Nine-year follow-up of the cementless Ring hip

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Because of the revived interest in cementless hip prostheses, 238 Ring prostheses from the period 1968 to1979 were reviewed; 127 hips with a median follow-up of 9 years were available for examination. Two thirds of the hips were rather painless, and 90 percent of the patients graded their result as excellent or good. Six hips had had a deep infection requiring removal of the prostheses in two hips, and 37 prostheses were removed because of loosening. By actuarial analysis the overall probability of survival and the average annual probability of removal were found to be 81 and 1.7 percent, respectively, after 12 years. The long-term survival of the Ring prosthesis seems to be comparable to the survival of some commonly used cemented prostheses.

The follow-up period of the present cementless prostheses is often short. Experience with the cementless Ring (1968) prosthesis may provide a basis for long-term evaluation of cementless arthroplasties. We reviewed all the patients treated with a Ring prosthesis in our hospital and made a survivorship analysis.

Patients and methods

During the period 1968–1979, 195 patients were treated with a Ring total hip arthroplasty; 43 patients were operated on bilaterally for a total of 238 hips. In 205 hips the indication for the operation was primary arthrosis, and 33 hips were operated on for arthrosis secondary to either dysplasia or trauma. The median age of the patients at the time of operation was 67 (20–82) years, and the median duration of symptoms was 10 years.

Fifty-one patients had died before the follow-up, median age 73 (58–89) years. Seventeen patients, with a median age of 80 (58–92) years, were unwilling to participate in the study, and 23 patients were excluded because of revisional surgery. These 111 patients with 131 hips were not evaluated in the follow-up, but they are included in the revision and infection rates and in the survivorship table. Thus, 104 patients with 127 hips attended the clinical and radiographic follow-up with a median observation time of 9 (6–17) years (Table 1).

Preoperatively, 1 year postoperatively, and at follow-up, all the hips were assessed on a 6-grade scale according to Charnley for pain, motion, and walking (Merle d'Aubigné and Postel 1954, Charnley 1972). In this classification the prefix A denotes a patient with only one hip involved, B denotes a patient with both hips involved, and C denotes a patient with some factor contributing to failure to achieve normal locomotion.

In order to compare the results with those found by other authors, a result of 18 or 17 points was considered excellent, 16 or 15 points good, 14 or 13 points fair, and less than 12 points poor. Patients were asked to grade the result subjectively in the same categories.

At the follow-up, radiographs were taken and compared with the immediate postoperative radiographs. Postoperative radiographs of revised hips were compared with those taken immediately before revisional surgery.

A survivorship table including all the arthroplasties was constructed (Dobbs 1980). The chi-square test was used, and $P < 0.05$ was considered significant.

Results

Clinical results

The median follow-up score was 6 for pain, 4 for motion, and 4 for walking (Table 1). All the follow-up scores showed a slight decline compared with 1 year

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Table 1. Grading of pain, motion, and walking according to the Charnley classification preoperatively and at follow-up. N 127

Grading of results	Pain		Motion		Walking	
	Preoperatively	Follow-up	Preoperatively	Follow-up	Preoperatively	Follow-up
	n	n	n	n	n	n
1	92	2	37	3	22	10
2	22	9	40	15	23	18
3	10	6	28	33	43	27
4	2	23	18	25	26	28
5	–	24	4	12	13	25
6	1	63	–	39	–	19

Table 2. Median score and ranges preoperatively, 1 year postoperatively, and at follow-up according to Charnley. The number of excellent (17–18), good (15–16), fair (13–14), and poor (≤12) results are shown

