Acta Orthop. Belg., 2012, **78**, 49-54

ORIGINAL STUDY

Revision of the well fixed Birmingham Hip Resurfacing acetabular component – Results using a novel device

Nemandra A. SANDIFORD, Sarah MUIRHEAD-ALLWOOD, John SKINNER

From the London Hip Unit, London and the Royal National Orthopaedic Hospital, Stanmore, U.K.

Revision of well fixed uncemented Birmingham Hip Resurfacing (BHR) acetabular components is challenging due to their dual radius design and their stabilising fins. These features preclude use of the standard Explant™ device. We investigated a novel device designed to simplify revision of this socket.

This prospective study included 6 male and 14 female patients. The reasons for revision, technique of revision and the scientific basis for use of this device are discussed. The sizes of revised and implanted components were measured and the amount of bone loss was calculated. Patient satisfaction was assessed as well as pre and post operative hip scores.

Six men and fourteen women were included. Average ages were 58 and 62.3 years respectively. The average diameters of the explanted and re-implanted sockets were 50.7 and 54.6 mm respectively. Average time for revision of the cup was less than 5 minutes. The average duration of follow-up was 13.2 months. All patients were satisfied with their outcomes.

This device simplifies the use of the Explant™ in removing well fixed BHR sockets with predictably minimal loss of host bone.

Keywords : hip resurfacing ; revision ; well fixed ; acetabular cup.

INTRODUCTION

The beaded, hydroxyapatite (HA) coated Birmingham Hip Resurfacing (BHR) acetabular component is designed to achieve optimal equatorial fixation into an appropriately prepared acetabulum. Removal of such well fixed acetabular components is a well documented challenge for revision surgeons. The main priority during acetabular revision is preservation of acetabular bone stock. Damage to host bone not only decreases revision options but can affect fixation and subsequent outcome of the inserted component.

Use of the Explant™ device which has proven successful in removal of well fixed uncemented acetabular cups (*7*) is difficult here for two reasons :

– Spherical centering devices made for the explant device are not large enough to fit the BHR acetabular cups ;

– The dual radius design of the BHR cup (Fig. 1A) means that a regular spherical insert would lead to impingement of the curved blade of the Explant™

■ Nemandra A. Sandiford MBBS, MRCS, MRCS Ed, Clinical Research Fellow.
The London Hip Unit, London, U.K.

■ Sarah Muirhead-Allwood BSc, MBBS, FRCS, Consultant Orthopaedic Surgeon.
The London Hip Unit and the Royal National Hospital, Stanmore, U.K.

■ John Skinner MBBS, FRCS (Tr/Orth), Consultant Orthopaedic Surgeon.
The Royal National Orthopaedic Hospital, Stanmore, U.K.

Correspondence : Nemandra Sandiford, 3 Eynswood Drive, Sidcup, Kent, BR7 6JB, U.K.

E-mail : nemsandiford@hotmail.com

No benefits or funds were received in support of this study

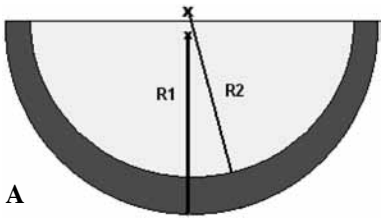


Fig. 1A. — The dual radius design of the BHR acetabular component. R1 illustrates the radius of the outer (fixation) surface. R2 illustrates the radius of the inner (bearing) surface.

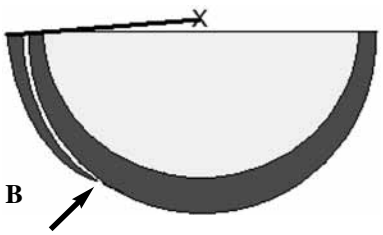


Fig. 1B. — With a normal Explant™ device the radius of curvature (R2) would lead to polar impingement (arrow).

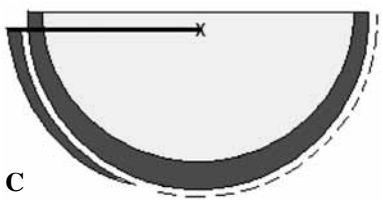
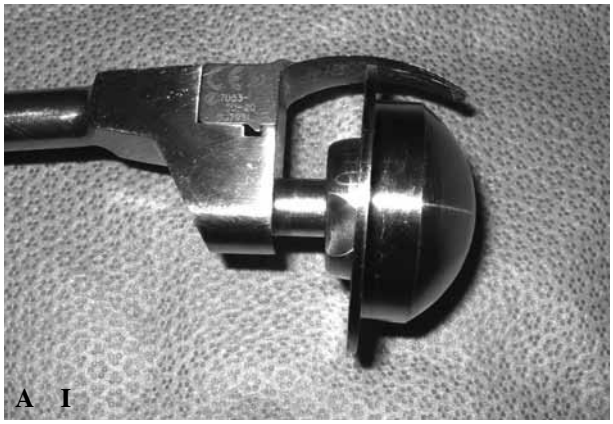


Fig. 1C. — When the radius of curvature is corrected by the adaptor device, the Explant™ blade passes freely around the cup.

device on the fixation surface of the cup (the blade itself is expensive to replace). This impingement prevents the blade from rotating and cutting the prosthesis bone interface.

