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ORIGINAL ARTICLE

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Successful hip arthroplasty using cementless titanium implants in rheumatoid arthritis

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Abstract Over a period of eight years, we implanted a total of 76 cementless hip prostheses in patients with rheumatoid arthritis. The clinical results of 47 patients (70 hips) increased from a mean Harris Hip Score of 33 to 85 after an average of 49 months (range 1–11 years). One threaded cup has had to be revised because of loosening, and one stem because of femoral fracture. At the latest follow-up, 88% of Hofer-Imhof threaded cups had complete bone ingrowth (Type 0); 10% had near-complete bone ingrowth with minimal radiolucency in one third of the bone contact area (Type 1), and 2% had radiolucency in two thirds of the bone contact area (Type 2). Hemispherical push-in cups showed significantly more radiolucency around the cup. For the stems (Uni, Zweymüller SL), 83% showed no radiolucency (Type 0); 17% had radiolucency only very proximally (Type 1). Minor remodelling (Type 1) occurred in 60% of the femoral shafts; 30% had moderate femoral density loss (Type 2), and 10% had severe bone loss and cortical thinning (Type 3). There was no correlation between marked shaft atrophy and clinical symptoms. With regard to radiolucency and remodelling, there was no significant difference between the two types of stem used. Cementless hip arthroplasty using titanium implants has an excellent outcome in the medium term.

Keywords Rheumatoid arthritis · Cementless hip arthroplasty · Titanium implants

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Introduction

In rheumatoid arthritis (RA), the bone stock of the hip joint is osteoporotic and weak. This fact, together with steroid medication and faulty joint loading patterns, can lead to central displacement of the femoral head, acetabular protrusion, thinning and fracture of the medial wall, collapse of the femoral head, and destruction of the acetabular dome. RA patients may also have torsion deformities of the femur, as well as contractures [12, 19]. As a result, the choice of implant is of crucial importance. Alternatives to total hip arthroplasties do not exist. By the time radiological changes are seen, synovectomy can no longer help, while earlier synovectomy is unlikely to produce a satisfactory long-term result. While, in adults, RA is less common in the hip than it is in other joints, hip involvement tends to increase in cases of long-standing disease. In the juvenile form of RA, the hip is frequently affected.

While in the upper limb unilateral joint disease can be compensated for by increased use of the contralateral extremity, this pattern is not an option in the hip joint disease. As a result, patients can walk only with difficulty, or they become chair-bound. Often, both hips will be affected, and patterns involving the knees as well are not uncommon. Hip and knee replacement is now a reliable management principle. Consequently, patients may be selected for joint replacement early in the course of the disease, before RA progression has made the state of their joints more challenging. Patients with refractory pain, decreased walking ability and progressive joint destruction should be considered for arthroplasty. The aim of cementless hip arthroplasty in RA patients is to obtain pain relief, to restore joint function, and to allow the patient to walk again. It should be borne in mind that, because of the involvement of other joints, the demands of RA patients on their replacement joints will be less than those of osteoarthritis (OA) patients. Patients with rheumatoid arthritis benefit mainly in terms of pain relief and improvement of function.

Rheumatoid arthritis patients tend to have a higher rate of cup, as opposed to stem, loosening [17, 18]. Whereas

Table 1 Summary of hip arthroplasty data of patients

	Overall value	Values for cup type		Values for stem type	
		Hofer-Imhof (threaded cup)	Harris-Galante (press-fit cup)	Zweymüller SL	Uni
No. of Patients	53				
No. of hips	76	45	31	60	16
No. bilateral	23				
Men	12				
Women	41				
Mean age (years)	60.2 (range 28–81)				
Revised cup	1	1 (loosening)	0	–	–
Revised stem	1	–	–	1 (fracture)	0
Died	2 patients/3 hips	2	1	2	1
Follow-up <12 months	2 patients/2 hips	1	1	1	1
No. followed up	70 cups and stems (92%)	41	29	56	14
Mean follow-up (months)	49 (range 12–131)				

the cup-to-stem revision ratio in OA patients is 1:1, it is 5:1 in RA patients [16]. While the lesser demands made on the hip joint should produce longer implant survival in RA patients, the patterns have been found to converge after 20 years [15].

Materials and methods

From March 1989 to September 1997, a total of 76 primary hip arthroplasties were carried out in 53 RA patients (Table 1). There were 41 women and 12 men; the mean patient age was 60.2 years (range 28–81 years). Ten hips showed acetabular protrusion. Indications for hip arthroplasty were refractory pain, major loss of function, and increasing acetabular destruction.

