RING UNCEMENTED HIP REPLACEMENTS

THE RESULTS OF REVISION

MARK PATTERSON

From Redhill General Hospital and Dorking General Hospital

Since 1964, 3573 uncemented Ring total hip replacements of all types have been performed; 194 (5.4%) have required revision for infection, loosening or breakage. Of these, 102 were available for review; 81 had satisfactory results five years after operation. These results are better than many of those reported after revision of cemented hip replacements. It is suggested that the absence of cement makes revision easier because bone erosion rarely occurs.

The uncemented total hip arthroplasty developed by Ring has, for the past 20 years, been regarded as a safe and accepted method of treating the arthritic hip (Ring 1968, 1974, 1981), and the long-term results of the metal-on-metal Ring hip replacement (Ring 1978) are comparable with those of a cemented metal-on-metal prosthesis (McKee and Chen 1973).

From 1964 until the late 1970s an uncemented metal-on-metal prosthesis was used, in which a metal cup with a long screw-thread was inserted into the iliopubic bar of bone; this cup matched a femoral component with a fenestrated Moore type of stem. As it became apparent that cemented metal-on-plastic articulations seemed better than metal-on-metal, a prosthesis was designed which incorporated an HDP head (high-density polyethylene) on the usual Moore type of stem and matched this with a metal pelvic cup. The wear of the convex HDP head, however, was sometimes excessive and this type of prosthesis was discontinued in 1977.

The Ring UPM hip (uncemented polyethylene metal) consists of a polyethylene cone-shaped cup (combined with a peg) which matches a solid-stem cobalt-chrome femoral component. Used routinely since 1979, the short-term results (Ring 1983a, b) are comparable with those of conventional cemented hip replacements (Charnley and Cupic 1973) and with other uncemented types (Judet et al. 1978; Lord and Bancel 1983).

The absence of cement makes revision much easier than that with a cemented joint, since bone erosion rarely occurs. In revising the articulation, one may simply

exchange one implant for another, if necessary, compensating for loss of bone length by using an implant with a longer neck and bringing down the acetabulum.

The early results after revision of Ring uncemented hip replacements were previously reported by Jones (1979); this study reports the longer-term results.

PATIENTS AND METHODS

Since 1964, 3573 uncemented Ring hip replacements have been performed at the Orthopaedic Units at Redhill and Dorking General Hospitals: 1797 hips were metal-on-metal articulations, 322 were of the metal acetabulum/polyethylene head type, and 1454 were polyethylene acetabulum/metal head (UPM) hips.

All patients with hip replacements were regularly reviewed by one surgeon; 80% of these patients were more than 60 years old at the time of the original operation, the average age being 65.2 years for metal-on-metal articulations and 68 years for metal-on-plastic joints. The ratio of men to women was 1:3.

From this clinical population, 183 patients with 194 hip arthroplasties required a revision operation (5.4%), and their case notes have been reviewed by the author. Of these, 102 hips are still currently being reviewed, and 80 hips, although no longer being reviewed, have also been included in this study. Of the original operations, 93% were for osteoarthritis, 4% for rheumatoid arthritis and 3% were performed after fracture or osteotomy. The average length of time between hip replacement and revision was 4 years 3 months; 101 of the 182 (56%) had revision within three years. Twelve implants were removed for infection or gross loosening, leaving a Girdlestone excision arthroplasty.

Of the metal-on-metal hips, 156 (8.7%) needed revision; this group had the longest period of follow-up (5 to 20 years). The group with plastic femoral heads presented special problems with excess wear of the convex HDP heads in some cases; 28 (8.7%) needed

M. Patterson, FRCS, Orthopaedic Registrar
Orthopaedic Research Units, Redhill General Hospital, Earlswood
Common, Redhill, Surrey RH1 6LA, and Dorking General Hospital,
Horsham Road, Dorking, Surrey RH4 2AA, England.

Requests for reprints should be sent to M. Patterson, 17 The Hamlet,
Champion Hill, London SE5 8AW, England.

