Total hip arthroplasty using the Wroblewski golf ball cup inserted through the posterior approach

A HIGH RATE OF DISLOCATION

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The Wroblewski golf ball acetabular cup was introduced by surgeons using the trochanteric osteotomy approach for revision total hip replacement (THR) in order to reduce the rate of dislocation. We have routinely used the Ogee long posterior wall (Ogee LPW) and the Wroblewski angle bore cups in THR. Although the new Wroblewski golf ball cup performed well there was a significant early rate of dislocation of 20%. Our rate of dislocation over a period of ten years using the Ogee LPW and Wroblewski angle bore cups had been 0.52%. We present our findings and an investigation as to why the new cup has such a high rate of dislocation when used with the posterior approach. We show that a relatively small change in the design of the acetabular component resulted in significant adverse clinical results.

The Ogee long posterior wall (Ogee LPW) cup (De Puy International Ltd, Leeds, UK) has been used in our unit for total hip replacement (THR) for more than ten years with very satisfactory results. However, some patients complain of restriction of hip flexion after THR with this cup. We have therefore also used the Wroblewski angle bore socket (De Puy International Ltd) in which the anterior edge of the polyethylene socket is cut away to allow a greater range of hip flexion before impingement occurs. This cup is available only in one size (43 mm outside/22.225 mm inside diameter). Both cups have performed equally well with a rate of dislocation of 0.52% over the past ten years in our practice.¹

The Wroblewski golf ball cup was a modification designed to address a rate of dislocation of 12% in one-stage revision procedures for deep infection.² The angle of the bore and the flange in this cup are both rotated posteriorly in relation to the pelvis. It is also available in a wider variety of sizes.

Our aim was to ascertain if the perceived mechanical advantages of the Wroblewski golf ball cup were manifest in clinical practice. In our experience the Ogee LPW and Wroblewski angle bore cups had performed efficiently and we planned to use the Wroblewski golf ball cup (DePuy International Ltd) if it performed as well.

Our study highlights the effects of a relatively small change in design on the clinical result.

Fig. 1a

Fig. 1b

Diagrams showing the standard Ogee cup with the bore at 90° to the surface.

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Patients and Methods

Between December 2000 and April 2001 the senior author (MHS) carried out 79 consecutive THRs using the posterior approach. There were 30 men and 49 women aged between 16 and 86 years. In almost all, the diagnosis was osteoarthritis (73 patients); a small number (six patients) had rheumatoid arthritis. The hips were randomly allocated to one of three types of cemented all-polyethylene cups using a

Fig. 2a

Fig. 2b

Diagrams showing the Wroblewski angle bore cup with a cut-away chamfer.

Fig. 3a

Fig. 3b

Diagrams showing the Wroblewski golf ball cup with the flange and bore rotated 30° posteriorly compared with the Wroblewski angle bore cup.

closed-envelope system. The Wroblewski golf ball acetabular cup was used in 35 patients (14 men, 21 women) the Ogee LPW cup in 22 (two men, 20 women) and the Wroblewski angle bore in 22 (14 men, 8 women).

All the cups had an internal diameter of 22.225 mm and an external diameter of either 40 mm or 43 mm. The Ogee LPW cup had the articulating bore drilled at 90° to the cup surface and had an Ogee flange (Fig. 1). The angle bore cup also had an Ogee flange but the bore was drilled at 45° to the cup surface to give additional cover to the head during flexion and adduction. It had a cut-away chamfer to improve the range of movement of the hip in flexion and adduction and to reduce the risk of impingement (Fig. 2). The golf ball cup was similar to the angle bore cup in that the bore was also drilled at 45° and it had an Ogee flange. However, the flange and bore were both rotated posteriorly by 30° compared with the angle bore cup (Fig. 3). The golf ball cup also had a dimpled convex surface to facilitate revision.

Each acetabular component was inserted using the Charnley cup holder at an inclination of 45°. The cup was placed in 30° of anteversion using a Charnley introducer and a 30° set square. The femoral stem was inserted in neutral version. The posterior capsule and short external rotator gap were closed in layers with a deep suction drain placed within the capsule. A Charnley foam wedge was secured between the patient's legs for the first 24 hours, after which active movement commenced.

Fig. 4

Photograph showing the laboratory model with the cup implanted in the dry pelvis in the lateral position. The set square and introducer place the cup in 30° of anteversion and 45° of inclination.