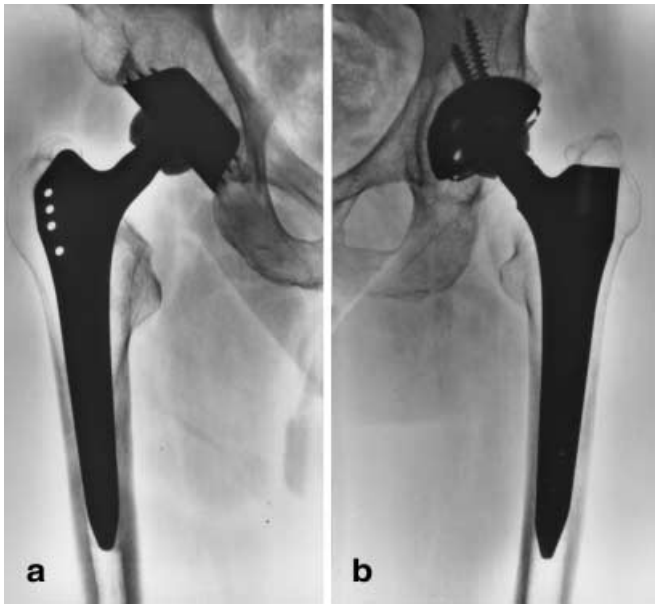

Fig. 1a, b Implants used in this study. **a** Right hip with parabola-shaped Hofer-Imhof cup and Zweymüller SL stem. **b** Left hip with Harris-Galante II cup and Uni stem. All implants are made of CP-titanium or titanium alloy. The straight, rectangular stems are corundum-blasted with a surface roughness (R_a) of 4–6 μm. The surface of the Hofer-Imhof cup has the same finish. The Harris-Galante cup has a fiber-mesh surface

All the bilateral replacements (n=23) were performed as staged procedures. Two types of cementless cups were used: second-generation corundum-blasted threaded devices (Hofer-Imhof, n=45), and hemispherical cups (Harris-Galante I/II, n=31). All the cementless femoral components (Zweymüller SL stems, n=60; Uni stems, n=16) had a straight stem tapering in two planes (Fig. 1).

With ten cups (six Harris-Galante I/II and four Hofer-Imhof devices), bone grafting was carried out to reconstruct the medial wall. The acetabular protrusion site was filled either with a segment of the femoral head or with autologous cancellous bone (Figs. 2, 3, 4), to restore the centre of rotation.

The two cementless stem designs used in this study were measured in both planes and found to differ only slightly, in the proximal part.

Surgery was performed under vertical laminar flow conditions, and using body exhaust suits. Single-shot prophylaxis with second generation cephalosporin antibiotics was given immediately preoperatively.

Follow-up assessment was performed using the Harris Hip Score (HHS) [9]. The minimum follow-up period was 12 months; the longest was 131 months. Two patients (three implants) died; two patients (two implants) had a follow-up of less than 12 months, or could not be followed up, partly because of their poor general health.

Postoperative comparative hip radiographs were obtained before discharge. These radiographs were screened for cup migration. For the threaded cups, radiographs were taken at a craniocaudal angle of 20°, for accurate visualisation of the threads. Cup zone assignment was carried out as described by DeLee and Charnley [6].

The extent of the *radiolucent lines along the cup-bone interface* (Fig. 5) was classified as follows:

- Type 0, no radiolucency
- Type 1, radiolucent lines on individual threads, in one zone, or up to a maximum of one third of the bone contact area
- Type 2, radiolucent lines along more than one third, but no exceeding two thirds, of the bone contact area
- Type 3, radiolucent lines along more than two thirds, or all along, the bone contact area

Radiolucent lines around the stems (Fig. 6) were classified as follows:

- Type 0, no radiolucency
- Type 1, radiolucent lines along not more than one third of the stem, in Gruen Zones I and VII

Fig. 2a–c Female patient, 69 years. **a** Rheumatoid arthritic hip with slight protusion. **b** Protrusion filled with cancellous graft. Postoperatively, there is incomplete bone contact in zone I. **c** At 6.5 years, unchanged cup position, homogenisation of the cancellous graft with sclerotic line in zone II, and radiolucency Type 1 (Hofer-Imhof threaded cup)

