HIP

High complication rate in reconstruction of Paprosky type IIIa acetabular defects using an oblong implant with modular side plates and a hook

We report the results of 62 hips in 62 patients (17 males, 45 females) with mean age of 62.4 years (37 to 81), who underwent revision of the acetabular component of a total hip replacement due to aseptic loosening between May 2003 and November 2007. All hips had a Paprosky type IIIa acetabular defect. Acetabular revision was undertaken using a Proxotyl E cementless oblong implant with modular side plates and a hook combined with impaction allografting.

At a mean follow-up of 60.5 months (36 to 94) with no patients lost to follow-up and one died due to unrelated illness, the complication rate was 38.7%. Complications included aseptic loosening (19 hips), deep infection (3 hips), broken hook and side plate (one hip) and a femoral nerve palsy (one hip). Further revision of the acetabular component was required in 18 hips (29.0%) and a further four hips (6.4%) are currently loose and awaiting revision.

We observed unacceptably high rates of complication and failure in our group of patients and cannot recommend this implant or technique.

Paprosky Type IIIa acetabular defects are characterised by > 3 cm of proximal migration of the femoral component above the obturator line, in the presence of moderate teardrop and ischial lysis with an intact Kohler line.1-2 Host bone is usually adequate for ingrowth. However, the acetabular rim is not fully intact. The superior dome is inadequate for support but the anterior and posterior columns remain intact.1,2

In these cases reconstruction is difficult and primary stable fixation of a revision component maintaining the anatomical centre of rotation is sometimes difficult. Treatment options include reconstruction with bulk allografts at the superior rim of the acetabulum, the use of oblong implants with or without modular side plates and a hook, and the use of a contemporary trabecular metal acetabular component with a trabecular metal augments or reconstruction with supporting rings/cages.3-8

The current literature includes several reports of generally good outcomes using oblong implants for the reconstruction of oval-shaped acetabular deficiencies.9,12 However, we encountered unusually high rates of complications and failure when using a specific oblong revision component with an additional side plate and hook, and we report this experience.

Patient and Methods

Between May 2003 and November 2007, 62 patients (62 hips in 17 males and 45 females) with a mean age of 62.4 years (37 to 81) underwent revision of the acetabular component due to aseptic loosening. All cases had Paprosky type IIIa acetabular defects with a mean history of 1.6 (1 to 3) previous operations on the hip. In 48 patients both components were revised, whereas in 14 patients only the acetabular component was revised with retention of a radiologically and intra-operatively stable femoral component.

Revision surgery was performed in 41 patients due to failure of a cemented acetabular component and in 21 due to failure of a non-cemented acetabular component. A posterior approach to the hip was used in all cases by two senior consultants (GCB, PM). After removal of the acetabular component, a standard hemispherical reamer was used for the preparation of the acetabulum preserving the anterior and posterior walls as far as possible. Allogeneic cancellous bone chips were additionally used in all cases to fill non-load-bearing areas of cavitary defects. We used a mean of 20 cc (10 to 50) allogenic cancellous bone chips according to the amount of cavitary acetabular bone defect which was assessed intra-operatively. The cancellous bone chips were mixed with patient’s blood from the surgical site and thereafter they were used to fill all cavitary defects. The allograft chips were packed into the defects using a bone impactor, and additional reverse reaming was
undertaken in order to place the allograft only at the site of bone defects and ensure it was not positioned between the intact host bone and the new implant.

The revision acetabular component used was a cementless implant (Procotyl E; Wright Medical Ltd, Pulford, United Kingdom) which is ovoid-shaped, featuring a +8 mm increment in the craniocaudal dimension with respect to the anteroposterior dimension. It is manufactured of titanium alloy with a 20° offset segment. The outer surface features a 300 μm thick porous titanium coating applied by plasma spraying, to encourage osseo-integration. Up to nine supplementary screws may be used for additional fixation. They can be placed in a double row by cranial direction. They can also be inserted into the iliac wing and/or positioned medially. Two further holes located on the inner caudal zone of the implant allow screws to be orientated towards the ischiopubic area, if required. There is also the potential of adding one of three different types of side plates at the superior rim of the implant and/or a hook at its inferior rim, according to the type of bone loss, the intra-operative difficulties or demands for multiple screw placement in different planes.

Various sizes were used but offset polyethylene liners and modular metal heads were used in all hips. No constrained liners were needed for additional stability.