We present our experience of revision of 20 well fixed BHR acetabular components using a novel custom adaptor (BHR cup extraction adaptor, Smith and Nephew, UK) (Fig. 2A, 2B) which enables removal using the standard Explant™ device. This new device corrects for the difference between the radius of the outer (fixation) and inner (articular) surfaces of the BHR cup and enables controlled removal of the acetabular component with minimal host bone loss. To our knowledge the results of this device have not been reported previously.



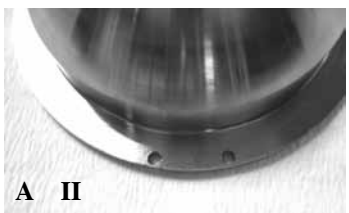


Fig. 2A. — (I) BHR cup adaptor device assembled to an Explant™ stem. (II) The peripheral slots for attachment to the *in situ* cup are clearly seen.

Fig. 2B. — The 'adaptor surface' of the Explant™ adaptor device. This picture shows variations in the diameter (white lines) to accommodate various cup sizes with the standard 28 mm recess for the centering head of the Explant™ (arrow).

PATIENTS AND METHODS

Twenty consecutive patients underwent revision of well fixed BHR acetabular components using this technique between September 2005 and December 2007. All procedures were performed by a single surgeon (SM-A) via a posterior approach.

Table I. — Patient demographics

	Males	Females
Number of patients	6	14
Mean Age/years	62.3 (58-67)	58 (48-64)
Mean acetabular size (mm)	55	49.1
Time to revision (months)	30 (12-60)	19.4 (7-40)
Acetabular defects	1 (Type 2)	2 (Type 2)

Preoperative assessment included clinical examination and routine anteroposterior (AP) radiographs of the pelvis centered on the pubic symphysis along with lateral (Lowenstein) views of the affected hip. The size of the explanted cup was documented in all cases along with the re-implanted cup and the last reamer used. Areas of bone deficiency were further assessed by computer tomography (CT) scans and were classified according to the American Academy of Orthopaedic Surgeons (AAOS) system (2). The final size of the new acetabular component was decided intra-operatively. One patient had a revision due to infection and this was performed as a 2-stage procedure. The sizes of the revised and implanted components were recorded as well as the largest reamer sizes.

Post operative follow-up was performed at 4 weeks, 12 weeks and 1 year post-operatively and at three year intervals thereafter. Oxford, Harris and Western Ontario MacMasters (WOMAC) hip scores were documented at each visit.

Surgical Technique

All procedures were performed via a posterior approach. The hip was dislocated after the common insertion of the short external rotators was divided along with the posterior capsule. The femoral neck osteotomy was then performed at the templated level and the head removed. Retraction of the proximal femur anteriorly clearly exposed the acetabular component. The adaptor (Fig. 2) was placed into the *in situ* cup and the Explant™ Acetabular Cup Removal System (Zimmer, Warsaw, Indiana) was inserted onto this with its 28 mm centering head.

The short blade was used to develop a plane in the dense peripheral bone at the bone prosthesis interface. The long curved blade was used to extend this plane along the fixation surface of the cup. Cup removal was effected by a series of circular movements until circumferential clearance was achieved. The standard technique described by Mitchell *et al* (7) of using the Explant™ was modified in two main ways. First the adaptor device was inserted into the *in situ* acetabular component to correct for the differing radii between the articulation and fixation surfaces of the BHR cup. This allowed unimpeded passage of the curved blade of the Explant™ around the socket (Fig. 3). The second difference was that the blade of the Explant™ had to be removed and reinserted between the stabilising fins of the BHR cup. This is more time consuming than removing a regular hemisphere (Fig. 3).

After removal of the socket the acetabular floor was assessed for the presence of cysts or defects and prepared with sequential hemispherical reamers. If defects were present these were filled with autograft harvested from the reamings or allograft. The new acetabular components were impacted into place. Initial fixation was augmented using 6.5 mm cancellous screws in all cases. Correct position of all prostheses was verified by post operative radiographs.

Patients were allowed to fully weightbear day 1 post operatively. Three doses of prophylactic antibiotics were routinely given to all patients, along with low molecular weight heparin, thromboembolic deterrent (TED) stockings and intermittent calf compression devices for thromboprophylaxis.