Fig. 3a–d Female patient, age 65 years. **a** Marked acetabular and femoral head destruction. **b** Medial wall grafted with cancellous chips. **c, d** Cup (Harris-Galante I) is stable at 39 months (**c**) and 8 years (**d**). The cancellous acetabular graft appears narrower and more uniform in texture, as evidence of medial wall remodelling (**c, d**)

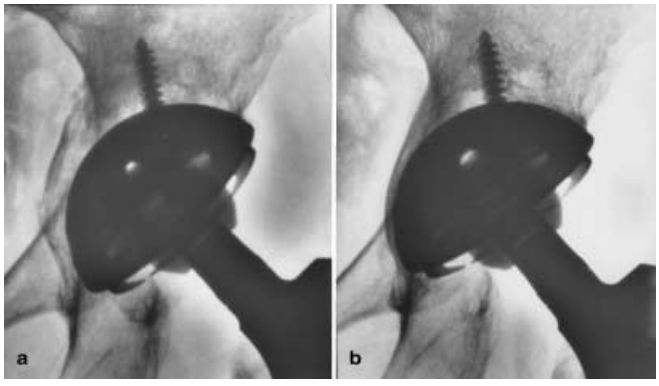

Fig. 4a, b Male patient, 55 years. **a** Moderate protrusion filled with cancellous graft. **b** Regression of acetabular protrusion after 13 months. The cancellous medial wall graft appears narrower and more uniform in texture (Harris-Galante II)

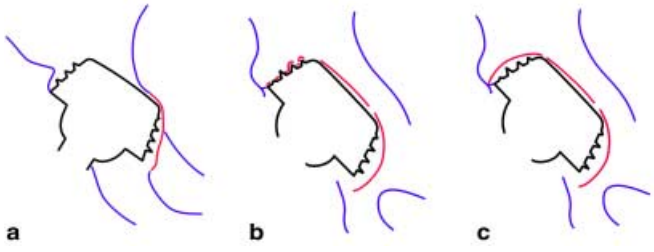

Fig. 5a–c Classification of radiolucency of cup. **a** Type 1, radiolucency in one zone, or only in one third of the cup. **b** Type 2, radiolucency in two zones, or along two thirds of the cup. **c** Type 3, complete radiolucency around the cup. Type 0, no radiolucency (not shown)

- Type 2, radiolucencies along more than one third but less than two thirds of the stem, in Gruen Zones I, II, VI, and VII
- Type 3, radiolucencies along more than two thirds or all along the stem

Bone remodelling around the stem (Fig. 7) was graded as follows:

- Type 0, bone pattern unchanged, no remodelling
- Type 1, minor bone remodelling; predominantly at the calcar (zone VII) and zone I
- Type 2, moderate loss of cortical density, diffuse remodelling in the entire shaft
- Type 3, marked femoral atrophy, with severe remodelling, and radiographic evidence of cortical thinning

Forty-seven patients, with a total of 70 cementless hip arthroplasties, could be clinically and radiologically assessed after a mean of 49 months (minimum 1 year, maximum 11 years).

Two patients, who had received a total of 3 hip replacements, died within the first postoperative year. One of them was a 69-year-old female patient who died postoperatively from general health problems that had been present before surgery. Two patients (two implants) were lost to follow-up.

The postoperative complications observed were two dislocations and one embolism.

To date, one threaded cup (Hofer-Imhof) has had to be revised because of loosening. At arthroplasty, extensive superior and medial bone grafting had been performed. Revision was carried out at 55 months. This gives a revision rate for the threaded cups of 2.4% (one cup out of a total of 41). Also, one stem revision (of a Zweymüller SL femoral component) has been carried out, for a traumatic femoral fracture. The patient was revised to a cementless Wagner revision stem. This gives a stem revision rate of 1.7% (1 stem out of a total of 60); there were no infections.

