Metal-on-Metal Hip Resurfacing with an Uncemented Femoral Component

A Seven-Year Follow-up Study

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Background: Metal-on-metal hip resurfacing with hybrid fixation has been introduced as an alternative to standard total hip arthroplasty, especially for young and active patients. There are few studies in the literature on the midterm results of cementless femoral side resurfacing. The purpose of this study was to present our seven-year clinical results of a series of twenty cementless metal-on-metal hip resurfacing procedures.

Methods: Between 1999 and 2000, eighteen patients (twenty hips) underwent primary metal-on-metal hip resurfacing with uncemented femoral and acetabular components. One patient was lost to follow-up. This left eleven men and six women, who had a mean age of forty-five years at the time of surgery. Clinical and radiographic examinations were performed prospectively, and the results were analyzed.

Results: The mean duration of follow-up was 7.4 years. There were four revisions, none of which was due to aseptic failure of the femoral component. Two were due to loosening of the acetabular component, one was due to a late hematogenous infection, and one was due to persistent pain despite normal radiographic findings. The mean preoperative Harris hip score was 54 points, and it increased to 94 points at the time of the last follow-up. Radiographic examination of the hips for which the procedure was successful revealed no femoral or acetabular radiolucencies, no migration of any implant, and no osteolysis. The radiographs of one patient (two hips) showed substantial narrowing of the femoral necks (a mean of 12%), which stabilized at three years postoperatively. This patient had a Harris hip score of 100 points for both hips at six years.

Conclusions: This study suggests that cementless femoral fixation may be a viable alternative to fixation with cement in metal-on-metal hip resurfacing. Further study of this concept in larger numbers of patients is warranted.

Level of Evidence: Therapeutic Level IV. See Instructions to Authors for a complete description of levels of evidence.

Conventional total hip arthroplasty may be associated with an unacceptably high midterm failure rate among younger and active patients[1-3]. Recently, some short-term and midterm follow-up studies have suggested that metal-on-metal hip resurfacing may be an alternative for this group of patients. The rate of wear of larger-diameter metal-on-metal bearing surfaces is approximately forty to 100 times lower than that of traditional metal-on-polyethylene implants[4]. Hip resurfacing preserves more normal proximal femoral bone for future revision operations. It potentially results in more normal hip biomechanics because a larger, more anatomic bearing surface structure is utilized, and it eliminates the need for most of the precautions required following hip replacement by decreasing the risk of hip instability. Most patients are allowed to return to an active lifestyle, including participation in sports[5-7].

Several clinical reports on stemmed total hip arthroplasty have shown the long-term survival rates of uncemented femoral implants to be better than those of cemented implants[8-10]. It is well known that the process of cementation results in some surrounding thermal injury and bone necrosis[11-13]. Our hypothesis, therefore, was that the combination of hip resurfacing and a cementless fixation technique might be a more ideal solution.

Appropriate uncemented femoral resurfacing components have not been readily available, primarily as a result of

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manufacturing-related difficulty. So far, only a few short-term reports on cementless hip resurfacing are available[7,14-17]. The purpose of this study was to present our seven-year clinical results of nineteen cementless hip resurfacing procedures with use of custom devices between 1999 and 2000. The femoral implant had a hydroxyapatite-coated bone-ongrowth surface but no porous coating.

Materials and Methods

Institutional review board approval was obtained for this study. The senior author (T.P.G.) started performing hip resurfacing operations in 1999. Between July 1999 and February 2000, a total of twenty procedures in eighteen patients were performed with use of the Corin Cormet 2000 Version-I cementless hip resurfacing implant system (Corin Group, Cirencester, Gloucestershire, United Kingdom) (Fig. 1). After this initial consecutive series of cementless hip resurfacing procedures, the senior author switched to using a cemented femoral component as an investigator in the Corin-sponsored United States Food and Drug Administration Investigational Device Exemption multicenter study on hip resurfacing.

