Hybrid total hip replacement

A 5–10-year follow-up study of 106 patients

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Between 1987 and 1992, 135 hybrid total hip replacements (THR) were performed in 124 patients. 106 patients, mean age 63 (52–77) years with 113 hips were followed for a an average of 6 (5–10) years. Porous coated PCA cups with 2 pegs were used in 21 cases, the Universal porous coated PCA in 62 and the Kirschner integrity cup in 30. Anatomic PCA stems were used in 83 cases and Kirschner dimension PC stems in 30. The preoperative Harris Hip Score (HHS) was 47. At follow-up, patients were evaluated clinically and radiographically. The position of the acetabular and femoral components were measured and the condition of the cement mantle and the bone-cement interface were determined. Postoperatively, the mean HHS was 89. 92% of the patients were symptom free. 3 THR were revised; 2 due to acetabular component loosening and 1 due to failure of the femoral component. The remaining cases were considered stable, although 3 cups were suspected of future loosening.

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Although the introduction of better cement techniques yielded a striking beneficial effect on duration of stem fixation, similar results were not observed in cup fixation (Mulroy and Harris 1990, Ranawat et al. 1988). Cup loosening was attributed to wear debris followed by tissue reaction (Eftekkhar and Nercessean 1986, Mulroy and Harris 1990, Tanzer et al. 1992, Willert et al. 1990), with polyethylene debris representing the greatest concern for aseptic loosening of cups (Jasty et al. 1992, Willert et al. 1990). As a result, uncemented cups, particularly the hybrid cup (Berger et al. 1996, Callaghan et al. 1996, Harris 1993, Mohller et al. 1995) were preferred by several surgeons. The primary advantages were the limited need for bone excision and the relative ease of revision, when necessary (Harris 1996, Rimnac et al. 1988, Woolson et al. 1996).

On the other hand, uncemented stems present several difficulties concerning filling and fitting compared to cemented stems. In addition, they presented substantial new problems, such as thigh pain, stress shielding and local periprosthetic osteolysis due to easier particle migration around the cementless stems (Martel et al. 1993, Tanzer et al. 1992). In contrast, modern cement techniques offer better fixation and sealing around the stem, not allowing massive particle migration and subsequent osteolysis (Mulroy and Harris 1990, Poss et al. 1988). Considering the different clinical and mechanical characteristics of the 2 components, uncemented porous coated press-fit cups with a cemented femoral component was used in this series.

Patients and methods

Between 1987 and 1992, 552 THR were performed by the same surgical team; of these 135 were hybrid THR in 124 patients (83 women). 106 patients with 113 hybrid hips were followed for a mean of 75 (55–116) months. Not included in this series is 1 hip which was revised 15 years postoperatively due to infection. There were 74 women and 32 men with an average of 63 (52–77) years. The underlying pathology was osteoarthrosis in 93 hips, rheumatoid arthritis in 11, avascular necrosis of femoral head in 5, and other in 4. The preoperative HHS was 47.

3 types of acetabular components were used: the 2-peg porous coated PCA in 21 cases; the Universal porous coated PCA in 62 and the Kirschner integrity cup in 30. Anatomic PCA femoral stems were used in 83 THR and Kirschner dimension PC femoral stems in 30. Both stems had porous coating on the proximal third (Figure 1).

Standard operative technique was used in all patients. Briefly, with an anterolateral approach without osteotomy of the great trochanter, the acetabulum was reamed using a reamer 2 mm smaller in size. The ace-

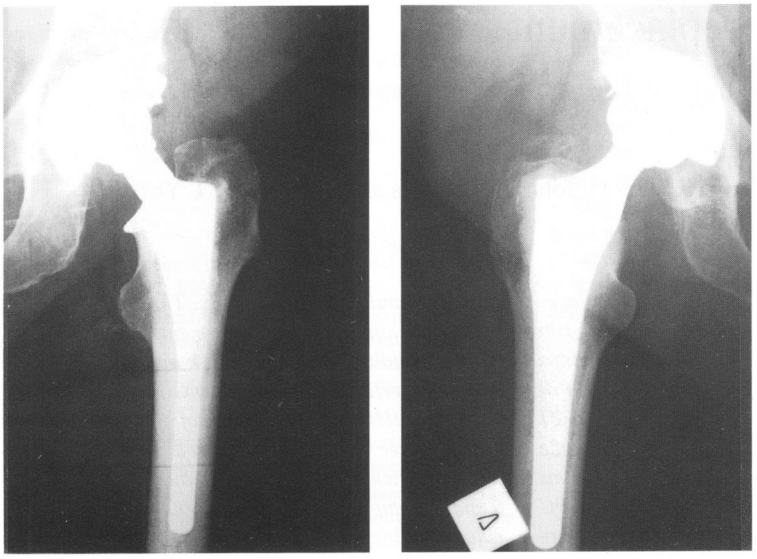


Figure 1. A cementless Kirschner integrity titanium cup with a cemented Kirschner dimension PC femoral stem hybrid THR on the left, and a cementless Universal PCA cup with a PCA femoral stem on the right.

tabular component was impacted in anatomic position on bone of homogeneous density. Screws were used in 3 cases for additional stabilization.