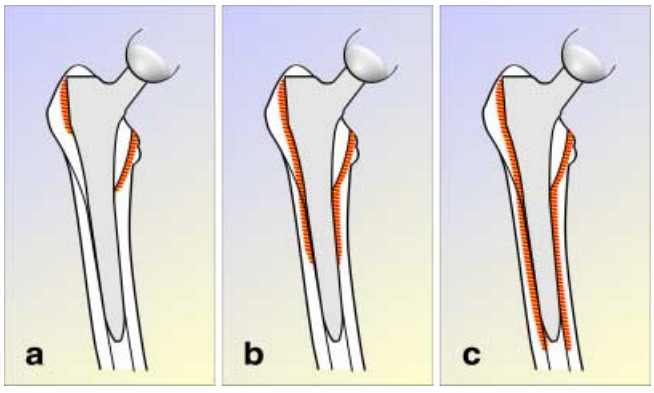

Fig. 6a–c Classification of radiolucency of stem. **a** Type 1, radiolucency along one third of the stem (two zones). **b** Type 2, radiolucency along two thirds of the stem (four zones)**. c** Type 3, complete radiolucency around the stem (more than four zones). Type 0, no radiolucency (not shown)

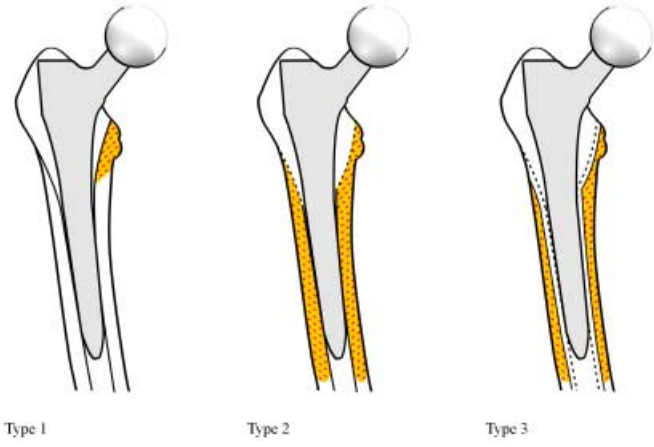

Fig. 7a–c Classification of femur remodelling. **a** Type 1, minor remodelling (zone VII). **b** Type 2, moderate remodelling. **c** Type 3, severe remodelling. Type 0, unchanged (not shown)

The bone contact area of a threaded cup removed from a 66-year-old female patient who died postoperatively was analysed. The cup had been inserted 10 months previously in the contralateral acetabulum. After removal, the bone-implant block was fixed in 7.5% buffered formalin, and radiographs were taken in two planes. The block was then sectioned into horizontal and coronal slices on a high-speed low-feed band saw (Exakt-Apparatebau Hermann, Norderstedt, Germany). The slices were embedded in methylmethacrylate. Slices, 100 µm thick, were cut from the blocks; these slices were ground and microradiographed. Further grinding was performed down to a thickness of about 10 µm, and the sections were polished on a PM2 polisher (Logitech, Glasgow, UK). Staining was done with toluidine blue. The bone contact area along and between the threads was measured separately using an image analysis system (Lucia D, Nikon, Austria).

The bone-implant contact index (BICI) [3, 8] was used to describe the area of implant along the threads and between the threads in direct contact with bone.

Statistical analysis

Categorical data were evaluated using Pearson's chi-square test and Fisher's exact test. Student's *t*-test for paired and unpaired samples was used for comparison of means.

Results

Clinical assessment

Only a few patients (*n*=9, approximately 13%) had minor symptoms in the region of the hip (mean HHS pain score 43 points, range 10–44). Overall, the mean HHS score increased from 33 points (range 7–59) preoperatively to 85 points (range 43–100) postoperatively (Table 2).

Radiological assessment

Cup radiolucency (Table 2)

Of the Hofer-Imhof threaded cups, 36 of 41 (88%) showed Type 0 (complete) osseointegration (Fig. 8); four cups (10%) had Type 1 osseointegration (Fig. 2), and one cup (2%) had Type 2. There was a slight change in the position of two cups that had been used with bone autografts for the management of acetabular protrusion. Since these cups did not migrate any further, and the patients were pain-free, revision was not considered necessary.

Of the hemispherical Harris-Galante I/II cups, 18 of 29 (62%) showed Type 0 osseointegration (Figs. 3, 4); ten cups (34%) had Type 1 osseointegration, while radiolucent lines in two of three zones (Type 2) were seen in only one hip (3%). None of the cups had moved.

Of the ten cups that had been implanted with additional bone grafting, all showed remodelling of the medial wall, with reduction of the protrusion. After as little as 1 year, the graft appeared to be well incorporated. Radiological assessment showed consolidation or reconstruction of the medial wall in all cases (Figs. 2, 3, 4).

Femoral radiolucency (Table 2)

For the stems (Uni and Zweymüller SL), 83% showed no radiolucency (Type 0); 17% had radiolucency only very proximally (Type 1).