RESULTS

Our cohort included 20 patients consisting of 6 men and 14 women who had revision of the BHR cup using this technique. The mean age of the males was 58 years (48-64) and 62.3 years (58-67) for the females. Average duration of follow-up was 23.2 months (23-31). Indications for revision are listed in Table I. Patient demographics are shown in Table II. Twelve patients (92.3%) presented with recurrent pain and effusion and one patient had an infected prosthesis. Reasons for revision are presented in Table II.

The average time between implantation and revision of the prostheses was 25.8 months (range : 7-60). In the male cohort the average time to revi-

Fig. 3. — An explanted BHR socket with the adaptor device *in situ* showing minimal acetabular bone loss. The stabilizing fins are also shown. These are at right angles to the fixation surface.

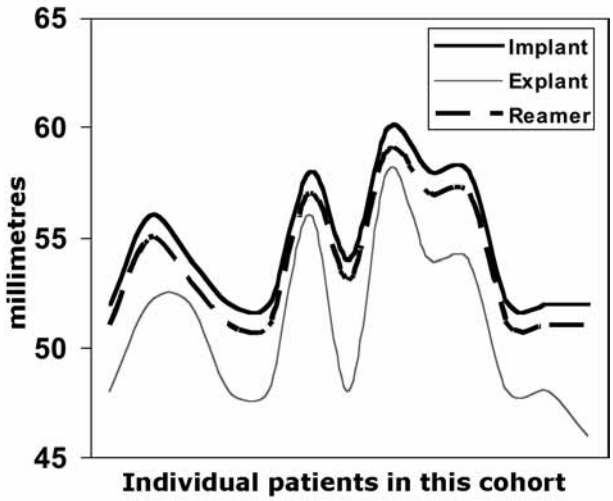


Fig. 4. — Relationship of components to final reamer size (explant = explanted cup ; implant = re-implanted cup).

Table II. — Diagnoses leading to revision surgery

Diagnosis	Number of patients
Infection	1
Unexplained pain and effusion	12
Unexplained pain. No effusion	4
Pain, click and posterior dislocation	1
Aseptic loosening	1
Pain and cystic change at the bone prosthesis interface	1

sion was 30 months (12-60) while in the female cohort it was 19.4 months (7-40). Complete removal of the cup took less than 5 minutes in all cases. Three patients had cavitary defects requiring bone graft. No host bone was removed with the explanted cups (Fig. 3). The average diameters of the retrieved and re-implanted cups was 50.7 mm (range : 46-58) and 54.6 mm (range : 52-60) respectively. The average difference between revised and re-implanted components was 3.9 mm. All re-implanted cups were regular hemispheres. These were all fixed using cancellous bone screws. The average difference between the explanted cups and the final reamer size was 2.9 mm. The relationship between the explanted and re-implanted cups and the final reamer sizes are shown in Figure 4.

Mean pre operative Harris, Oxford and Western Ontario MacMasters (WOMAC) hip scores were 42.75, 35.75 and 52.5 respectively. Post operative scores at an average of 13.2 months were 90.6, 15.3 and 5.9 respectively. All patients have reported complete resolution of their pre operative pain and had returned to normal activities and sports at last follow-up. They were all satisfied with their outcome up to the time of last follow-up.

DISCUSSION

The major challenge during revision of the well fixed acetabular cup is preservation of acetabular bone stock. Instruments used to achieve this historically include curved osteotomes (*6*) and pneumatic devices (*4*). Mitchell *et al* (*7*) described the use of the Explant™ device (Zimmer, Warsaw, Ind, USA) for this purpose, the reported benefits of which include acetabular bone preservation without sacrificing operative time.

They described three absolute conditions which had to be met for successful use of the Explant™ . These included knowledge of the external diameter of the shell, the external geometry of the shell and having a centralising liner to allow the blade of the Explant™ to pass around the cup without unnecessary removal of bone or damage to the blade which

Table III. – Diameters (in mm) of the implants removed and of those re-implanted in the 20 patients in the study

Implant removed	Final reamer	Pre-operative template	Component implanted
48	51	54	52
52	55	58	56
52	53	56	54
48	51	56	52
48	51	54	52
56	57	62	58
48	53	54	54
58	59	60	60
54	57	60	58
54	57	58	58
48	51	54	52
48	51	56	52
46	51	54	52
52	53	56	54
48	51	56	52
52	53	56	54
48	51	56	52
46	51	54	52
52	53	56	54
48	51	56	52

itself is costly. The Explant™ system is provided with 22 -32 mm centering heads progressing in 2 mm increments. These do not fit the BHR cups which start at 38 mm diameter. The dual radius design of this cup also precludes the use of a standard liner which would lead to impingement of the blade on the cup (Fig. 1C). The BHR cup adaptor has an internal diameter of 28 mm and external diameters designed to fit the BHR cup (Fig. 2). It corrects for the differential radii between the outer and inner surfaces of this component.