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Table I. Causes of failure of Ring uncemented hip replacements requiring revision

Causes of failure	Type of prosthesis			Total
	Metal-on-metal	HDP head	UPM	
Loose femoral component	38	5	5	48
Loose acetabular component	22	3	1	26
Loose acetabular and femoral components	52	17	1	70
Infection	10			10
Broken acetabular component (cup screw)	9			9
Broken femoral component	11			11
Malposition	1			1
HDP wear		3		3
Ankylosis	1			1
Dislocation	2			2
Metal sensitivity	3			3
Femoral fracture			2	2
Unexplained	7		1	8
Total	156	28	10	194

revision. Only 0.7% of the current UPM hips have needed revision, but these, of course, have the shortest follow-up.

Loosening of one or both components and consequent pain was the reason for revision of 144 prostheses: there were 26 loose acetabular components, 48 loose femoral components and 70 with loosening of both. In 20 of the 182 hips reviewed, revisions were needed because of failure of the prosthesis: 11 femoral stems and nine cup screws broke. The other causes of failure are shown in Table I.

Of the 80 revisions no longer under current assessment, information on 66 was available from the notes of their last attendance at a mean follow-up of 4 years 1 month (Table II); for 10, follow-up was for less than one year; and for four, no assessment was made. All hip revision patients are normally seen annually until

they die; inevitably, some patients develop intercurrent disease which makes it impossible for them to attend for routine supervision and these are classified as "subsequently lost to assessment". Inclusion of this group in the review was done in an attempt to determine whether results were significantly different from those still being assessed.

Types of revision. There were three:

1. Removal of both components and replacement with another uncemented joint (Figs 1 and 2).
2. Removal of both components and insertion of a cemented joint (Figs 3 to 7).
3. Removal of both components and replacement with an uncemented acetabular component matched with a cemented femoral implant (Figs 8 to 10).

Thirty revisions were performed with uncemented components, 109 with both components fully cemented, and 35 with uncemented acetabular components and cemented femoral components. Eight revisions did not follow this protocol: one had a cemented acetabular component with an uncemented femoral stem, two had new metal acetabular screw cups, one had the acetabular component tightened, three had replacement of the HDP head and one had a new cone-cup with osseous peg.

Operation. To prevent deep vein thrombosis 500 ml of Dextran is administered during the operation and 350 ml daily for two days after it. Cephalosporin is also given during the operation, after culture swabs have been taken.

The posterolateral incision from the primary replacement is used to approach the joint. The capsule is excised, protecting the sciatic nerve at all stages, and the joint dislocated with bone-holding forceps controlling the neck of the femoral component. A swab is taken for culture. With the older femoral components, an osteotome is passed down parallel to the stem to fracture any bone which may have grown through the fenestrations. After clearing any fibrous tissue at the top of the greater trochanter, a longitudinal force is then applied to the bone-holders still around the neck. Because of the lack of cement, broken femoral stems are usually retrieved easily without needing to cut a window in the femur.

The acetabular component is then removed. The old type of screw-in component can be unscrewed with the introducer, until enough of the screw-shank can be held

Table II. Results of revision of Ring uncemented hip replacements

Assessment	Hips still available for review (102)		Hips lost to assessment (66)*	
	Number (per cent)	Overall	Number (per cent)	Overall
Excellent	62 (60.8)	79.4 Satisfactory	27 (40.9)	77.3 Satisfactory
Good	19 (18.6)		24 (36.4)	
Fair	5 (4.9)	20.6 Unsatisfactory	8 (12.1)	22.7 Unsatisfactory
Poor	16 (15.7)		7 (10.6)	

*See text

Fig. 1

Fig. 2

Figure 1 – Breakage of the acetabular component in an early prosthesis. Figure 2 – The result 10 years after revision: another uncemented Ring prosthesis with oversize components was used.

with bone-holding forceps to obtain purchase for removal.