The diameter of the modular head was 22 mm in 12 hips where stable monobloc femoral components had been retained, 28 mm in 43 hips (in two of which the femoral head was exchanged but the stem was retained) and 32 mm in seven. In 30 hips a standard (+0 mm) head was used, in five -3.5 mm, in nine +3.5 mm, and in six cases a +7 mm head.

The femoral components used included distal fixation fluted stems with modular metaphyseal and modular neck sections (Profemur R; Wright Medical Ltd) in 18 hips, distal fixation fluted monobloc stems (Wagner; Zimmer, Swindon, United Kingdom) in 22 and cemented revision stems (Echelon; Smith & Nephew, Memphis, Tennessee) in eight hips.

All patients were reviewed clinically and radiologically at one, three, six, 12 months and annually thereafter. The mean follow-up was 60.5 months (26 to 84). The clinical assessment was undertaken using the original Harris hip score (HHS) and the Western Ontario and McMaster Universities osteoarthritis index (WOMAC). Radiographs taken in the immediate post-operative period and at the most recent follow-up were assessed for the presence of radiolucent or radiodense (condensation) lines around the acetabular component according to the three zones defined by DeLee and Charnley. Radiolucencies around the acetabular component according to the presence of radiolucent or radiodense (condensation) lines were defined as complete if greater than 1 mm in width in all three zones. Migration of the acetabular component and the pre-operative and post-operative centres of hip rotation were estimated by measuring the position of the implant with respect to fixed pelvic landmarks. The abduction angle of the acetabular component was measured between the lateral opening of the implant and the horizontal interteardrop reference line by two independent observers (GCB, VIS). Radiological evaluation showed good inter-observer (kappa = 0.79) and intra-observer agreement (kappa = 0.9). A linear migration > 3 mm or a rotational change > 5° was considered to indicate component migration. Incorporation of the bone graft was considered to be successful if there was trabecular bridging between the graft and host bone in plain radiographs.

The survivorship of the acetabular component was presented using the Kaplan-Meier method with calculation of the 95% confidence intervals (CI). Failure was defined as any component that had already undergone revision or was awaiting revision.

Results
After a mean follow-up of 60.5 months (36 to 94) no patient was lost and one patient had died due to an unrelated illness. In all, 24 patients (38.7%) had complications at a mean of 32.5 months (26 to 84) after surgery; these included aseptic loosening in 19 (30.6%), deep infection in three, broken hook and side plate in one and femoral nerve palsy in one. Re-revision of the component was performed in 18 hips (29.0%) (Fig. 1) and four more were considered to be loose and are awaiting revision.

The mean HHS increased from 45 points (0 to 82) pre-operatively to a mean of 81 points (35 to 98) at 12 months, giving a result which was excellent (90 to 100 points) for nine hips (14.5%), good (80 to 89) for 34 (54.8%), fair (70 to 79) for 13 (21%) and poor (<70 points) for six (9.6%). However, at 36 months the results were excellent for seven hips (11.3%), good for 18 hips (29%), fair for 19 hips (30.6%) and poor for 18 hips (29%). The subjective outcome as assessed by the WOMAC score was found to be increased from a mean of 27.3 (21.9 to 34.4) pre-operatively to a mean of 51.6 (26.4 to 72.7) at 12-month follow-up.

Regarding the clinical evaluation of the 43 surviving implants only, the mean HHS improved from a mean score of 46 points (0 to 78 points) pre-operatively to 80 points (35 to 98) at 12 months and to a mean of 88 points (40 to 98) at 36 months post-operatively. For these 43 surviving hips, at the 36-month follow-up the result was excellent (90 to 100 points) for five hips (12.5%), good (80 to 89) for 16 (40%), fair (70 to 79) for 14 (35%), and poor (<70 points) for five patients (12.5%). The WOMAC score increased from a mean of 28.9 (21.9 to 32.4) pre-operatively to a mean of 52.8 (34.4 to 72.7) at 36-month follow-up.

The Kaplan-Meier survival for the acetabular components with revision or definite radiological loosening as the
end-point at 24 months was 98% (95% CI 96.2 to 99.9), at 36 months 71% (95% CI 68.7 to 71.3) and at 60 months 64.5% (95% CI 62.5 to 68.8).

