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R3 Cup Does Not Have a High Failure Rate in Conventional Bearings: A Minimum of 5-Year Follow-Up

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ABSTRACT

Background: The R3 cementless acetabular system was first marketed in Australia and Europe in 2007. Previous papers have shown high failure rates of the R3 cup with up to 24% with metal-on-metal bearing. There are currently no medium term clinical results on this cup. The aim of the study is to review our results of the R3 acetabular cup with conventional bearings with a minimum of 5-year follow-up.
Methods: Patients who were implanted with the R3 acetabular cup were identified from our center's arthroplasty database. A total of 293 consecutive total hip arthroplasties were performed in 286 patients. The primary outcome was revision. The secondary outcomes were the Oxford Hip Scores (OHS) and radiographic evaluation.
Results: The mean age of the patients was 69.4 years. The mean preoperative OHS was 23 (range 10-34) and the mean OHS was 40 (range 33-48) at the final follow-up. Radiological evaluation showed an excellent ARA score in all patients at 5 years. None of the R3 cups showed osteolysis at the final follow-up. There were 3 revisions in our series, of which 2 R3 cups were revised. The risk of revision was 1.11% at 5 years.
Conclusion: Our experience of using the R3 acetabular system with conventional bearings showed high survivorship and is consistent with the allocated Orthopaedic Data Evaluation Panel rating of 5A* as rated in 2015 in the United Kingdom.

The use of uncemented fixation methods for primary total hip arthroplasty (THA) has become increasingly popular worldwide with good documented survivorship of cementless acetabular components [1–4]. The R3 cementless acetabular system supports crosslinked polyethylene (XLPE), metal, and ceramic liners with several options for the femoral head component. The R3 cup was first marketed in Australia and Europe in 2007. It is a modular hemispheric titanium shell with an asymmetric porous titanium powder coating that is designed to enhance fixation and promote bony in-growth. It has an option of no holes, 3 holes, or multiholes for adjuvant screw fixation.

In 2012, the Medical and Healthcare products Regulatory Agency in the United Kingdom issued a medical device alert for the R3 cup acetabular system with metal liners because of a higher than acceptable revision rate, advising to stop its use and increase surveillance of this implant. Greater corrosion of failed R3 cup-liner interfaces has been shown when compared with the DePuy PINNACLE Cup (DePuy Synthes, Chester, PA), and has been proposed as a contributing factor to the higher failure rates of the metal-on-metal (MoM) R3 system [5]. More recently, corrosion on the backside of the metal liners of the R3 acetabular system has been cited as another unique method of failure [6]. A previous paper suggested that there is a 24% failure rate in the R3 cup when used with MoM bearing in their series [7]. MoM hip arthroplasty is associated with higher failure rates secondary to biological responses of tissues from metal particulate release at component interfaces [8]. Nevertheless, the R3 cup with ceramic or XLPE liner remains a popular system and is the third most used cementless acetabular component for primary THA in Australia [4].

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There are no medium term clinical papers on the R3 acetabular cup. The aim of the study is to review our results of the R3 acetabular cup with a minimum of 5-year follow-up.

Materials and Methods

Patients who were implanted with the R3 acetabular cup (Smith & Nephew, Memphis, TN) were identified from our center's arthroplasty database. Our center started implanting the R3 acetabular cup in August 2009 and only conventional bearings were used. For this study, we only included patients with a minimum of 5-year follow-up (until June 2011). Over this period, 293 consecutive THAs were performed in 286 patients, of which 7 were bilateral staged THAs. The main indication for performing THA in our study was severe osteoarthritis (OA) causing pain and loss of function having failed conservative treatment. Primary arthroplasty made up 94% of the casemix (n = 275), whereas complex arthroplasty included Perthes disease, posttraumatic OA, failed fixation, or painful hemiarthroplasty following neck of femur fractures and revision (n = 18) made up the other 6%. The diagnoses were as follows: OA (89%), osteonecrosis (5%), Perthes disease (2%), neck of femur fracture (2%), rheumatoid arthritis (1%), and others (1%).

The operations were performed via standard posterior approach by 8 different consultants or by trainees under the consultant's direct supervision as first assistant. The R3 acetabular component was inserted with the standard instruments provided by the company. The acetabulum was reamed as per preoperative template and the final component impacted was either under-reamed by 1 mm or reamed line-to-line depending on the bone quality and size of the acetabulum. The operations were performed in a filtered air laminar-flow operating theatre and the surgical team all wore total body exhaust suits. All patients underwent the same postoperative protocol. The R3 acetabular system ranges from cup size 40-68 mm, where 52 mm is the minimum size for a 36-mm femoral head. We used the 3-hole option R3 cup in all our patients.