Acetabular bone loss was minimal in this group with the use of this novel adaptor device. While the average circumference of the retrieved and re-implanted cups was 50.7 mm (46-58) and 54.6 mm (52-60) respectively with a difference of 3.9 mm, this does not accurately reflect the amount of acetabular bone loss as we routinely oversize the acetabular component by 1 mm. Bone loss is more accurately assessed by comparison to the size of the last reamer used. This was 53.6 mm in our series. The average difference between the explanted cups and the final reamer size was 2.9 mm (Fig. 4) representing minimal bone loss. This is encouraging when viewed in context with the improved hip scores and overall high levels of patient satisfaction.

Most revisions in our series were performed to relieve persistent pain. Twelve patients (60%) had effusions proven by ultrasound and computer tomography (CT) scanning. In three patients the cup angles were > 60 degrees and in one case the femoral component was inserted in varus and found to be loose at surgery. There were three cases of osteolysis with cystic defects behind the acetabular components. In one case this led to loosening of the component and in the other it was asymptomatic.

We suspect that the unexplained pain with or without fluid collections, is part of the aseptic lymphocytic vasculitis associated lesions (ALVAL) spectrum of diseases associated with metal on metal

bearing surfaces (*1,8*). Two patients in our series had femoral neck fractures. The acetabular component was revised in these cases because both patients had chronic discomfort prior to falling. Both patients had high acetabular cup abduction angles and in one patient the cup had shifted during the fall. It was felt that to treat all their symptoms effectively, the acetabular component should be revised as well.

However the histological findings were not always identical to the changes described for ALVAL syndrome and description of the histology falls out of the scope of this paper. We have therefore categorised patients based on descriptive terms. There is a low incidence of such symptoms in metal on metal (MoM) articulations which appears to correlate with increased acetabular angles. It is postulated that this facilitates edge bearing which increases metal ion levels and may cause a local soft tissue reaction. Until more certainty regarding the cause of the pain exists and allergy/hypersensitivity is excluded, it would seem sensible to change the bearing couple rather than just the acetabular component.

It is imperative to conserve bone during revision surgery. It has previously been suggested that hip resurfacing is not conservative of acetabular bone and that larger sockets are inserted when resurfacing compared to total hip replacement in age matched cohorts (*5*). If this is true then the importance of bone preservation during revision of the socket is even greater.

This introduced a new problem in how to safely and effectively remove well fixed resurfacing acetabular component without damaging host bone stock. This is compounded by the presence of fins and the fact that the BHR cup has a dual centre of rotation precluding the use of the conventional Explant™ devices. This difficulty seems to have been addressed successfully with the custom BHR cup adaptor which is now commercially available.

We recognise that this study has several limitations, namely that the study population is small and no statistical analysis was performed for this reason.

REFERENCES

1. **Davies AP, Willert HG, Campbell PA, Learmonth ID, Case CP.** An unusual lymphocytic perivascular infiltration in tissues around contemporary metal-on-metal joint replacements. *J Bone Joint Surg* 2005 ; 87-A : 18-27.
2. **D'Antonio JA, Capello WN, Borden LS *et al.*** Classification and management of acetabular abnormalities in total hip arthroplasty. *Clin Orthop Relat Res* 1989 ; 243 : 126-137.
3. **Hodgkinson JP, Shelley P, Wroblewski BM.** The correlation between the roentgenographic appearance and operative findings at the bone-cement junction of the socket in Charnley low friction arthroplasties. *Clin Orthop Relat Res* 1988 ; 228 : 105-109.
4. **Lachiewicz PF, Anspach WE 3rd.** Removal of a well fixed acetabular component. A brief technical note of a new method. *J Bone Joint Surg* 1991 ; 73-A : 1355-1356.
5. **Loughead JM, Starks I, Chesney D *et al.*** Removal of acetabular bone in resurfacing arthroplasty of the hip : a comparison with hybrid total hip arthroplasty. *J Bone Joint Surg* 2006 ; 88-B : 31-34.
6. **Mallory TH, Lombardi AV Jr, Fada RA *et al.*** Noncemented acetabular component removal in the presence of osteolysis : the affirmative. *Clin Orthop Relat Res* 2000 ; 381 : 120-128.
7. **Mitchell PA, Masri BA, Garbuz DS *et al.*** Removal of well-fixed, cementless, acetabular components in revision hip arthroplasty. *J Bone Joint Surg* 2003 ; 85-B : 949-952.
8. **Willert HG, Buchhorn GH, Fayyazi A *et al.*** Metal-on-metal bearings and hypersensitivity in patients with artificial hip joints. A clinical and histomorphological study. *J Bone Joint Surg* 2005 ; 87-A : 28-36.