Femoral remodelling (Table 2)

For the most frequently used stem design (Zweymüller SL, Figs. 1, 9, 10), 33 of the 56 stems (58%) had Type 1 remodelling; 16 (28%) had Type 2 (Fig. 9), while 7 (14%) had Type 3 remodelling (Fig. 10).

Osteolysis

One cup with minor eccentric position of the cup showed osteolysis in zones I and VII of the femoral shaft.

Table 2 Summary of results of hip arthroplasty using cementless devices (*HHS* Harris Hip Score, *HO* Brooker's heterotopic ossification classification)

	Overall score	Score for cup type		Score for stem type	
		Hofer-Imhof	Harris-Galante	Zweymüller	Uni
No. assessed	70	41	29	56	14
Preoperative HHS	32.8 (7.3–58.9)				
Postoperative HHS	85 (43–100)				
Pain score	43 (10–44)				
Remodelling (femur)					
Type 0	0			0	0
Type 1	42 (60%)			33 (58%)	9 (64.3%)
Type 2	21 (30%)			16 (28%)	5 (35.7%)
Type 3	7 (10%)			7 (14%)	0
Remodelling – pain score					
Type 0	–	–	–		
Type 1 (*n*=42)	43.3				
Type 2 (*n*=21)	41.9				
Type 3 (*n*=7)	40.4				
Pain score (HHS)				42.1	41.2
Radiolucency					
Type 0 (no radiolucency)	58 (83%)	36 (87.8%)	18 (62%)	47 (83.9%)	11 (78.6%)
Type 1 (1/3)	12 (17%)	4 (9.8%)	10 (34.5%)	9 (16.1%)	3 (21.4%)
Type 2 (2/3)	–	1 (2.4%)	1 (3.5%)	–	–
Type 3 (3/3)	–	–	–	–	–
Heterotopic ossification					
HO 0	40 (57%)				
HO I	27 (38.5%)				
HO II	1 (1.5%)				
HO III	2 (3%)				

Bone contact

The threaded cup that was retrieved from a patient who died 10 months after arthroplasty had 48% bone contact along the threads, 27% between the threads, and 56% at the pole; the mean bone contact of the entire cup surface was 38% (Fig. 11).

Statistical analysis

Comparing the pre- and postoperative status, the difference between scores was highly significant ($P<0.001$). There were no significant differences between the preoperative scores of the stems ($P=0.511$). With regard to radiolucency, there was a significant difference between the two cups ($P<0.05$). There was more radiolucency around the Harris-Galante I/II cups. The results in terms of radiolucency ($P=0.63$) and remodelling ($P=0.30$) of the Uni stems did not differ significantly from the Zweymüller SL ones. While there was more Type 3 remodelling in the Zweymüller SL group, the difference was not statistically significant. There was no correlation between clinical symptoms and marked shaft atrophy (Type 3 remodelling), of the kind known in OA patients [7].

However, heterotopic ossifications were found significantly more often in OA patients ($P<0.01$).

Discussion

Cemented hip arthroplasty in RA is fraught with the problem of mechanical loosening in a substantial number of cases [15]. This is why cementless hip prostheses are being increasingly used.

Cracchiolo and colleagues [5] analysed 40 hip arthroplasties (HG, PCA or AML devices) that had been implanted without cement in 34 patients (mean age 41 years). After 3.7 years of follow-up, 7.5% of the patients had thigh pain. Forty-three percent of the stems and 12.8% of the cups showed radiolucent lines; however, there was no completely surrounding line of radiolucency. Stem subsidence was seen in two hips. In spite of excellent bone contact, there was cup migration. In 8.1%, there was femoral fracture, and internal fixation was necessary in two cases; all the fractures healed, but two showed subsidence, which was attributed to the poor quality of the bone stock. One patient with a femoral fracture showed radiolucent lines in three of the seven zones.

