The Bimetric cementless total hip replacement: 7–18 year follow-up assessing the influence of acetabular design on survivorship

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Abstract The purpose of this study was to evaluate the mid- to long-term survivorship of Bimetric cementless total hip replacement and assess how it is affected by the acetabular design. This was a retrospective analysis of 127 Bimetric cementless total hip replacements in 110 patients with a follow-up of 7–18 years. A single design stem and three different cementless metal-backed acetabular designs were used. Patients were assessed clinically using the Harris hip score and radiologically by independent review of current hip radiographs. There was only one case of aseptic loosening of the femoral stem. The earliest acetabular design showed a high failure rate whilst the latter two designs showed a 96% survivorship at a mean of 9.5 years. We conclude that a combination of the bimetric stem with either of the latter acetabular cup designs has a good mid- to long-term performance.

Résumé

l'étude de l'évaluation à moyen ou à long terme de la survie d'une prothèse sans ciment de type Bimétric. il s'agit d'une étude prospective de 127 prothèses totales de hanche chez 110 patients avec un suivi moyen de 7 à 18 ans. Un seul dessin de tige fémorale et trois dessins différents de cupule métal back sans ciment ont été utilisés. Les patients

ont été évalués sur le plan clinique (score de Harris) et sur le plan radiologique. Un seul cas de descellement aseptique de tige fémorale a été retrouvé. Sur les trois modèles de cupule, le premier modèle montre un taux d'échec très important alors que les deux derniers modèles ont un taux de survie de 96% à 9,5 ans de recul. En conclusion, nous pouvons affirmer que la combinaison d'une tige de type bimétric associée aux modèles acétabulaires les plus tardifs ont permis un bon résultat moyen à long terme.

Introduction

The Bimetric cementless total hip prosthesis is widely used worldwide. Short- and mid-term results [2, 5, 13] have been documented for this prosthesis but there is a lack of longer-term review.

The aim of this study is to evaluate radiographically and functionally the mid- to long-term performance of the Bimetric total hip replacement and investigate the influence of acetabular design on survivorship.

Materials and methods

One hundred ten patients underwent an uncemented Bimetric total hip replacement between 1982 and 1995 in our department. Patients were included if they were under 60 years of age and had the radiological appearances of a normal shaped acetabulum with grossly normal bone stock on X-ray. At the time of assessment, nine patients had died with none having required a revision of their hip replacement. A further two patients were lost to follow-up two years after surgery. This resulted in 99 patients (103 hips) being available for review. There were 55 females and 44

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Table 1 Comparison of the age of patients at the time of surgery and clinical review in the different acetabular groups

Age group	Cup A (N=15)		Cup B (N=24)		Cup C (N=64)	
	At surgery	At review	At surgery	At review	At surgery	At review
20–29	0	0	0	0	2	0
30–39	0	0	1	0	0	2
40–49	0	0	6	1	16	0
50–59	10	0	15	5	27	15
60–69	4	7	2	16	19	27
70–79	1	3	0	2	0	20
80–89	0	4	0	0	0	0
90–99	0	1	0	0	0	0

males with an overall mean age of patients at the time of surgery of 56.2 years (see Table 1). The preoperative diagnosis for 96 of the patients was osteoarthritis with the remaining three cases being diagnosed as rheumatoid arthritis. Five consultant surgeons performed the surgery, using the posterior approach. The femoral prosthesis used was collared, straight, tapered, and made of titanium (Fig. 1).

Three designs of acetabular cups were used. The TTAP cup (cup A) was the earliest design and implanted from 1982 to 1990. This is a conical-shaped cup made of titanium with coarse threads and a snap in mechanism for liner fixation (Fig. 2). Due to a high early failure rate of cup A, the biomex and universal models were preferentially used after 1990. The biomex cup (cup B) is a titanium porous-coated hemispherical shell with a four fin design for initial stability and has a ring loc mechanism for liner fixation (Fig. 3). The universal acetabular cup (cup C) has a press-fit mechanism for liner fixation and is titanium plasma-coated with dome and rim holes available for screw

Fig. 2 Cup A **Fig. 1** The bimetric femoral stem **Fig. 3** Cup B

Fig. 4 Cup C

insertion (Fig. 4). All patients had a high wall liner made of processed compression-moulded ultra-high molecular weight polyethylene.

All patients were reviewed in a dedicated clinic and assessed functionally by measuring the Harris hip score. AP and lateral radiographs were reviewed by an independent radiologist. Any identified radiological evidence of lucency and osteolysis was measured in millimetres and recorded according to Gruen zones. Linear wear of the polyethylene liners was assessed by a modification of the Livermore method. A compass was used to find the shortest distance from the acetabular cup to the centre of the femoral head on the current radiographs. This measurement was repeated on the postoperative film.

Results

At a mean follow up of 9.6 years, the survivorship of the uncemented femoral stem was 97.5% and the overall survivorship of the uncemented total hip replacement was 88.9% (Table 2, Fig. 5). Best and worst scenario graphs were plotted for survivorship of the hip replacement and femoral stem depending on whether the two patients lost to follow-up were asymptomatic or assumed to have required revision immediately after becoming untraceable at two

Fig. 5 Survivorship of the bimetric uncemented total hip replacement

years (Figs. 5, 6, 7). The cups B and C performance were superior to cup A (Fig. 6). Excluding cup A, survivorship of the uncemented bimetric total hip replacement was 96.0% at a mean follow up of 9.6 years (Table 3).

At the time of assessment, 13 of the 127 hips had been revised. Ten of the 13 hips had undergone revision due to aseptic loosening of the acetabulum. Nine of the ten hips revised for aseptic loosening of the acetabulum were due to a loose type A cup. The mean survival in this revised group of ten hips was 10.4 years.

