

## REVIEW OF 10-YEAR RESULTS OF PCA HIP ARTHROPLASTY

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**OBJECTIVE:** To assess the long-term results of the PCA uncemented total hip replacement.

**DESIGN:** A prospective nonrandomized clinical trial. Follow-up ranged from 8 to 11 years (mean 10.3 years).

**SETTING:** A university hospital.

**PATIENTS:** One hundred consecutive PCA arthroplasties were performed on 89 patients. All operations were supervised by a single surgeon. The patients' status was reviewed between September and November 1996 by an independent observer. Seventy-three total hip replacements were available for review.

**INTERVENTION:** PCA uncemented acetabular and femoral replacement through a lateral surgical approach.

**MAIN OUTCOME MEASURES:** The need for revision, which was classified as failure, and definite 3-zone acetabular radiolucency, which was considered radiologic evidence of loosening.

**RESULTS:** The time to failure of the acetabulum averaged 8 years. Femoral failure occurred in 3 patients an average of 4 years postoperatively. The overall failure rate for the acetabulum was 13% and for the femur 7%.

**CONCLUSIONS:** The acetabular failure rate is unacceptably high. Patients who have had hip replacement with the PCA prosthesis should be followed over the long term.

**OBJECTIF :** Évaluer les résultats à long terme de l'arthroplastie totale de la hanche avec prothèse PCA non cimentée.

**CONCEPTION :** Étude clinique non randomisée prospective. La durée du suivi a varié de huit à 11 ans (moyenne de 10,3 ans).

**CONTEXTE :** Hôpital universitaire.

**PATIENTS :** On a procédé à cent arthroplasties consécutives avec prothèse PCA sur 89 patients. Toutes les interventions ont été supervisées par le même chirurgien. Un observateur indépendant a étudié l'état des patients entre septembre et novembre 1996. Les révisions ont porté sur 73 arthroplasties totales de la hanche qui étaient disponibles.

**INTERVENTION :** Arthroplasties acétabulaires et fémorales avec prothèse PCA non cimentée par intervention chirurgicale latérale.

**PRINCIPALES MESURES DE RÉSULTATS :** Le besoin de révision, qui a été classé comme un échec, et la transparence aux rayons-x définie à 3 zones de l'acétabulum, considérée comme une preuve radiologique de relâchement.

**RÉSULTATS :** Il s'est écoulé en moyenne huit ans avant la défaillance de l'acétabulum. Trois patients ont connu une défaillance fémorale en moyenne quatre ans après l'intervention. Le taux global de défaillance s'est établi à 13 % dans le cas de l'acétabulum et à 7 % dans celui du fémur.

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CONCLUSIONS : Le taux de défaillance acétabulaire est inacceptable. Les patients qui ont subi une arthroplastie de la hanche avec prothèse PCA devraient être suivis pendant longtemps.

Concerns about the long-term survival of cemented total hip arthroplasty, particularly in young patients, led to the development of uncemented hip arthroplasty. Various designs were introduced, one of which was a porous coated anatomic prosthesis (PCA; Howmedica, Rutherford, NJ). The principle of the design was that biologic fixation to the porous coating of both the acetabular and femoral components and an anatomic design would lead to greater longevity of the arthroplasty.

The components were cobalt-chromium alloy (Vitallium) with a double layer of scintered Vitallium beads behind the acetabular component and circumferentially on the proximal one-third of the femoral

component. The mean pore size was 675 microns. The femoral component had a posterior bow to conform to the shape of the proximal femur. The acetabular component had 2 peripheral lugs for rotational stability. A range of sizes was available.

There was initial enthusiasm for this prosthesis and several short-term studies were published.<sup>1-3</sup> More recently the results of some 5- to 7-year studies have been reported.<sup>4-7</sup>

In May 1996, Astion and associates<sup>8</sup> published the results of their series of PCA prostheses implanted between 1983 and 1987 and expressed concern about the rate of acetabular failure.

The purpose of this study was to review the results of a single surgeon's first 100 consecutive arthroplasties using the PCA prosthesis done in patients enrolled in a prospective study with an 8- to 11-year follow-up.

## METHOD

One hundred PCA arthroplasties were performed on 89 patients (40 women, 49 men) between January 1985 and November 1987. The mean age of the patients was 56.2 years (range from 28 to 76 years). The preoperative diagnoses for the 100 hips

are shown in Table I. The average preoperative Harris hip score<sup>9</sup> was 31.9 (range from 2 to 66).