Of the eighteen patients treated with cementless hip resurfacing, one (one hip) was lost to follow-up after three months and was excluded from this study. Therefore, nineteen hips in seventeen patients were evaluated. Patient demographics are listed in Table I. There were eleven men and six women with a mean age of forty-five years (range, thirty-one to fifty-eight years) at the time of surgery. The mean body mass index was 31 kg/m^2 (range, 18 to 38 kg/m^2). The principal diagnoses were osteoarthritis in fourteen hips, developmental dysplasia in three, postinfectious arthritis in one, and rheumatoid arthritis in one.

The implants utilized in this study were the first version of the Corin Cormet 2000, which included both an uncemented femoral and an uncemented acetabular component. These implants were made of high-carbon cobalt-chromium alloy. The femoral component had only a hydroxyapatite coating on a grit-blasted undersurface of the head and a partial hydroxyapatite coating on the proximal part of the stem. The distal part of the stem was polished and uncoated. There was no porous ingrowth surface on the femoral component. In order to prevent rotation between the implant and bone, there were three evenly spaced longitudinal splines on the undersurface of the femoral component. There were five different femoral component sizes (40, 44, 48, 52, and 56 mm) in 4-mm increments. The matching acetabular component had a bone-ingrowth surface of plasma-sprayed cobalt-chromium and a hydroxyapatite coating (a dual coating). In order to prevent relative rotation between the implant and bone, there were two sets of small antirotation splines as well as one short 1-cm-long apical fixation peg on the acetabular component. The acetabular component was equatorially expanded (the diameter at the rim was larger than that at the pole).

Clinical data on all seventeen patients were collected before the operation. Sixteen operations were performed through an anterolateral approach and three, through a posterior approach. (At this point in time, the senior author had not yet decided on his preferred approach for hip surface replacement.) The anterolateral approach, when used, was modified by placing a 3-cm posterior "T" into the fascia lata and then releasing the short external rotators in order to gain adequate exposure. Cysts in the femoral head were filled with processed bone graft. Postoperatively, the patients used crutches with 10% weight-bearing for six weeks and then were gradually allowed to return to their regular activities, including impact sports, without restrictions.

Fig. 1
Corin Cormet 2000 Version-I metal-on-metal uncemented hip resurfacing implant system. (Printed with permission of Corin, Cirencester, United Kingdom.)

Follow-up clinical data (Harris hip scores[18]) were collected at routine intervals. Anteroposterior and lateral hip radiographs were made preoperatively and postoperatively at each follow-up interval and evaluated by the senior author. Narrowing of the femoral neck was assessed with the method of Hing et al.[19].

Results

Four of the nineteen hip replacements failed for reasons that were not related to the fixation of the femoral component. One of the remaining patients, who had had a bilateral replacement, died of unrelated causes approximately 5.5 years after the primary surgery; both implants were functioning well.

The four failures required a revision. One patient (Case 3) was lost to follow-up initially but then returned three years postoperatively with an acute onset of septic arthritis due to hematogenous spread from a chronically neglected infected tooth. At the time of the initial presentation of the septic arthritis, radiographs revealed well-fixed implants. The patient underwent a two-stage revision due to the infection. Another patient (Case 9) had a failure of acetabular bone ingrowth due to a technical error. The femoral component was stable at the time of revision, but the replacement was converted to a cementless standard stemmed total hip arthroplasty with a screw fixation cup twenty-two months after the index operation.