Patients were enrolled prospectively into a local database and they were followed up at 6 weeks, 3 months, and 1 year postoperatively. Standard anteroposterior radiograph of the pelvis and cross-table lateral radiograph of the proximal femur were taken preoperatively, postoperatively before discharge, and during each follow-up visit. After a satisfactory 1-year follow-up assessment, the patients were enrolled in our virtual arthroplasty clinic where an Oxford Hip Score (OHS) questionnaire and standard radiographs were performed at 3, 5, 7, and 10 years from initial procedure. The virtual arthroplasty clinic is run by our local arthroplasty consultant hip surgeons. Any patients who reported poor OHS or exhibit unsatisfactory radiographs are invited back to a face-to-face follow-up clinic.

The primary outcome was revision. The secondary outcomes were the OHS and radiographic evaluation. Anteroposterior pelvis and cross-table lateral radiographs at last follow-up were analyzed for the presence of radiolucent lines and osteolytic lesions around the acetabulum according to the zones defined by De Lee and Charnley [9]. Osteolysis was defined as a lucent zone devoid of trabecular bone and usually with a sclerotic border not visible on the immediate postoperative radiograph [10]. The acetabular component was considered to be loose if there was migration of >3 mm in any direction over time or a circumferential radiolucent line. The acetabular ARA-scoring method, from poor (1 point) to excellent (6 points), was used as a radiographic evaluation of the status of the cup [11]. Intraoperative and postoperative complications, such as periprosthetic fracture, dislocation, superficial wound infection, deep infection, and venous thromboembolic events were noted.

Table 1
Cup Size Used in Our Series.

Cup Size	No. of Patients
46	1
48	13
50	28
52	95
54	47
56	43
58	41
60	21
62	2
64	2

Results

The mean age of the patients was 69.4 years (range 20-100 years). There were 117 men and 169 women in our series, with 131 left THA and 162 right THA. No patients were lost to follow-up. However, 32 patients died of unrelated causes (average 34 months, range 3-64 months), leaving 261 THAs at the last follow-up.

Most THAs in our series were cementless (n = 283; 97%) and the rest were hybrid (n = 10; 3%). The femoral stem used was the POLARSTEM (Smith & Nephew) for all the cementless THA and Exeter cemented stem (Stryker, Exeter, United Kingdom) for all the hybrid THA. The cup sizes used in our series are shown in Table 1. The most frequently used cup size was 52 mm (n = 95; 32%). Thirty-four (12%) R3 acetabular cups required screw(s) to achieve an intraoperative stable fixation (1 screw, n = 16; 2 screws, n = 13; and 3 screws, n = 5). The articulation bearings were as follows: ceramic-on-ceramic (n = 167; 57%), ceramic-on-poly XLPE (n = 97; 33%), oxinium-poly XLPE (n = 19; 6.5%), stainless steel-poly XLPE (n = 10; 3.5%). The femoral head sizes used were either 32 (n = 40; 14%) or 36 mm (n = 253; 86%).

The mean preoperative OHS was 23 (range 10-34) and the mean OHS was 40 (range 33-48) at the final follow-up. Radiological evaluation showed an excellent ARA score in all patients at 5 years. None of the R3 cups showed osteolysis at the final follow-up.

There were 3 revisions in our series, of which 2 R3 cups were revised. The first patient had an exchange of his ceramic malaligned liner at day 4 postoperation (Fig. 1). This was picked up by the postoperative check radiographs. There was no obvious cause found for the malaligned liner and the liner looked flush on superior and posterior area, but was offset by 1-2 mm in the inferior and anterior area with no soft tissue interposition found. The R3 cup was well fixed and the liner was exchanged. This is likely due to a surgical error and this problem has not been encountered again in our center.

The second patient had a late dislocation of her R3/Polar ceramic-on-ceramic cementless THA after a fall when dancing at 1 year from index operation. She was a revision from a previous MoM resurfacing hip arthroplasty for metal hypersensitivity. After the dislocation, she complained of ongoing squeaking with groin pain. This was investigated thoroughly; but as she remained symptomatic, this was revised to a trabecular metal acetabular shell 4.5 years from index operation. Intraoperatively, the femoral head was heavily stained with titanium posteriorly, presumably due to the previous dislocation. The alignment was found to be satisfactory with a combined anteversion of 10°, but there was evidence of neck impingement with 1 mm of wear to posterior aspect of femoral stem. Although this impingement could not be reproduced on table, it could not be accepted, therefore decision made to revise cup reducing anteversion.