Earlier pelvic revision consisted of cementing a plastic cone-cup into the prepared acetabulum. Recently a cone-cup with an oversize Freeman osseous peg has been developed for revisions, and this is now in routine use. The iliopubic bar of bone, which held the long screw of the metal acetabular component, is prepared to accept the osseous peg and the cup is punched in firmly. This cup can also be used to revise the UPM peg cup if this proves necessary.

The femur is then prepared to receive either a larger uncemented component or a routine cemented femoral stem. With cement a restrictor and cement gun are used. If there has been considerable femoral neck absorption, a cemented femoral component is usually required in order to regain leg length.

The joint is then reduced and the wound closed with tension sutures. Suction drains are not routinely used. Skin traction is applied for 48 hours and the patient is then mobilised with a frame, progressing to elbow crutches which are used for six weeks.

The patient is encouraged to use a walking stick permanently in order to protect the joint. Follow-up for assessment is arranged at annual intervals and the results of operation are noted as excellent, good, fair or poor (Ring 1968). To be classified as excellent a hip must be painless, have at least 90° of flexion, and 20° of abduction, and the patient must be able to walk without a stick or Trendelenburg gait. If the hip is painless but has less movement or the patient needs a stick, the result is downgraded to good; two adverse features downgrade

the result to fair and more to poor. All hips requiring revision operation are graded poor.

This method of assessment has been used in this research unit for 20 years and has not been altered. Although less precise than other methods, results obtained are comparable (Jones 1979).

RESULTS

One hundred and two patients are still being reviewed, and have been followed for an average of five years (1 to 13 years); the results were satisfactory (excellent or good) in 81 (79.4%) and unsatisfactory (fair or poor) in 21 (20.6%) (Table II). The results comparing cemented with

Fig. 3

Fig. 4

Figure 3 – Breakage of the femoral stem in an early prosthesis. Figure 4 – Results five years after revision with a cemented cone-shaped cup and a cemented Stanmore femoral stem.

Fig. 5

Fig. 6

Fig. 7

Figure 5 – A Ring replacement with a loose femoral stem. Figure 6 – Revision with a fully cemented Stanmore replacement. Figure 7 – Result after 10 years.

Fig. 8

Figure 8 – Ring hip replacement with loosening of the femoral stem and femoral neck absorption. Figure 9 – Revision with a cemented Müller femoral stem and an uncemented acetabulum with an oversize osseous peg. Figure 10 – Three years after revision.

Fig. 9

Fig. 10

uncemented prostheses at revision are shown in Table III.

The 21 unsatisfactory revisions are listed in (Table IV). Five patients, all of whom had had fully cemented revisions, had residual discomfort and most needed a walking stick; four of these had a loose femoral stem and one had a loose acetabular component, but their discomfort and physical signs were not considered sufficient to justify revision and their results were judged as fair. The other 16 failures were considered poor: nine had had cemented revisions and seven uncemented revisions, and all required further operations. Two prostheses had become infected, 11 had loose components, two had broken femoral prostheses and one patient had unexplained pain. At a mean follow-up of 5.0 years from the second revision only 56.3% remained satisfactory. Two hips were operated on a third time but had poor results. Twelve revised hips failed early (within five years or less); seven were cemented revisions and five were uncemented. After five years there were nine failures: seven were cemented revisions and two were uncemented.

Complications. *Dislocation.* Two hips dislocated in the postoperative period. Both were treated by closed reduction, but one hip dislocated again and needed transplantation of the greater trochanter. Both patients had an excellent final result.

Infection. There were two cases of late deep infection. One prosthesis was removed and the other was treated by a delayed exchange procedure with a poor result. In retrospect, it was thought that both had had wound problems after operation. One wound burst open and organisms were grown; the other leaked but there was no growth on the swab.

Greater trochanter. One greater trochanter became detached but the result was still excellent, with a negative Trendelenburg. One trochanter was transplanted for dislocation (as mentioned above).

Femoral fracture during operation. Three patients suffered fractures of the femur at the time of revision; these were cracks around the shaft rather than a shattering of the femur. All then had cemented femoral prostheses. One fractured calcar yielded a poor result, with the femoral component becoming loose. Two fractured femoral shafts yielded one excellent result and one fair.