TABLE I Demographic and Clinical Data

Case	Age *(yr)*	Sex	Approach	Duration of Follow-up *(yr)*	Patient Weight *(lb [kg])*	Harris Hip Score *(points)*		Side	Component Size *(mm)*		Diagnosis
						Preop.	Latest Follow-up		Femoral	Acetabular	
1	46	M	Posterior	8.0	250 (113)	58	100	L	48	54	Osteoarthritis
2	42	M	Posterior	7.0	240 (109)	48	93	R	48	54	Osteoarthritis
3*	31	M	Anterolateral	NA	220 (100)	44	NA	R	52	58	Osteoarthritis
4	43	F	Anterolateral	8.3	135 (61)	51	90	L	40	46	Developmental dysplasia
5	48	F	Anterolateral	8.0	140 (64)	59	100	R	40	46	Developmental dysplasia
6	48	F	Anterolateral	7.8	140 (64)	58	100	L	40	46	Developmental dysplasia
7	35	F	Anterolateral	8.3	185 (84)	49	99	R	44	50	Osteoarthritis
8	41	F	Anterolateral	8.0	115 (52)	40	100	R	44	50	Rheumatoid arthritis
9*	45	F	Anterolateral	NA	232 (105)	NA	NA	R	48	54	Osteoarthritis
10	58	M	Anterolateral	8.2	240 (109)	44	69	L	52	58	Osteoarthritis
11*	39	M	Anterolateral	NA	240 (109)	23	NA	L	52	58	Postinfectious arthritis
12*†	32	M	Anterolateral	NA	NA	NA	NA	L	48	54	Osteoarthritis
13	45	M	Anterolateral	6.0	285 (129)	70	96	R	52	58	Osteoarthritis
14†	53	M	Anterolateral	5.5	232 (105)	71	97	R	48	54	Osteoarthritis
15†	53	M	Anterolateral	5.3	232 (105)	71	83	L	48	54	Osteoarthritis
16	53	M	Anterolateral	7.9	165 (75)	66	97	R	52	58	Osteoarthritis
17	41	M	Anterolateral	8.0	210 (95)	41	100	R	52	58	Osteoarthritis
18	55	M	Anterolateral	7.9	236 (107)	52	92	R	48	54	Osteoarthritis
19	47	F	Posterior	7.0	280 (127)	65	98	R	48	54	Osteoarthritis

*Surface replacement failed. †Patient died.

One patient (Case 11) had a history of drug abuse and a chronic infection of the hip prior to the hip resurfacing. At the time of the five-year follow-up evaluation, he reported increasing pain, and radiographs showed a loose acetabular component. There was no evidence of loosening of the femoral component. Seven years after the index operation, he underwent a revision total hip arthroplasty at another institution. At that time, he had a loose acetabular component and severe scalloping of the femoral neck without loosening of the femoral component. The fourth patient (Case 12) had persistent groin and lateral hip pain after the hip resurfacing. The radiographs did not reveal any component abnormalities. This arthroplasty was revised elsewhere after two years, and the patient died from an unknown cause one year after that revision operation. In summary, the analysis of our four failures suggests that none of them were due to aseptic loosening of the femoral component.

The latest follow-up Harris hip scores after the fifteen successful arthroplasties are listed in Table I. The mean preoperative score was 54 points (range, 23 to 71 points), and the mean score at the time of final follow-up was 94 points (range, 69 to 100 points).

One patient (Case 10) had a low Harris hip score (69 points). He also had a well-functioning total hip replacement on the contralateral side and severe spinal stenosis. Radiographs of both hips showed no abnormalities, but he had chronic back pain referred to the lower limbs and that was believed to be the cause of the low Harris hip score.

At a mean of seven years after the surgery, the overall survival rate, with use of revision of any kind as the end point, was 78.9% for this hip resurfacing procedure. When revision due to aseptic acetabular loosening was used as the end point, the survival rate was 89.5%. When revision due to aseptic femoral loosening was used as the end point, the survival rate was 100%.

Radiographic evaluation of the fifteen hips with a successful replacement revealed no femoral or acetabular radiolucencies, no migration of any implant, and no osteolysis (Fig.