Both types of cemented femoral components were inserted by broaching the intramedullary canal with removal of all loose cancellous bone, followed by thorough irrigation and drying of the canal. A distal plug was inserted and cement was injected in retrograde fashion before implant insertion.

Postoperatively, all patients were treated with intravenous administration of antibiotics and subcutaneous administration of prophylactic anticoagulation with low molecular weight heparin. We followed the same protocol of physical therapy and rehabilitation. This included touch weight bearing in the second postoperative week, partial weight bearing after the 4th week using a cane and full weight bearing after the 8th week.

Patients were evaluated immediately and at 6 months postoperatively and at yearly intervals thereafter. Follow-up evaluation included clinical examination, HHS and radiographic examination to determine position of components and cement mantle. The position of acetabular component was evaluated by measuring its inclination (mean 41° (17°–58°)), horizontal cup distance (2–4 cm) and vertical cup height (1–3 cm), while the position of the femoral stem was assessed by measuring the vertical distance of the greater and lesser trochanter (Figure 2). In 105 THR, cup coverage was greater than 90% and in 87 THR the cup was anteverted.

Migration of the acetabular component, polyethylene wear (inferred from the radiographic head diameter image) and radiolucent lines in the 3 zones of acetabulum according to Delee and Charnley (1976) were assessed in postoperative radiographs. The presence of radiolucent lines in 7 zones of the femur was also noted and the cement mantle was graded as described by Schmalzried et al. (1992).

Radiographs were also examined for heterotopic ossification and metal beads. Migration of the acetabular prosthesis or the appearance of radiolucent lines larger than 2 mm in all 3 zones of the acetabulum were considered as loosening and failure. The appearance of a complete radiolucent line, or change in the initial position of the femoral component were considered as signs of loosening of the femoral stem.

Results

Clinical evaluation showed a mean HHS of 89, overall. Specifically, THR using the universal PCA cup and anatomic stem or the Kirschner integrity cup with dimension stem had a HHS of 91, while THR with a 2 peg PCA cup and anatomic stem had a HHS of 88. 92% of the hips were pain free. Results were excellent in 79 hips, good in 26, fair in 5 and poor in 3 (93% excellent and good results).

3 of the 113 hips were revised; 2 due to wear or migration of the acetabular component (1 universal PCA cup and 1 PCA cup with 2 pegs) and one for loosening of the femoral stem (anatomic PCA) (Figure 3). The acetabular components in another 3 cases (2 PCA with pegs and 1 universal PCA) with radiolucencies in 2 or 3 zones greater than 2 mm, migration and excessive wear, appeared to be loose. In the initial fixation, absence of full contact of the prosthesis to

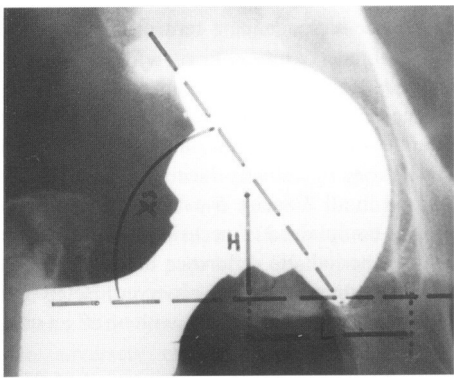


Figure 2. Measurements used to determine the position of prosthesis for the (left) acetabular component: L – horizontal cup distance, H – vertical cup height, (x) – horizontal cup angle; and (right) for the femoral component: A – greater trochanter vertical distance, B – lesser trochanter vertical distance