All arthroplasties were performed through a direct lateral approach by one surgeon (D.E.H.) as described by Hardinge.<sup>10</sup> The acetabular component was available in 7 sizes. The last 4 patients in the series received a modular acetabular component whereas the others received a non-modular component. The polyethylene thickness in each of the sizes is shown in Table II.

The femoral components were right and left and were available in 7 sizes for the standard components. A larger size of mid-stem and a long femoral component were available. In 99 hips, the standard size component was used. In 1 hip a long femoral component was inserted. A Morse taper modular head was used with a neck that was available in 2 lengths. A 32-mm head was used in all hips as no other size was available.

In 1996 the patients were reviewed by an independent observer (H.T.). Whenever possible the patient was seen and rated according to the Harris hip score. Anteroposterior and cross-table lateral radiographs were obtained. The incidence and severity of thigh pain were noted. When the patient could not be seen because of distance or illness, a Harris hip rating was done by telephone and radiographs obtained locally were reviewed.

## Radiologic examination

Current radiographs were compared with the initial postoperative radiographs. Migration of the components was evaluated according to the method of Callaghan, Dysart and Savory.<sup>3</sup> Femoral and acetabular radiolucency was measured according to the zones of

**Table I**

**Preoperative Diagnosis in 100 Hips that Required Replacement With the PCA Uncemented Prosthesis**

Diagnosis	No. of hips
Osteoarthritis	71
Rheumatoid arthritis	13
Avascular necrosis	3
Ankylosing spondylitis	7
Failed Wagner resurfacing	6

**Table II**

**Size of the Acetabular Component**

Acetabular size, mm	Polyethylene thickness, mm	Total no. of hips	No. (and %) failed
46	3.3	7	4 (52)
49	3.3	21	2 (10)
52	6.3	23	5 (22)
55	6.3	17	0
58	9.3	14	2 (14)
61	9.3	16	0
64	12.3	2	0

Gruen, McNeice and Amstutz<sup>11</sup> for the femur and DeLee and Charnley<sup>12</sup> for the acetabulum. Evidence of osteolysis was recorded and its maximum diameter measured. The number of loose beads around both components was compared with the number present in the initial postoperative films.

An anteroposterior and particularly a lateral radiograph were used to assess polyethylene wear by the eccentricity of the head in the acetabulum. Prostheses with greater than 2 mm of eccentricity were recorded. Heterotopic ossification was graded according to the classification of Brooker and associates.<sup>13</sup>

Progressive radiolucency around the components or progressive migration of components was interpreted as loosening.

## RESULTS

Seventy-three hips were available for review. The average follow-up was 10.3 years (range from 8 to 11 years).

### Patients not available for review

Of the patients associated with the 27 hips not reviewed, 1 was lost to follow-up and 12 had died of unrelated causes but had not required revision. Nine hips had been revised. Four patients (5 hips) had multiple medical problems and we could not obtain radiographs or complete a hip score. Of the 9 hips revised, 1 had both acetabular and femoral components revised because of infection 17 months after surgery. This was the only infection in the series.

In 7 hips the acetabulum had been revised for aseptic loosening. This was done 58 to 135 months (average 101.7 months) after the initial procedure. In 2 of these cases, the failure of the acetabulum was catastrophic. In the first case the acetabular component

migrated through the medial wall of the acetabulum (Fig. 1). In the second case, the polyethylene liner dissociated from the outer shell. A large area of osteolysis was also present superior to the acetabulum (Fig. 2).

In 1 hip the femoral component was revised after 85 months for aseptic loosening.

In 1 other hip, revision has been recommended due to severe osteolysis of both acetabular and femoral components (Fig. 3).

In 13 hips mild or moderate thigh

pain was noted, requiring only occasional analgesia. In 4 of these hips the femoral component was radiographically loose. In the remainder it appeared satisfactory (Fig. 4). Severe thigh pain was not associated with any of the hip replacements.

### Patients available for review

The radiographic results of the remaining 73 hips are summarized in Table III.

In 5 hips there was evidence of



FIG. 1. Catastrophic failure of the medial wall 9 years postoperatively due to asymptomatic osteolysis. Note the loose beads.



FIG. 2. Dissociation of the liner at 10 years. Note the large area of osteolysis at the apex of the acetabulum.



FIG. 3. Severe femoral and acetabular osteolysis. The patient had rheumatoid arthritis and was asymptomatic.