Ankylosis. The hip of one patient became almost completely ankylosed after revision; this had also happened after the original hip replacement. The revision had been cemented and had yielded a good clinical result, but there was less than 90° of flexion and radiological evidence of a loose acetabular component.

Revision in patients aged less than 50 years. One hundred and fifty-three Ring hip replacements have been performed on patients under 50 years old. Seven patients with eight hip replacements performed for osteoarthritis needed revision, on average about six years after the first operation. Six patients had loosening of the components

and in two the acetabular component had broken. Follow-up after revision averaged 7 years 8 months; six patients were available for follow-up and all had satisfactory results with no major complications.

Radiographic changes. Changes were noted on the radiographs of 49 of the 102 patients still being reviewed (48%). Two of the 12 uncemented revisions showed absorption of the femoral neck. Forty-six of the 65 fully cemented revision prostheses showed evidence of radiographic change, with frank loosening in 20 and demarcation at the bone-cement interface in 26 (Table V). Only one of the 22 revisions with cemented femoral stems showed loosening of the stem in the radiographs.

DISCUSSION

Overall, 79.4% of 102 revised hips available for review had satisfactory results after an average follow-up of five years. This compares favourably with the findings of Jones (1979), who reviewed revised Ring hip replacements and reported satisfactory results in 81% of patients after a mean follow-up of three years.

There have been many reported results of revision of cemented hip replacements (Dandy and Theodorou 1975; Hunter et al. 1979; Stillwell et al. 1980; Broughton and Rushton 1982; Carlsson, Gentz and Lindberg 1983; Kavanagh, Ilstrup and Fitzgerald 1985; Pellicci et al. 1985). Satisfactory results range from 24% (Hunter et al. 1979) to 83% (Stillwell et al. 1980). The overall results of several cemented series show that 54% of revision operations are satisfactory (James, Hunter and Cameron 1982).

Reports of revision operation of other uncemented series showed satisfactory results in 75% (Judet et al. 1978) and 77% (Lord and Bancel 1983). The present series shows virtually identical results, and all compare favourably with those of revised cemented hip replacements.

Three-quarters of the total number of revision operations were performed for loosening, representing 4% of primary hip replacements requiring revision; a similar figure was found by Simesen (1980), who performed hip replacement "ad modum Ring".

As problems with technique, implant design and friction have been overcome, the overall annual revision rate has dropped from 2.1% in 1971 to 0.5% in 1983. By contrast, it has been suggested that the number of revisions of cemented Charnley or Müller hip replacements would double by the end of this decade (Morscher 1983; Morscher and Schmassmann 1983).

The complication rate after revision hip operation is recognised to be higher than that after primary replacement, and complication rates of 56% have been reported (Amstutz et al. 1982). Complications such as dislocation, infection, fractures and stiffness occurred in 10% of our series of 102 revised hips. Sixteen (15.7%) needed a second revision operation, and two were removed for infection. This compares favourably with the report on

Table III. Assessment of 102 revisions comparing cemented and uncemented implants

Assessment	Cemented acetabular and femoral implants		Uncemented acetabular and cemented femoral implants		Uncemented acetabular and femoral implants		Other
Excellent	39	(78.5)	18	(95.5)	5	(66.7)	0 (33.3)
Good	12		3		3		1
Fair	5	(21.5)	0	(4.5)	0	(33.3)	0 (66.7)
Poor	9		1		4		2
Total	65		22		12		3