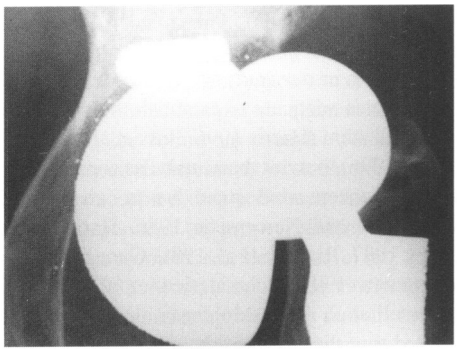


Figure 3. Postoperative failure of components. Rotation of acetabular component due to loosening, 7-years postoperatively in a 71-year-old man (above). Note the appearance of metal beads. 6-year postoperative radiograph showing radiolucency in the bone-cement interface in all zones in a 62-year-old woman, with loosening of the femoral component (right).

the bone was noted in 45 THR, but in only 2 was the gap more than 1 mm. In 38 THR the remaining gap was located in zone 2, in 5 in zones 1 and 2, in 1 in zones 2 and 3 and in 1 in all three zones. After 5 years, gaps remained in only 6 THR.

Radiolucency less than 2 mm in 1 or 2 zones appeared in 16 acetabular components during follow-up (Table 1). Prognosis did not appear to be influenced by the initial coverage, fit and orientation of the cups, but rather seemed to be affected by the different bone densities. The 3 cups which showed signs of excessive radiolucency and loosening, as well as the 11 of 16 cups which developed a radiolucent line during the follow-up were fixed in bone of different density. Linear wear was estimated by measuring the decrease of the thickness of the polyethylene liner. Average wear was 0.2 mm per year in Kirschner cups, 0.25 mm in universal PCA and 0.3 mm in PCA with 2 pegs (Figure 4). Although excessive osteolysis was not observed, small lesions were seen around the pegs in 2 PCA cups.

Of the 113 acetabular components, 108 appeared to be excellent at 55–116 months follow-up. The remaining 5 (3 PCA with 2 pegs, 2 universal PCA) were loose or probably loose. Of the 113 femoral components, 109 had excellent and good clinical or radiographic results. Excessive osteolysis was observed in 1 stem, and subsidence greater than 3 mm was noted

Table 1. Radiographical assessment of the porous coated acetabular component at follow-up

Cups	A (n=21)	B (n=62)	C (n=30)
Radiolucency	6	7	3
zone I	2	1	1
zone II	–	1	1
zone III	1	1	–
zones I & II	1	2	1
zones II & III	1	–	–
zones I & III	1	2	–
Migration or excessive radiolucency	3	2	–
Wear (>0.3 mm/ year)	13	4	3

A PCA cup with pegs
B Universal PCA cup
C Kirschner integrity titanium cup

in 3 femoral components. Stress shielding was seen in 11 patients, mainly in zones 1 and 7. Bone resorption was not observed in the calcar in 101 of 113 THR. Of the remaining 12, 6 had titanium stems inserted. 54% of the cases demonstrated perfect cement technique postoperatively. The remaining hips showed a defect at least in 1 zone, in the cemented mantle. 111 hips had no signs of symptomatic radiographic loosening.

The cement mantle was at least 2 mm thick and completely surrounded the prosthesis with no local defects (grade A) in 14 cases. Cement penetration which did not extend completely through the cancellous bone with some areas of trabecular bone at the cement-bone interface (grade B) was observed in 47 cases. Cement mantles with focal deficiencies (grade C) were seen 41 hips, while grade D stems with multiple focal and/or extensive diffuse mantle defects were recorded in 11 cases. Excellent and very good cement technique with adequate cement mantle was attained in 61 of the 113 hips.

Only 1 prosthesis with pain and radiographic evidence of loosening between the stem and the cement mantle was revised. A second revision was performed 5 years postoperatively due to radiolucency which appeared in all 7 zones. 5 patients had thigh pain, but only 2 complained of occasional pain during the follow-up period. No difference between the 2 types of femoral components was observed. Heterotopic ossification occurred in 12 hips, with no effect on the final outcome.

With a minimum follow-up period of 55 months, loosening of the acetabular and femoral component in hybrid THR was 4%. The clinical outcome which did not differ between the 3 types of prostheses used, was satisfactory (excellent or good results) in 93% of the cases.

Discussion

Follow-up in our study which was between 6 and 10 years, was adequate to establish the condition of the femoral stem (Harris 1996, Poss et al, 1988, Woolson et al. 1996), but not the acetabular component, as failure of uncemented cups due to wear occurs later (Eftekhar and Nercessean 1986, Harris and Penenberg 1987, Rimnac et al. 1988, Garcia-Cimbrello and Munuera 1992, Schmalzried et al. 1992a, 1992b, Martell et al. 1993, Mohler et al. 1995). It should be noted that the average age of the patients (63 years) was such that they did not engage in heavy labor.