Group	Preoperatively				1 year				Follow-up				Follow-up			
	P	M	W	T	P	M	W	T	P	M	W	T	Excellent	Good	Fair	Poor
A	1 (1–4)	3 (1–5)	4 (2–5)	8 (5–11)	6 (4–6)	6 (3–6)	5 (2–6)	16 (12–18)	6 (2–6)	4 (3–6)	4 (3–6)	15 (8–18)	6	6	3	9
B	1 (1–6)	2 (1–5)	3 (1–5)	6 (3–12)	6 (2–6)	5 (1–6)	4 (2–5)	14 (9–18)	5 (1–6)	4 (1–6)	4 (1–6)	13 (6–18)	8	12	8	30
C	1 (1–3)	2 (1–5)	2 (1–5)	5 (3–9)	6 (3–6)	5 (3–6)	4 (1–6)	15 (9–18)	6 (1–6)	5 (2–6)	3 (1–6)	13 (5–18)	7	9	8	21
A, B, C	1 (1–6)	2 (1–5)	3 (1–5)	6 (3–12)	6 (2–6)	5 (1–6)	4 (1–6)	15 (9–18)	6 (1–6)	4 (1–6)	4 (1–6)	13 (5–18)	21	27	19	60

P = pain, M = motion, W = walking, T = total

postoperatively. The scores for walking were highest in group A and lowest in group C (Table 2).

Most had been gained with respect to pain, with an increase in the median score from 1 to 6; two thirds of the hips were either painless or caused negligible intermittent pain compared with 89 percent at the 1-year examination. Twenty percent of the patients had pain after activity, which disappeared rapidly at rest. There were two hips with severe pain.

A summation of the points for each hip yielded the following overall results: 38 percent of the hips were graded as good or excellent, 16 percent fair, and 46 percent poor. In contrast to these figures, 58 percent of the hips were graded as excellent by the patients, 32 percent good, 8 percent fair, and 2 percent poor.

Complications

Of 238 hips, 40 (17 percent) were revised. Two hips were revised owing to infection and one secondary to a femoral fracture complicated by infection 2.5 years postoperatively. The remaining 37 prostheses were removed because of pain with or without radiographic radiolucency or migration and replaced by cemented Lubinus or Stanmore prostheses.

There were 16 superficially infected hips, and six hips were deeply infected. Four hips dislocated, two of them a few days after the operation and two several years postoperatively. There were no deaths associated with the operation.

Radiographic findings

Upon reviewing the radiographs of the 37 revised hips before revision, we found that six hips had been revised on the complaint of pain only; there were no radiographic signs of loosening. However, these six hips were found to be loose peroperatively. Of the remaining 31 hips, three hips had a radiolucent zone exceeding 2 mm around the components. In 10 hips a migration exceeding 5 mm of the components had occurred, and in 18 hips there was both a radiolucent zone exceeding 2 mm and a migration exceeding 5 mm. Of the 127 hips seen at follow-up, 47 hips had no radiographic radiolucency or migration, in 3 hips a radiolucent zone exceeding 2 mm was seen, and in 50 hips only migration was observed. In 27 cases, there were both migration and radiolucency.

When comparing the radiographic findings between the two groups and excluding hips that had been removed because of infection, we found that the number of hips with radiolucency was higher among hips where the prostheses were ultimately removed ($P < 0.001$), as was also the number of hips where both migration and radiolucency had taken place ($P < 0.001$). Migration, however, was not more frequent in the removal group.

Excellent or good results in the follow-up group were more frequent among hips without radiolucency or migration ($P < 0.05$).

Table 3. Survivorship analysis for 238 Ring total hip arthroplasties

Interval since operation (years) x to x + 1	Number at start of interval	Number removed	Number withdrawn	Number at risk	Probability of removal	Standard error	Probability of survival	Percentage of survivors after x years
0–1	238	3	2	237	0.0126	0.0072	0.987	100
1–2	233	4	4	231	0.0173	0.0086	0.983	99
2–3	225	5	3	224	0.0223	0.0099	0.978	97
3–4	217	7	9	213	0.0328	0.0122	0.967	95
4–5	201	4	5	199	0.0201	0.0099	0.980	92
5–6	192	3	7	189	0.0159	0.0091	0.984	90
6–7	182	4	6	179	0.0223	0.0110	0.978	88
7–8	172	1	5	170	0.0059	0.0059	0.994	87
8–9	166	4	3	165	0.0243	0.0120	0.976	86
9–10	159	2	6	156	0.0128	0.0090	0.987	84
10–11	151	2	10	146	0.0137	0.0096	0.986	83
11–12	139	1	5	137	0.0073	0.0073	0.993	82
12–13	133	–	3	132	–	–	–	81
13–14	130	–	3	129	–	–	–	–
14–15	127	–	–	–	–	–	–	–

Average annual probability of removal $\frac{0.2073}{12} \times 100 = 1.72$.