Fig. 5

Photograph of the laboratory model showing posterior impingement of the stem in extension on the posterior rim of the Wroblewski golf ball cup, leading to anterior dislocation.

Results

Before the introduction of the golf ball cup our rate of dislocation over a period of ten years was 0.52%. All dislocations were posterior.¹ This rate increased dramatically to 8.8% after the introduction of this cup. All dislocations occurred within the first six weeks, and were anterior, which is unusual for the posterior approach. In addition, all were in patients who had been allocated the Wroblewski

golf ball cup, giving a rate of dislocation of 20% for hips using this cup. There were no dislocations in patients in whom the Ogee LPW or the Wroblewski angle bore cups had been used.

Of the seven patients whose hips dislocated, three were treated by bedrest and subsequent mobilisation and two by a hip brace for six weeks. None of these patients had a further dislocation. The remaining two patients underwent revision of the cup to an Ogee LPW cup because the instability recurred. Neither has sustained a further dislocation since revision surgery. When these early results of our comparative study were available, we stopped using the Wroblewski golf ball cup.

We carried out laboratory studies of all three types of cup in a dry bone workshop by fixing them into a series of plastic bone pelvises. The bones were held in a vice in the lateral position similar to the position of the patient during surgery. The cups were positioned with 45° of inclination from the vertical and 30° of anteversion, using a Charnley introducer and a 30° set square in accordance with our usual surgical procedure (Fig. 4).

A Charnley roundback femoral stem at zero anteversion was placed in each acetabular cup and moved through a range of flexion and extension until impingement caused dislocation (Figs 5 and 6). Impingement of the neck on the posterior wall of the golf ball occurred at between 10° and 15° of extension (Fig. 6). Because of the position of the bore and the cut-away edge in the golf ball cup, there was no resistance to the head subluxing anteriorly. Using the angle bore cup, impingement resulting in anterior dislocation did not occur until the femoral component reached at least 25° of extension (Fig. 6). Because of the different position of the

Fig. 6

Photograph of the laboratory model showing the difference in extension limit of the Wroblewski golf ball and Wroblewski angle bore cups, predisposing to anterior dislocation with the Wroblewski golf ball cup.

Fig. 7

Photograph of the laboratory model showing the femoral stem in the Wroblewski golf ball cup in 15° of extension. The neck of the stem clearly impinges on the posterior rim of the Wroblewski golf ball cup and the anterior aspect of the cup does not contain the head because of the position of the chamfer.

Fig. 8

Photograph of the same model with the femoral stem in the Wroblewski angle bore cup in 15° of extension showing no impingement on the posterior wall. The anterior cup supports the femoral head because of the more superior position of the anteromedial chamfer.

bore and the cut-away chamfer, the anterior rim of the angle bore cup resisted anterior subluxation and so prevented dislocation (Figs 7 and 8).

Discussion

We introduced the Wroblewski golf ball cup on a trial basis because of the apparent advantages it offered, in particular the greater range of hip flexion by avoiding impingement anteriorly. However, when the cup was implanted in our standard manner, an unacceptably high rate of dislocation occurred. Our rate of dislocation had been 0.52% before the introduction of the golf ball cup.¹ This compared favourably with the wide range of rates after THR quoted in the literature, varying between less

than 1% and greater than 5%.^{3,4} Over a short period our overall rate of dislocation increased dramatically to 8.8% and we immediately discontinued usage of the Wroblewski golf ball cup.

In THR positioning of the cup is critical to prevent impingement and dislocation. Most surgeons implant the cup at 45° of inclination.^{5,6} However, it is the combined anteversion of the stem and cup which ultimately determines the stability of the prosthetic hip. In our series the cup was anteverted to 30° and the stem placed at zero anteversion, giving a combined anteversion of 30°. This maximised the offset and the stability of the hip.

We conclude, however, that the golf ball cup is not suited to placement in 30° of anteversion.

Anteversion of the cup leads to early impingement of the posterior wall and a risk of dislocation, which in our series, was always in an anterior direction. The originator of the cup has since stated that it was designed to be inserted in neutral version (Wroblewski BM, personal communication).

Our experience demonstrates the effect of a small change in the design of an implant leading to an unpredictable result and emphasises the importance of understanding the design of components and the technique used by surgeons. It also emphasises the necessity to monitor individual practice critically, particularly when changing a technique or introducing new components.

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