Radiologically, the 18 failed hips that had been revised had radiolucent lines at the implant-bone interface in all zones and a vertical migration > 5 mm with tilting of the implant (mean 65° (55° to 80°)). Additional radioluencies were noted around the intact screws and one or more screws and modular parts of the component (side plates and/or hook) were broken or deformed. Furthermore the four other patients who are awaiting revision had radioluencies around the implant and screws. One of these had migrated > 5 mm from its initial position. Accordingly at a mean follow-up of 50.5 months (26 to 84) only 44 (70.9%) of the implants were not loose. In 12 patients minor radiolucent lines (< 1 mm) were detected in the DeLee and Charnley zones: eight in zone 1, three in zone 2 and one in zone 3. In one hip there was osteolysis around one screw. In two hips migration by 2 mm was identified at 12 and 16 months after surgery. In 32 hips good osseo-integration of the implant was seen, without circumferential radioluencies, osteolysis or implant migration.

The mean vertical distance of the hip centre was 36.2 mm (18 to 63) proximal to the inter-teardrop line before revision and 24 mm (10 to 51) proximal to the inter-teardrop line after revision. The lateral distance of the centre of hip rotation to the medial aspect of the teardrop was a mean 22 mm (18 to 24) before revision and 43 mm (40 to 45) after revision.

Full resorption of the morsellised bone grafts was evident in 18 hips (29%), partial resorption was recorded in 15 hips (24.2%) and complete incorporation in 29 (46.8%). Only 12 (19.3%) of the hips showed full remodelling of defects at the latest follow-up.

We examined all 18 retrieved implants macroscopically. None of the acetabular shells had broken or distorted but in one implant the side hook was broken, in 12 implants the side plate and one or more screws had broken, and in two hips both the hook and the side plate were broken. In one hip the hook although not broken was disassembled from the body of the acetabular component. None of the retrieved implants had any macroscopic sign of bone ongrowth or ingrowth. In all the grid blast coating was completely lost and the backside surface of the implants appeared smooth (Fig. 2). Histological analysis of the soft tissue that was attached to the backside of the implant and/or was present in the acetabular cavity revealed it to be non-specific fibrous tissue.

Discussion

In our series of Paprosky type IIIa acetabular defects reconstructed with impaction bone grafting and a cementless oblong acetabular component we found an unexpectedly high failure rate at a mean of 60.5 months. Although the clinical outcome showed an improvement in both subjective and objective parameters, and radiological assessment was consistent with restoration of hip centre of rotation, there was a high incidence of complications and aseptic loosening, requiring further revision of the acetabular component at an unexpected early stage, compared with other series in the literature.9,11,17-20

A study by Köster et al11 reported on the outcome of 102 hip revisions treated with a cementless oblong acetabular component at a mean of 3.6 years (2 to 7). Only two hips required further revision for aseptic loosening and eight other hips had some migration, but in all this was < 5 mm, and none had failed clinically. A more recent study, using the same implant, reported on 40 acetabular revisions at a mean...
follow-up of 63.5 months (40 to 99) with excellent clinical results, with no cases of migration and no revisions. Other series using similar uncemented oblong acetabular components report better results and longer follow-up than in our patients. However, all these studies have included mixed types of acetabular deficiency including the less severe Paprosky types I and II, as well as type III defects, which may have enhanced the overall outcome. In our study, only cases with type IIIa defects were included in order to preserve the homogeneity of our material.

Götze et al identified a 16% re-revision rate due to deep infection (4%) and hip instability (12%) in their series of 50 consecutive cases (48 patients) with acetabular revision using an oblong revision component. Chen et al reported, using oblong components for more severe acetabular defects, that the results are not satisfactory, with only 76% stable in a series of 37 acetabular components; 8% were probably loose with a change in the screw position but no definite migration and 16% loose at a mean follow-up of 41 months. In eight of the nine loose or probably loose components, superior migration was > 2 cm. On the basis of their early rate of probable or definite loosening of 24% and the technical difficulties involved, the authors did not recommend the routine use of an oblong acetabular component.

We suggest a number of possible causes that might predispose to early failure. This specific implant is bulky and heavy compared with other ovoid-shaped implants that are available. This might produce a high rotational moment resulting in increased shear forces and cyclical micromotion. These would compromise effective osseo-integration, leading to fibrous fixation and early aseptic loosening. The macroscopic appearance of the retrieved implants showed the outer surface to be almost bare. The oblong shape of the implant makes it technically difficult to match it to the reamed cavity. Other potential mechanisms of failure include poor bone quality of the acetabular bone bed and imperfect impaction grafting.

In conclusion we found that, when used with impaction bone grafting for Paprosky type IIIa acetabular defects, the Procotyl E uncemented acetabular revision component was associated with a high rate of early complications often requiring further revision.

Supplementary material

A table showing the acetabular component sizes implanted at revision is available with the electronic version of this article on our website www jbjs org uk.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

References