Thickening distal to the stem tip with diaphyseal hypertrophy, and proximal resorption were considered to be

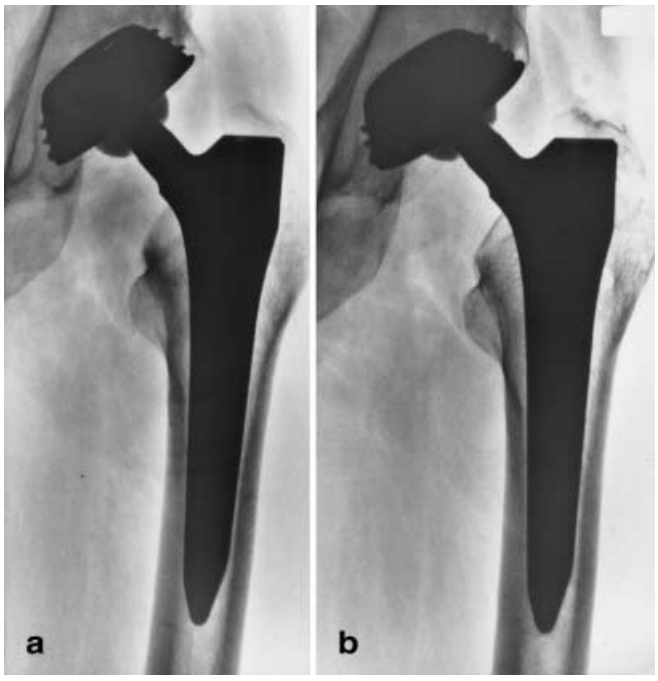

Fig. 8a, b Male patient, 56 years. **a** Immediately postoperative, incomplete bone contact at the Uni-stem in zones II and III on the anteroposterior radiograph without any adverse effects on stability and osseointegration postoperatively (radiolucency Type 0, remodelling Type 1). **b** No adverse effects on stability at five years. Newly formed trabecular bone in zone III, indicative of load transfer and osseointegration. At final follow-up, the situation was radiographically unchanged around the Hofer-Imhof cup. No radiolucency (radiolucency Type 0)

Fig. 9a, b Female patient, age 77 years. **a** Incomplete bone contact at the stem laterally, immediately after surgery, without any adverse effects on stability or osseointegration. Moderate rarefaction of the cortical bone (remodelling Type 2). No radiolucency (radiolucency Type 0). **b** At seven years, the situation was unchanged around the Hofer-Imhof cup, with trabecular bone formation at the polar curvature and minor bone rarefaction between the threads

evidence of the load transfer pattern; they did not, however, affect the clinical result. Pain relief was the most significant parameter. The less marked improvement in function and activity was attributed to the patients' multiple-joint involvement. Porous-coated cup components were recommended for patients with a minimum life expectancy of 5 years. Because of the better results obtained with the cemented stems, cemented arthroplasty was used for patients with poor bone quality and over 60–65 years. In the authors' opinion, cement is also necessary for cup fixation in the rare patients with very poor bone quality. Cementless implants should be used in younger patients with good bone quality.

Lachiewicz [11] obtained good results with a cementless hip arthroplasty system (Harris Galante, *n*=35) in patients with juvenile arthritis and in adults with rheumatoid arthritis, followed up for 4.5 years. The mean patient age was 41 years. The mean HHS was 91 points, and 86% of patients had excellent or good results. No pain in the hip or thigh was experienced in 31 hips, and there was only occasional or mild pain in four. Neither early nor late infection occurred and none of the hips had to be revised because of loosening. One reoperation was performed because of recurrent hip dislocation; the components were left in situ. The screw-fixed cup did not show any loosening at the longest follow-up of 6.5 years after implantation. Only one cup had a non-progressive radiolucent line in all three zones. Polyethylene wear was observed with only one cup. Thirty-two of the 35 cementless stems showed stable fixation. In three, there was non-progressive subsidence of the stem. However, one of the patients with stem subsidence was symptomatic. Osteolysis around the stem was seen in three cases.

Since the main problem is cup fixation, Munzinger and Drobny [16] advocated a hybrid system. After 5 years, the survival rate of the CLS-cup and of the conical Zweymüller cup was 100%.

In 5 of 21 hip arthroplasties with the CLS cup, Löhr and colleagues [14] observed migration of the cup, but no loosening. Cementless hip arthroplasty was seen as a promising concept for patients with rheumatoid arthritis.

Where there is protrusion in rheumatoid arthritis, the acetabulum should be restored with bone grafting and restoration of the centre of rotation [10], in order to prevent central migration of the cup. The restoration of the centre of rotation is vital, since otherwise cup-loosening will occur.