FIG. 4. The PCA prosthesis 11.5 years postoperatively in a man who weighed 100 kg (patient no. 2 in our series). His only complaint was occasional mild thigh pain.

loosening of both components. One of these had extensive osteolysis, and revision was recommended. In 2 hips there was evidence of femoral loosening only and in 1 hip acetabular loosening only.

Heterotopic ossification was not a problem in this series. One hip had grade III ossification but none had grade IV ossification (Table III).

In addition to the 9 hips that required revision there were 8 with radiologically loose components. These hips had minimal symptoms but the probability of them requiring revision is high and they were classified as failures, contributing to an overall failure rate of 17%.

**Table III**

**Radiographic Results in 73 Hips**

Finding	No. of hips
<b>Acetabulum</b>	
Osteolysis	
< 10 mm diameter	9
> 10 mm diameter	2
Loose beads*	16
Eccentric wear	13
Increasing radiolucency	11
<b>Femur</b>	
Osteolysis	
< 10 mm diameter	10
> 10 mm diameter	3
Sclerotic lines	29
Loose beads*	10
Subsidence > 5 mm	11
Migration, varus/valgus	3
Increasing radiolucency	7
<b>Heterotopic ossification, grade</b>	
I	4
II	5
III	1
IV	0

\*Increasing in number since initial postoperative radiograph

There were 7 revisions for aseptic acetabular loosening and another 6 hips in which the acetabulum was radiographically loose. The sizes of the failed acetabular components are shown in Table II.

There was no correlation between acetabular wear and cup position. The radiologic fit and fill of the femoral component were not measured.

In 19 patients with scores of 80 or less Table IV, 5 showed evidence of loosening of one or both components. Seven patients had multiple joint problems or medical problems, giving them a low score, but none had pain in the hip.

## DISCUSSION

An overall acetabular failure rate of 13% at 12 years compares poorly with that reported in studies of similar duration with cemented hips,<sup>14-16</sup> even though these studies examined arthroplasties using outdated cementing techniques. It also compares poorly with failure rates using more modern cementing techniques.<sup>17</sup>

There are few long-term follow-up studies of uncemented hip arthroplasty in the literature. However, it appears that despite good initial reports for these prostheses,<sup>2,3</sup> the results deteriorate as follow-up times increase.<sup>4,5,7</sup> In particular, Astion and associates<sup>8</sup> noted a significant failure rate of the acetabular component in their series and also a high rate of osteolysis and polyethylene wear.

**Table IV**

**Harris Hip Scores**

Score	No. of hips
Excellent, 91-100	40
Good, 81-90	14
Fair, 71-80	13
Poor, < 70	6

In our study there are several factors that may have contributed to the failure rate. One of these is the use of 32-mm femoral head. Since 1984 when this study was begun, it has been shown that a smaller femoral head may be associated with less polyethylene wear.<sup>18</sup>

It has also been recognized that the acetabular components were poorly designed in that despite being non-modular there was movement between the polyethylene liner and metal backing allowing for possible polyethylene wear debris. At the time of revision we noted that the liner was often grossly mobile, and in 1 case it had separated entirely.

It has also been recognized that the small acetabular components (an outer shell 55 mm or less) had a maximum 6.3-mm layer of polyethylene.<sup>8</sup> Size 46 and 49 mm acetabular components had a 3.3-mm layer of polyethylene. Eleven of the 13 acetabular components that failed in our series had an acetabular component size of 55 mm or smaller.

The problems of subsidence and loose beads have been discussed in the literature.<sup>1,2,6,7</sup> Heekin and associates<sup>6</sup> have suggested that progressive subsidence greater than 5 mm and shedding of beads after the postoperative radiographs are indicative of micromotion at the prosthesis-bone interface and suggest loosening of the components. However, in our study we noted that one of these findings could be present without any other indications of loosening such as progressive radiolucency around the components.

Although there was only 1 revision in our series for a loose femoral component, 6 more hips had evidence of femoral loosening including 1 in which revision is pending. Mulroy, Estok and Harris<sup>17</sup> reported a 9% incidence of femoral loosening at 15 years using second-generation cementing



techniques. The incidence of femoral loosening in our study is probably comparable to this.

Overall there is an unacceptably high failure rate of the PCA hip prosthesis due primarily to acetabular failure. This type of arthroplasty has been abandoned at our institution.

We recommend that patients with this implant should be followed carefully over the long term, because of the problems we have described with the acetabular component.

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