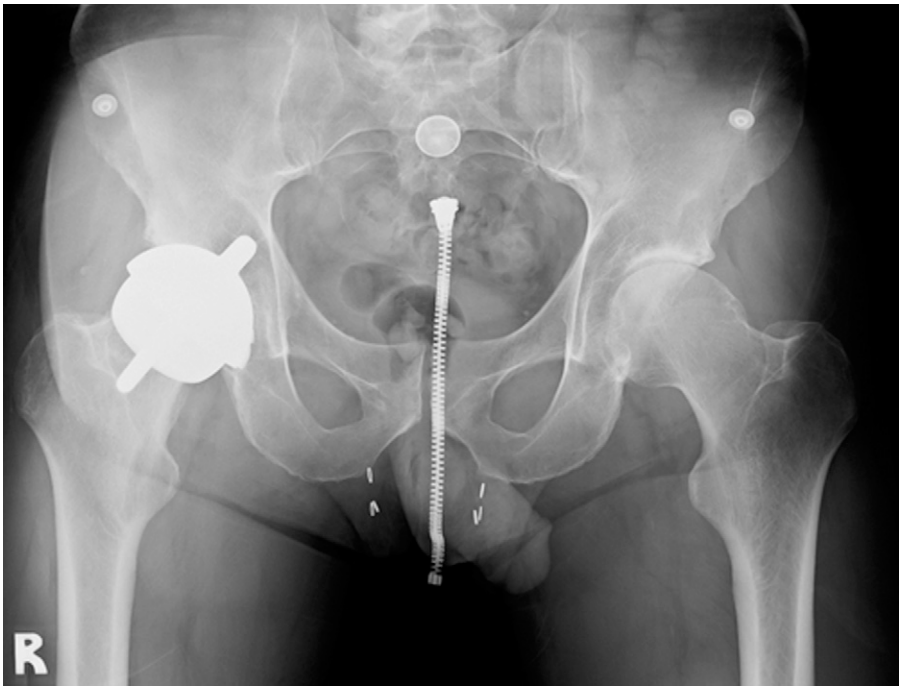

Fig. 2

Anteroposterior hip radiograph made eight years after a cementless metal-on-metal hip resurfacing. No radiolucency, osteolysis, neck narrowing, or component migration can be seen.

2). The change in the femoral neck diameter was <10% in all hips except for two in one patient. That patient had 10% narrowing of the right femoral neck and 14% narrowing of the left femoral neck at three years postoperatively, and the narrowing remained stable at eight years postoperatively. At the time of final follow-up, this patient had a Harris hip score of 100 points.

Discussion

The current standard for hip resurfacing is a metal-on-metal bearing with fixation of the femoral component with cement and cementless acetabular fixation[20]. Several recent studies have demonstrated promising clinical results following use of uncemented femoral components[15,21]. However, those studies were limited by their short-term follow-up. Therefore, we thought that it would be valuable to report the midterm results (at an average of seven years) of cementless hip resurfacing.

Over time, there has been a gradual evolution of methods for fixation of total hip arthroplasty implants to bone. Generally, it has been accepted that the implants must be well fixed for the arthroplasty to be successful. Initially, implants

TABLE II Results of Studies of Cementless Metal-on-Metal Hip Resurfacing

Study	Type of Implant	Years Ops. Performed	Mean Duration of Follow-up *(yr)*	No. of Hips	Survival Rate *(%)*	
					Total	Femoral
Wagner and Wagner[17]	Wagner	1991-1994	1.7	35	85.7	88.6
McMinn et al.[24]						
Group 1: uncemented, uncoated, press-fit implants	Corin and McMinn	1991-1992	4.2	70	87.1	91.4
Group 2: hydroxyapatite-coated implants	Corin and McMinn	1992	3.3	6	100	100
Schmalzried et al.[16]	Wagner	1993-1994	1.3	4	100	100
Lilikakis et al.[15]	Corin Cormet I	2001-2002	2.4	70	97.1	98.6
Current study	Corin Cormet I	1999-2000	7.5	19	78.9	100

were merely wedged (press-fit) into bone. This led to early loosening and clinical failure in many cases. Charnley enhanced mechanical interlocking of the implant with the bone by using methylmethacrylate cement, which improved the results of total hip arthroplasty[22]. Gradually, cementless fixation, usually of an implant with a porous surface, has replaced cementing as the preferred method of fixation. This technique was adopted first for fixation of the acetabular component and then, increasingly, for fixation of the femoral component. Meanwhile, hip resurfacing was developed and has been promoted as an alternative for younger patients because of the high failure rate of traditional total hip arthroplasty in this group[20,23]. Because of a concern about the long-term viability of cement fixation of total hip implants in young patients, the senior author thought that it was logical to pursue cementless fixation on the femoral side of a hip resurfacing.