Only one patient in the study required a revision for aseptic loosening of the femoral stem. The other two patients in the revision group required revision for loosening due to deep infection.

The mean Harris hip score of the surviving 103 hips was 91.11 at a mean of 11.1 years, compared to a mean preoperative Harris hip score of 43.4. Statistically, there was a significant difference in the median Harris hip scores between the three acetabular cup types ($P=0.011$, Kruskal–Wallis test), with type A being significantly worse than the two other cups (Table 4).

Radiological assessment (Table 5) of the surviving hips revealed evidence of lucency or lysis in 14 of 15 cases for the type A cup compared to one of 23 and six of 64 for cups B and C, respectively. The presence of lucency or lysis was limited to 1 mm for the B and C cups but varied from 1 mm to 3 mm for the cup C group. There was radiological evidence of liner wear in 12 of the hips, although this was asymptomatic.

Table 2 Survivorship of the uncemented bimetric total hip replacement

Type	Survival rate						
	3 y (%)	5 y (%)	8 y (%)	10 y (%)	13 y (%)	15 y (%)	18 y (%)
Total hip replacement	99.13	98.26	98.26	97.39	93.04	88.70	88.70
Femoral stem	99.1	99.1	99.1	98.3	97.5	97.5	97.5
Universal cup	97	97	97	97	97	97	
Biomex cup	100	100	100	100	100	100	
TTAP cup	100	96	96	92	80	65	65

Fig. 6 Survivorship of cups A, B, and C acetabular components

Fig. 7 Survivorship of the uncemented bimetric femoral stem

Table 4 Functional performance of the acetabular cups

Acetabulum	Number of THRs	Mean Harris hip score	Mean time after surgery (y)
Cup A	15	75.236	12.5
Cup B	24	95.31	8.5
Cup C	64	91.11	9.97

Table 5 Radiological findings at the time of assessment of the acetabular cups

Radiological finding	Cup A N=15	Cup B N=24	Cup C N=64
Lucency (zones)			
1	14 cases (eight-1 mm, five-2 mm, one-4 mm)	0	6 cases (all 1 mm)
2	10 cases (eight-1 mm, two-3 mm)	0	3 cases (all 1 mm)
3	11 cases (four-1 mm, six-2 mm, one-4 mm)	1 case (1 mm)	6 cases (all 1 mm)
Lysis (zones)			
1	11 cases (six-1 mm, four-2 mm, one-4 mm)	0	5 cases (all 1 mm)
2	9 cases (seven-1 mm, two-3 mm)	0	1 case (1 mm)
3	14 cases (six-1 mm, seven-2 mm, one-4 mm)	1 case (1 mm)	5 cases (all 1 mm)
Orientation satisfactory	15	23	64
Cyst formation	0	0	0

Table 6 Complications of surgery

Complications	Frequency of occurrence
Intraoperative death	0
Femoral fracture	1
Dislocation	2
Deep infection	2
Thigh pain	2
Heterotopic calcification	9

Table 3 Acetabular cup survivorship

Acetabular cup	Number	Revisions	Survived	Survival rate	Log rank test comparing TTAP with each cup
Cup C	65	1	64	98.46%	$P=0.0334$
Cup B	23	0	23	100%	$P=0.138$
Cup A	27	12	15	55.56%	–

On up-to-date radiographs, none of the Bimetric femoral prostheses had measurable migration. Three out of the 102 femoral stems had radiolucent lines. This was limited to 1 mm with one case having more than one Gruen zone involved. All cases were within the range of 3° of valgus to 3° of varus. There was no evidence of cyst or pedestal formation. There were 12 cases of calcar bone resorption and nine cases of heterotopic calcification.

Discussion

Excluding cup A, the overall survivorship of the cementless Bimetric total hip replacement in this series is 96% at a mean of 9.6 years. This compares favourably with a report from the Finnish hip register that gives a survivorship of 65% at nine years [12]. The poor survivability of the Bimetric cementless hip replacement in the Finnish series was accounted for by a high cup A failure rate and poor performance of the hexloc liner. Our series did support a higher failure rate of the cup A compared to the other cups. A review of the literature reveals several recent publications that support a good survivorship for this prosthesis [6, 7, 9, 14]. Furthermore, our study provides results up to 18 years, with only two patients lost to follow-up, and includes information on three different acetabular components and the femoral stem prosthesis.

At an early stage, our own results plus other reports [12] suggested that the earliest cup used in this series, cup A, had a high failure rate. The subsequent use of cups B and C showed a good survivorship with no radiographic evidence of backside wear or significant osteolysis. Previous reports have documented a high rate of marked osteolysis with uncemented metal-backed acetabular cups [10, 11], although this was not the authors experience in this study. Liner wear was seen on radiographs, although not to such a high extent as described previously [11].

It had been decided to revise liners in asymptomatic active patients where there was significant wear, in order to prevent subsequent acetabular loosening.

In our series, the femoral stem had excellent survivorship with only one case of loosening. Intraoperative femoral fracture [8] and postoperative thigh pain [4] have been described previously as potential problems associated with the use of uncemented prostheses, although these complications were uncommon in this study (Table 6). There were nine cases of heterotopic ossification (7%) in this series; previous studies have suggested an incidence of heterotopic calcification up to 67.2% for uncemented prostheses [3]. We support the view that the advantages of using an unce-

mented prosthesis include a lower number of intraoperative cardiac complications [1] and a shorter operation time.

In conclusion, the results of this study support the use of the cementless Bimetric femoral stem with either cup B or cup C. Our experience suggests that these are safe choices for cementless prostheses with good mid- to long-term results.

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