more than one DeLee and Charnley zone. There was no change in abduction angle of any component.

There was no significant difference, in the most recent clinical scores, between those hips with acetabular RLLs, and those without (Table III) (OHS p = 0.895, HHS pain p = 0.289, HHS function p = 0.708, EQ p = 0.793, EQ health state p = 0.174).

Complications. Three patients (three hips) sustained an intra-operative fracture of the greater trochanter. These were treated with internal fixation or cerclage wiring during the operation.

Two patients (two hips) had a post-operative haematoma requiring a washout and treatment with intravenous

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**Table I.** Median (n, interquartile range (IQR); range) pre- and post-operative hip scores

<table>
<thead>
<tr>
<th>Score</th>
<th>Pre-operatively</th>
<th>Minimum ten year post-operatively</th>
<th>p-value (Wilcoxon signed rank test)</th>
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<tbody>
<tr>
<td>OHS (0 to 48)</td>
<td>18.5 (104, IQR 11, 3 to 38)</td>
<td>43.0 (108, IQR 13, 7 to 48)</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>HHS pain (0 to 44)</td>
<td>20.0 (104, IQR 10, 0 to 40)</td>
<td>44.0 (107, IQR 4, 0 to 44)</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>HHS function (0 to 47)</td>
<td>25.0 (104, IQR 11, 0 to 40)</td>
<td>32.0 (107, IQR 17, 5 to 47)</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>Euroqol (0 to 1)</td>
<td>N/A</td>
<td>0.80 (89, IQR 0, 0 to 1)</td>
<td></td>
</tr>
<tr>
<td>Euroqol health state (0 to 100)</td>
<td>N/A</td>
<td>70.0 (87, IQR 25, 1 to 100)</td>
<td></td>
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</tbody>
</table>

OHS, Oxford hip score; HHS, Harris hip score; N/A, not applicable

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**Table II.** Radiolucent lines

<table>
<thead>
<tr>
<th>Max width of radiolucent line</th>
<th>DeLee Charnley zone(s) involved</th>
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<tbody>
<tr>
<td>≤ 1 mm</td>
<td>1</td>
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<tr>
<td></td>
<td>22</td>
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<tr>
<td>&gt; 1 mm</td>
<td>5</td>
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Example radiographs of Exeter Contemporary flanged cemented acetabular components demonstrating different degrees of radiolucent line (Note the radiographs demonstrate components with different wire markers. At its introduction in 1998 the Contemporary acetabular component had a wholly equatorial marker-wire. In 2001/2002 this was changed to the partly equatorial and partly polar wire with which we are familiar today). a) demonstrates a radiolucent line in zone 1 ≤ 1 mm, b) demonstrates a radiolucent line in all zones, measuring ≤ 1 mm, c) demonstrates a radiolucent line in zones 1 and 2 measuring > 1 mm.
antibiotics. They recovered fully and had no further concerns by their six-month review.

Three patients (three hips) had a post-operative deep vein thrombosis and one patient (one hip) had a post-operative pulmonary embolus. All four were treated with six months of warfarin and made a full recovery.

Two patients (two hips) sustained periprosthetic femoral fractures as a result of trauma. They were treated with open reduction and internal fixation of the femoral shaft and their acetabular components were not revised.

One further patient had recurrent dislocation of her THA. The option of acetabular revision was discussed but no revision surgery took place and the patient subsequently died.

Survivorship. The Kaplan–Meier survivorship at 12.5 years with 40 hips (38 patients) remaining at risk was 97.8% (95% CI 95.6 to 100) for revision of the acetabular component for any reason and 100% for revision of the acetabular component for aseptic loosening (Fig. 4).

Discussion

While debate continues regarding the relative merit of cemented versus uncemented acetabular components, the Swedish Hip Arthroplasty Register continues to demonstrate the superior survivorship of cemented THA. Revision-free ten-year survival of cemented versus uncemented acetabular components was reported in the Swedish hip registry to be 94% versus 85%, respectively (p < 0.001). No age or diagnostic group benefited from the use of uncemented fixation.

The 2014 NJR report for England, Wales and Northern Ireland shows ten-year Kaplan–Meier cumulative percentage revision of 3.20 (95% CI 3.03 to 3.39) for all cemented hips (cemented stem and acetabular component) compared with 3.95 (95% CI 3.60 to 4.34) for hybrid hips (cemented stem with an uncemented acetabular component).

The New Zealand Joint Registry demonstrated the same finding; that regardless of age, the overall all-cause revision rate in uncemented THA is higher than in cemented THA. However, in contrast to the other registries above, they found that uncemented acetabular components performed better in the medium term (nine years) across all age groups.

Mäkelä et al reviewed the combined Nordic arthroplasty databases and found that the ten-year survival of cemented implants was higher than that of uncemented, hybrid and reverse hybrid implants in patients aged over 65 years. However, the survivorship of cemented and uncemented implants in the age group 55 to 64 years was found to be similar.

A systematic review and meta-analysis of randomised controlled trials by Abdulkarim et al concluded that
cemented THA is similar if not superior to uncemented THA and provides better short-term clinical outcomes.

A recent literature review by Toossi et al.\(^2\) has concluded that fixation of cemented acetabular components is more reliable than that of cementless components beyond the first post-operative decade.

We believe the key to the good survivorship of the acetabular component in our cohort is rigorous implementation of modern techniques. The majority of acetabular component failures are known to occur at the cement-bone interface. Optimising the mechanical interlock here increases the tensile and shear strength. This is achieved with thorough preparation of the acetabulum, and by ensuring good cement penetration secondary to good pressurisation.\(^23\)\(^{-}\)\(^27\) The presence of an outward facing flange at the periphery of an acetabular component aids in pressurisation of cement and has been shown to reduce the incidence of radiological demarcation at the cement bone interface.\(^28\)\(^{-}\)\(^30\)

We acknowledge the limitations of this study. This is a retrospective review of a series of patients and not all patients were able to attend for a formal clinical and radiographic assessment. Unfortunately, some patients had their early radiographs destroyed by their health authority.

Our results show that the Exeter Contemporary flanged cemented acetabular component has excellent outcomes when used with the Exeter stem in THA. At a minimum of ten years post-operatively, our cohort demonstrated significant improvement in clinical scores. Radiological review found RLLs to be present in 37 hips (36 patients, 36%) with most confined to DeLee and Charnley Zone one. There was no implant migration. At 12.5 years the Kaplan–Meier survivorship with revision for aseptic loosening as the endpoint is 100% and 97.8% (95% CI 95.6 to 100) for all causes.

Author contributions:
J. L. Maggs: Data compilation, radiographic analysis, primary author.
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S. L. Whitehouse: Data compilation and statistical analysis.
J. Charity: Data collection, background advice and editorial review.
G. A. Gie: Data collection and editorial review.
A. J. Timperley: Data collection and editorial review.

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References