The 3 types of acetabular components we used were uncemented with press-fit fixation, with differences, however, in manufactured materials and de-

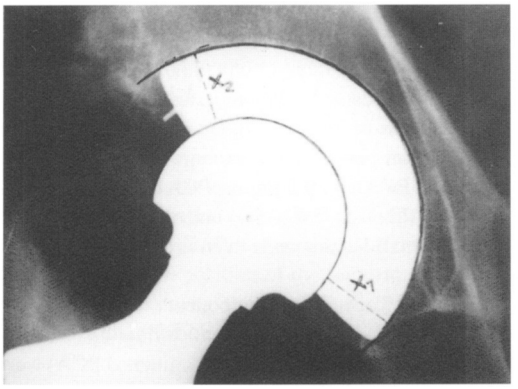
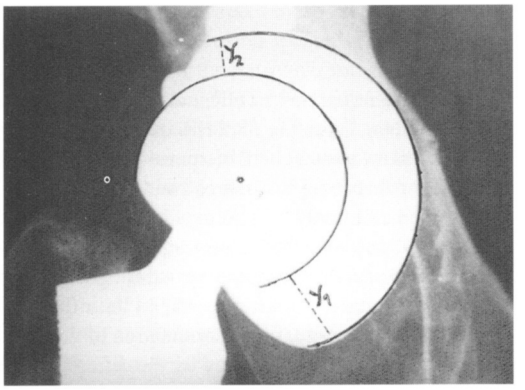


Figure 4. A Universal PCA cup 5 years postoperatively in a 65-year-old woman in which 0.7 mm of wear was measured.



A PCA cup 8 years postoperatively in a 69-year-old woman showing excessive linear wear measuring 3.4 mm. Note the upper lateral position of the femoral head in the acetabular component.

sign. In most cases (110 of 113) no screws were used for additional stability. Fixation was achieved without difficulties in almost all cases. It should be noted that hybrid THR with the additional use of bone grafts were excluded from this study.

Femoral components were anatomic without a collar or straight with collar with a porous coating on the proximal third. Stems with a collar appeared beneficial only in hips with poor bone quality, where load had to be partially transmitted by the proximal neck stump. Stems with stress producing sharp edges were found to adversely effect stem-cement bonding. When cement was pressurized in proximally coated stems with an adequate cement mantle, the results were substantially improved as bonding was enforced and pathways for debris migration into the bone interface was decreased (Harris 1993, Mulroy and Harris 1990, Poss et al. 1988, Ranawat et al. 1988). No difference was observed between the anatomic and straight cemented stems. Femoral component failure was observed in 4% as seen in other series (Berger et al. 1996, Callaghan et al. 1996, Godberg et al. 1996, Harris 1996, Mohler et al. 1995, Woolson et al. 1996).

A grade C cement mantle did not seem to affect the outcome during the follow-up period. Although microcracks appeared in the cement of stable prostheses, it is generally accepted that prosthetic fixation and survival are dependent on proper cement insertion and an adequate cement mantle (Poss et al. 1988, Ranawat et al. 1988, Mulroy and Harris 1990). Press-fit acetabular components appeared to remain stable, even in cases where full initial contact was not achieved (40% of the cases). This supports the suggestion that cup survival depends more on the homogeneous quality of the bone bed and the resistance to penetration by wear debris, rather than on initial fill (Garcia-Cimbrello and Munuera 1992, Martell et al. 1993, Havelin et al. 1995, Goldberg et al. 1996).

Early definite or probable loosening of the acetabular component in our study was 4% which appears a bit higher than those reported by others (Martell et al. 1993, Havelin et al. 1995, Mohler et al. 1995, Berger et al. 1996, Callaghan et al. 1996, Harris 1996, Woolson et al. 1996). This is attributed mostly to the radiographic signs of loosening which appeared more often in the 2-peg porous coated PCA cup (3 of 21 cups). Only 2 cups of the 92 other two types used showed similar signs. Differences in shape, thickness, fixation technique and quality of polyethylene lining may explain these results (Rimnac et al. 1988).

Clinically, 92% of the patients were pain-free and satisfied with the operation and had a HHS similar to other series (Mohler et al. 1995, Berger et al. 1996, Callaghan et al. 1996, Godberg et al. 1996, Harris 1996, Lewallen et al. 1996, Woolson et al. 1996). Overall, the use of a hybrid hip replacement gave satisfactory clinical and radiographic (93%) results with a follow-up of 55–116 months. However, longer follow-up is necessary in order to accurately assess the prognosis of uncemented cup prostheses in hybrid hips.

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