In our patients, protrusion was present in ten cases. Segments of the resected femoral head, or – mainly – bone chips were used for grafting. Post-arthroplasty, the protrusion was found to have regressed, with narrowing and homogenisation of the cancellous grafts (Figs. 2, 3, 4), resulting in a reconstruction of the medial wall. Two of the threaded cups inserted with medial bone grafting were found to have migrated slightly; one threaded cup in a pa-

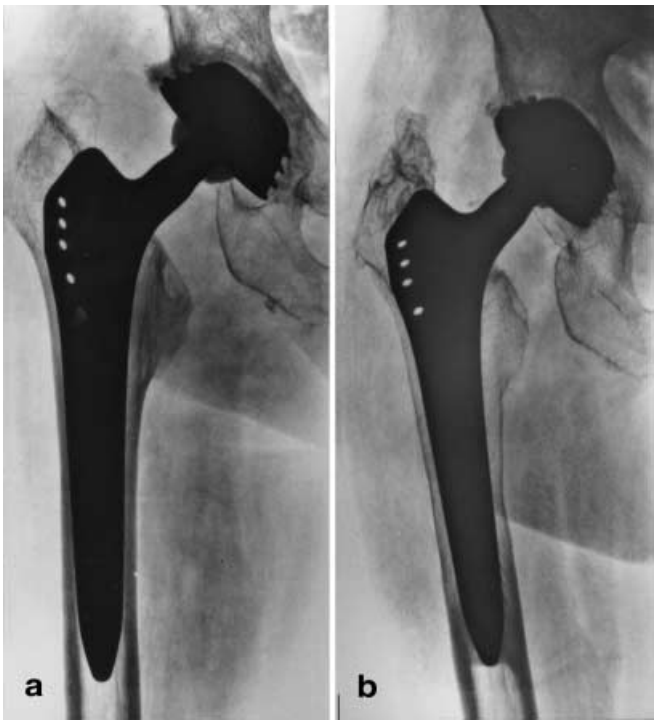

Fig. 10a, b Male patient, age 64 years. **a** Correct postoperative position of Hofer-Imhof cup and Zweymüller SL stem. **b** At seven years, severe atrophy (rarefaction of the cortical bone) of the femur (remodelling Type 3). No radiolucency around the stem (radiolucency Type 0). Lateral and medial trabecular bone formation in zones III and V, indicative of distal load transfer and osseointegration. Unchanged situation around the cup (Type 0)

tient that had required filling of superior and medial cavity defects failed early (at 55 months) from loosening.

Notwithstanding the RA patients' poor bone stock and potentially bone-weakening medications, cementless fixation also appears to ensure more lasting fixation in the acetabular region. Bogoch and colleagues [2] described increased osteogenesis in animal models of rheumatoid arthritis. They found that this newly formed bone could not withstand load transmission. There was, however, higher osteoclast activity with more newly formed bone. The method of fixation did not appear to have any influence. In spite of its osteoporosis-induced lower resistance, the bone exhibited a fairly normal reaction pattern.

In histomorphometric studies of acetabular and femoral shaft bone biopsy specimens taken after arthroplasty in 42 RA and 61 OA patients, Akesson and colleagues [1] found bone trabecular volumes to be essentially the same; however, the RA patients had a higher osteoid volume, larger osteoid and resorption surfaces, and increased bone formation. The increased bone turnover with a higher proportion of non-mineralised tissue as well as increased resorption activity was regarded by these authors to be an important cause of the increased migration rate of the acetabular component and of the higher loosening rates in RA patients.

Trancik and colleagues [20] had doubts about the ingrowth of bone into the implant surface because of inhibition of osteogenesis as the result of steroid treatment; Morscher [15] did not see any problems in this respect.

The histological examination of the periprosthetic bone structures of a 66-year-old female patient who died 10 months after operation showed rarefaction of the entire bone structure, a pattern of trabeculae predominantly radiating towards the implant surface, and foot-like broadening of the trabeculae at the interface with the implant metal (Fig. 11).

The bone contact area, 38% on average, seen around threaded cups is less than that seen in OA patients; it is greater, however, than the area observed in an experimental study [8]. The high bone contact at the threads (48% on average) and at the polar curvature (56% on average) indicates load transfer and osseointegration. Lintner [13] found areas of bone contact around threaded conical cups of 55% after 14 months, 35.6% after 3 years, and 42.3% after 37 months. Although the bone contact area in RA is lower, the cups are fully osseointegrated and stable.