Table IV. Reasons for unsatisfactory results after revision in 21 patients

Age at primary THR (years)	Sex	Diagnosis	Years to first revision (2nd revision)	Reason for revision	Type of revision	Reason for unsatisfactory result after revision	Present assessment	Follow-up since last revision (years)
58	F	OA	7	Both components loose	Cemented	Loose femoral component	Fair	13
68	M	OA	2	Loose femoral component	Cemented	Loose femoral component	Fair	13
71	M	RA	7	Loose femoral component	Cemented	Loose femoral component	Fair	2
59	M	Avascular necrosis	1	Both components loose	Cemented	Loose femoral component	Fair	4
74	F	OA	2	Loose acetabular component	Cemented	Loose acetabular component	Fair	5
63	F	OA	4 (5)	Broken acetabular component	Cemented	Unexplained pain	Excellent	10
70	F	OA	2 (12)	Both components loose	Uncemented	Both components loose	Excellent	3
83	M	OA	1 (4)	Loose femoral component	Uncemented	Loose femoral component	Fair	2
67	F	OA	2 (2)	Both components loose	Uncemented	Both components loose	Third revision (poor)	4
77	F	OA	3 (1)	Loose acetabular component	Uncemented	Infection*	—	—
57	F	OA	3 (7)	Both components loose	Cemented	Both components loose	Excellent	5
70	F	OA	3 (1)	Both components loose	Cemented	Loose acetabular component	Poor	12
57	F	OA	1 (3)	Loose femoral component	Uncemented	Infection†	Poor	11
68	M	OA	5 (3)	Loose femoral component	Cemented	Loose femoral component	Fair	7
59	F	OA	2 (8)	Loose femoral component	Cemented	Loose femoral component	Excellent	3
59	F	OA	2 (11)	Loose acetabular component	Cemented	Loose femoral component	Excellent	2
51	F	OA	3 (10)	Broken acetabular component	Cemented	Broken femoral component	Excellent	2
55	F	OA	3 (1)	Unexplained pain	Uncemented	Loose femoral component	Fair	9
63	F	OA	3 (1)	Loose femoral component	Cemented	Broken femoral component	Good	4
54	F	Post-osteotomy	2 (10)	Loose femoral component	Cemented	Loose femoral component	Excellent	2
61	F	OA	1 (4)	Loose HDP head	Uncemented	Loose femoral component	Excellent	3

OA, osteoarthritis
RA, rheumatoid arthritis

* Removed
† Exchanged

Table V. Radiographic changes with cement

	Number
Fully cemented revised hips (65)	
Optimal appearance	19
Loose components	
Acetabular	5
Femoral	14
Both	1
Demarcation at bone—cement interface	
Acetabular	6
Femoral	10
Both	10
Cemented femoral stems (22)	
Optimal appearance	21
Loose component (femoral)	1

McKee-Farrar prostheses in which 23% of the revisions needed excision, 17% became infected, and 60% needed a third operation (Dandy and Theodorou 1975). The better figures in our series can be explained by the absence of cement, the revision being easier, the infection rate reduced and the bone stock preserved. Morscher has pointed out that ingrowth into uncemented porous-coated implants may make their revision just as difficult as that of cemented prostheses, if not more so (Morscher 1983).

Revision in the presence of known infection was performed only once, with a poor result. Infection of the primary replacement is extremely uncommon, but is generally treated by excision arthroplasty. This has not been necessary in the last five years.

Of the various types of revision, those with an uncemented acetabular replacement matched with a cemented femoral stem have given the best results; this is the treatment of choice in the older patient. Both Denham (1973) and Andrew et al. (1985) found that Ring hip revision utilising cemented femoral stems yielded better results.

The results also show that cemented revisions are more likely to fail in time. In the younger patient one should thus strive to retain the uncemented prosthesis for as long as possible and to revise the joint without the use of cement and with bone grafting where necessary.

Assessment of radiographic changes after revision of hip replacement is notoriously difficult, but such changes in the cemented replacements are worth noting, especially since Pellici et al. (1985) found that asymptomatic hips with progressive radiolucent lines are the ones most likely to fail. In the present study 40% of the fully cemented joints showed demarcation at the bone—cement interface, and a further 30% were radiographically loose; 10% of these loose hips remained clinically satisfactory but must be considered the most likely to fail. The mean follow-up for this group with cemented replacements is seven years after revision.

In summary, the results of revision of Ring uncemented hip replacements remain good after five

years: they are better than those reported for revised cemented hip replacements, and the small number of primary replacements needing revision continues to justify the use of uncemented implants.

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