Survivorship

Using a survivorship analysis (Dobbs 1980), in which removal was chosen as an end point and in which it was assumed that withdrawals (patients who had died or were lost to follow-up within the given interval) survived half the interval, we found that the overall probability of survival was 81 percent after 12 years. The average annual probability of removal was 1.7 percent (Table 3).

Discussion

Our results confirm that the main benefit of total hip replacement is the elimination or considerable reduction in pain. Range of motion and walking ability were only moderately improved (Jinnah et al. 1985, Simesen 1980, Lord and Bancel 1983). Decreasing scores for motion and walking are also to be expected with increasing age and observation times. The number of excellent and good results may therefore vary considerably in studies with different observation times. This partly explains why the number of excellent and good results in our study seems lower than what was found in other studies with a shorter observation time (Halley and Charnley 1975, Ring 1978).

The high rate of deep infection (2.5 percent) in our study may be explained by the fact that for some years prophylactic antibiotics were not used routinely, and for several years the orthopedic operation rooms were shared with general surgeons.

Revision represents a considerable problem in all types of total hip prostheses (Charley 1972, Lord and Bancel 1983, Andrew et al. 1985 Chafetz et al. 1985). Radiolucency and migration are frequent radiographic findings associated with loosening of the implant subsequently leading to revision (Simesen 1980, Morscher 1983, Hamilton and Joyce 1986, Older 1986).

The problem is, however, whether the same criteria for loosening can be used in cemented and uncemented hip arthroplasties, especially in cementless implants that are not designed for bony ingrowth. Ring (1978) in a study of 1,808 Ring arthroplasties found that there was no constant association between the radiographic changes around the implant and the appearance of symptoms. He therefore concluded that the concept that loosening of a component can be identified radiographically is false.

Few would remove an implant from a painless hip. On the other hand, severe pain may lead to implant removal in spite of the absence of radiographic changes. When looking for a possible correlation between loosening and radiographic changes, it therefore seems more relevant to compare radiographic findings between a group of patients where the implant was actually loose at revision and a group of patients in whom the implant had not been removed.

We found that radiolucency was more frequent in hips where the implant was subsequently removed, whereas there was no difference between groups as to migration of the implant. Moreover, excellent or good results in the follow-up were more frequent when there were no radiographic changes. This indicates that radi-

olucency is correlated with loosening even in cementless hip arthroplasties. Migration may lead to limping and decreased motion and therefore reduced the score.

Morscher (1983) and Cameron (1986) have found that good primary anchoring is mandatory in cementless arthroplasties in order to avoid loosening. This may be accomplished, e.g., by designing prostheses for bony ingrowth or by designing several options for stem size. Neither was the case with the Ring prosthesis in this study, and it is possible that one of these alternatives might have prevented some of the loosenings or migrations.

Survivorship tables give a possibility for standardized evaluation of results of total hip replacement. Dobbs (1980) found in his study on 248 Stanmore metal-on-plastic prostheses that the overall probability of survival after 8 years was 88 percent and the average annual probability of removal 1.5 percent. The corresponding figures in our study were 86 percent and 1.9 percent, respectively. Jinnah et al. (1986) in their study of 149 Charnley metal-on-plastic prostheses found an overall probability of survival after 10 years of 83 percent, which is identical to what we found for the Ring prosthesis.

We conclude that the long-term survival of the uncemented metal-on-metal Ring total hip arthroplasty is comparable to the survival of some of the commonly used cemented metal-on-plastic prostheses. Like cemented prostheses, these prostheses do not overcome the problem of loosening.

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