Two earlier studies on hip resurfacing with an uncemented femoral component showed very poor results because the implants were of the press-fit variety, which did not allow adequate bone fixation[17,24] (Table II). The original McMinn device had an unmodified grit-blasted cobalt-chromium surface without any coating or supplemental fixation. The Wagner device, which has a grit-blasted titanium surface, was theoretically somewhat better, but adequate fixation of these implants was not achieved in one series[17], although Schmalzried et al. reported the success of four of these components at the time of short-term follow-up[16]. The McMinn device fared better with the addition of a hydroxyapatite coating to the grit-blasted cobalt-chromium undersurface of the femoral component; the survival rate in six patients was 100% at approximately three years[24]. There were also several versions of cementless femoral components during the metal-on-polyethylene resurfacing era. Some of these implants were non-ingrowth press-fit designs, and others had a bone-ingrowth surface[20]. Some of the bone-ingrowth components appeared to have ingrown bone, but the results were poor because of osteolysis.

Recently, Lilikakis et al. reported promising results with use of the Corin Cormet 2000 Version-I prosthesis in seventy hips followed for a mean of 2.4 years[15]. They reported a 97.1% rate of survival free of revision and a 98.6% rate of survival of the cementless femoral component. Katrana et al. also reported the short-term results associated with the Corin Cormet 2000 Version-I prosthesis with the ongrowth femoral component and compared them with those associated with a hybrid Birmingham Hip Resurfacing System implant (Smith and Nephew, Cambridge, United Kingdom)[21]. They found no clinical differences between the two methods of femoral fixation at two years postoperatively: the survival rate was 98.6% for the Corin uncemented femoral component and 100% for the cemented Birmingham femoral component. The authors did note less narrowing of the femoral neck in the hips with the uncemented component, which may theoretically be better, but the relevance of this finding is not yet known.

Two to six years after hybrid hip resurfacing, Hing et al. found that 77% of the hips had narrowing of the femoral neck, which was >10% in more than a quarter of them[19]. The narrowing did not, however, progress after three years. Hing et al. found femoral neck narrowing to occur particularly in women and in patients with an anatomically valgus femoral neck. No adverse clinical consequences of the femoral neck narrowing were found after durations of up to six years. Our findings with regard to femoral neck narrowing were similar; in our series, only one patient, a woman with anatomically valgus femoral necks, had 10% narrowing on one side and 14% narrowing on the other side. The narrowing was nonprogressive after three years, and the patient had a Harris hip score of 100 points.

This study had several limitations. The first is that the sample size was small. In addition, the twenty cases included in the study were the senior author's first hip resurfacing procedures and therefore potentially represent his initial learning curve for this technique. In retrospect, we realized that there was one case with a technical error and two cases of poor patient selection. The failures on the acetabular side, in such a small series, cloud the issue of femoral fixation.

To the best of our knowledge, this report presents the longest-term follow-up data available on uncemented femoral components in modern hip resurfacing. This small study is obviously not adequate to show that cementless fixation of femoral components is even equivalent to cemented femoral components at the time of midterm follow-up[25]. Nevertheless, the uncemented femoral components of the fifteen successful arthroplasties were functioning well at a mean of seven years postoperatively, and that does indicate that the concept has some promise. We do not suggest widespread use of uncemented femoral components yet; further study of cementless fixation of improved (particularly porous-coated) components is still needed. ■

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