The choice of implant is vital for the long-term results; this is particularly true with regard to the cup. The selec-

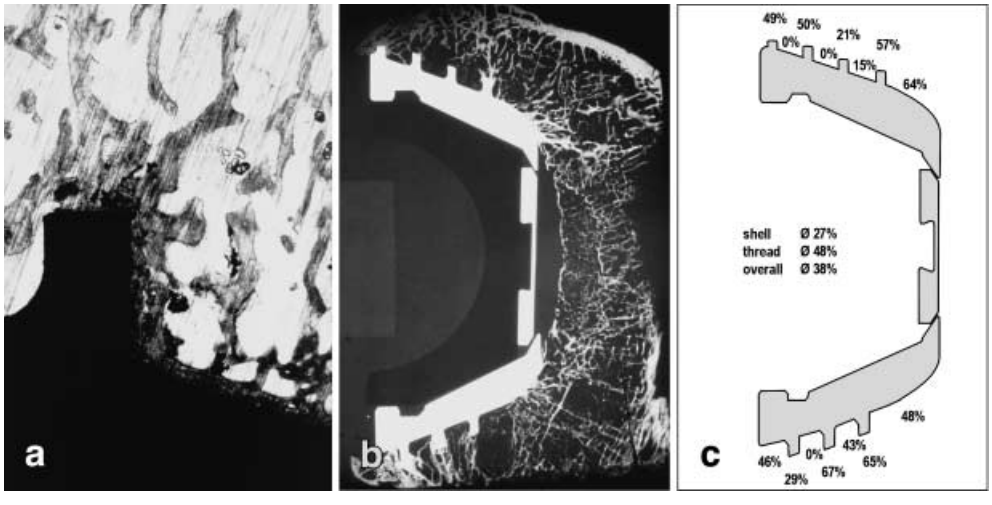

Fig. 11a–c Histological microradiographic examination of tissues from a 66-year-old female patient who died 10 months after arthroplasty. **a, b** Rarefaction of all bony structures; trabeculae arranged mainly in radial pattern towards the implant surface. Foot-shaped broadening of trabeculae at the interface with the metal implant. **c** Bone contact of 48% at the threads and 27% between the threads on average

tion of an appropriate device and the optimal primary implantation and fixation of the implant will reduce the need for secondary operations, with their attendant problems. For hip replacement in RA patients, hemispherical press-fit cups [14] and threaded devices may be used. Primary stability is predicated upon employing a meticulous insertion technique that preserves the sclerotic subchondral bone, since primary fixation comes from the threads biting into the sclerotic bone.

As in our series, the use of cementless implants is independent of age; the mean age of the patients (60 years) was only five years below that of the OA patients. This resulted, however, in low scores (84) in the overall assessment using the HHS. The largely pain-free state of the patients is reflected in the pain scores (mean score 43).

According to Chmell and colleagues [4], RA hips are characterised not only by osteoporosis but also by a disparity of diaphyseal and metaphyseal size, and by proximal rotational malalignment. Where these features are encountered, the use of custom-made prostheses or modular devices should be considered. This permits matching of the patient's metaphyseal and diaphyseal size pattern, and adjustment of neck anteversion. In our RA patients, standard cementless implants could be used in all of the primary hip arthroplasties without any need for modular stem systems.

The recommendation, made by some authors, to use cemented stems is justified by the results obtained with these devices, and on cost grounds. As far as performance is concerned, we have been using the Zweymüller SL stem system since 1987, and the Uni system since 1992; over these periods, there has been no problem with implant loosening.

Whereas, regarding the cup, loosening may not become apparent until some time after implantation, bone remodelling (Types 0–3) around the stem will become obvious within the first year, without any regression thereafter. Bone remodelling patterns that are directed medially and laterally from stem tip (Figs. 8, 9, 10) are evidence of osseointegration.

On the basis of the results so far available for cementless cups [11, 14], as well as our own results showing superiority in terms of loosening rates over cemented cups, the decision should favour cementless implants. Cementless devices may also be used on the femoral side, in patients with poor bone quality, since osseointegration will occur providing that the stem has been implanted with sound primary stability. Cementless implants should also be easier to revise than cemented ones, which tend to leave the femur with a thin, smooth, poorly vascularised shell of bone that does not provide a favourable bed for the revision device.

The results of cementless hip arthroplasty in rheumatoid arthritis patients are very promising. This means that cementless cup and stem systems can, and should, be used in these patients. As regards the shape of the cup to be used, hemispherical implants have been found to be useful in hips with acetabular defects that require bone grafting, while threaded cups may be used where the acetabulum is reasonably sound.

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