Hydroxyapatite-coated total hip replacement in Paget's disease

20 patients followed for 4–8 years

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ABSTRACT – 20 patients, who had had total hip replacements for symptomatic osteoarthrosis secondary to Paget's disease, were followed for a mean of 6 (4–8) years. Proximal hydroxyapatite-coated stems were implanted in all patients. 12 patients received hydroxyapatite-coated, 2 cemented (Muller type) and 6 cementless cups (Morsher type). The mean Harris hip score was 31 (7–40) points preoperatively and 88 (74–100) postoperatively. The radiographic evaluation revealed good stability and fixation using Engh's criteria. One stem subsided early more than 5 mm and then seemed to stabilize. Our findings support the use of hydroxyapatite total hip implants for patients with this disease and osteoarthrosis.

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Paget's disease affects between 2% and 4% of the general population older than 40 years of age (Collins 1956, Pygott 1957, Mercow and Lane 1985). Symptomatic hip osteoarthrosis develops in 40% of these patients and sometimes total hip replacement is required (Merkow et al. 1984, McDonald and Sim 1987, Ludkowski and Wilson-MacDonald 1990). Cemented total hip arthroplasty in patients with Paget's disease of the hip has been reported to result in successful outcome (McDonald and Sim 1987). In deciding to use uncemented hip implants, consideration should be given to the increased rate of turnover of bone. This may have the advantage of rapid bone ingrowth into the bone-metal interface, but the disadvantage of early loosening of the bone-metal interface that is already ingrown.

To our knowledge, there are few reports on porous hip replacements and none on hydroxyapatite hip implants in such patients (Alexakis et al. 1997). We determined the clinical and radiographic outcome in patients with Paget's disease treated with hydroxyapatite-coated implants for hip osteoarthrosis.

Patients and methods

The series included 20 primary total hip replacements performed in 20 patients with Paget's disease (12 men) between 1989 and 1997 at the Carmel Medical Centre, Israel, and the St. George Private and Bankstown-Lidcombe Hospitals, Australia. Their mean age was 72 (62–82) years. The diagnosis of Paget's disease was based on increased alkaline phosphatase levels and typical radiographic findings. In 10 patients, the levels strongly suggested bone formation (>500 IU/L). In 6 patients they were moderately elevated (250–500 IU/L) and in 4, they were around the upper normal limit (120–250 IU/L). Radiographs revealed osseous involvement of the femur alone in 6 patients, the acetabulum alone in 8 and in both the femur and acetabulum in 6 patients (Table 1).

The operation was done under spinal anesthesia. An anterolateral approach was used in 13 patients and posterolateral in 7. The former was used at Carmel Medical Centre with hydroxyapatite-coated Landos stems (Corail, Chaumount, France) in all patients, while hydroxyapatite-coated cups

Table 1. Data on patients and last clinical outcome

Patient No.	Age	Follow-up years	Alkaline phosphatase (IU/L)	Pagetic bone		HA-coated		HHS	
				Femur	Pelvis	Stem	Cup	Pre	Last
1	73	5	650	_	+	O	O	36	97
2	80	6	250	_	+	O	O	34	93
3	69	7	560	_	+	O	O	32	93
4	72	6	150	_	+	O	O	35	100
5	73	4	1020	+	+	O	O	40	85
6	69	5	330	_	+	O	O	30	100
7	82	4	750	+	+	O	O	7	74
8	62	8	600	+	+	L	RM	36	85
9	64	6	200	+	_	L	–	35	83
10	68	8	950	+	+	L	RM	30	75
11	69	6.5	850	+	+	L	RM	30	83
12	74	5	400	+	_	L	–	35	87
13	78	4.5	660	+	+	L	RM	28	98
14	65	7	180	+	_	L	–	40	90
15	63	6.5	550	_	+	L	–	35	88
16	75	6	450	+	_	L	–	31	86
17	75	5.5	220	+	_	L	–	27	85
18	79	5.5	280	+	_	L	–	30	90
19	80	6	700	_	+	L	RM	20	87
20	66	5.5	410	+	_	L	–	33	89

HHS Harris Hip Score, RM Robert Mathys coated H.A., O Omnifit unthreaded cup/stem (Osteonics), L Landos (Corail), – Non HA cup (cemented Müller or cementless Morsher).

(H.A.) (Robert-Mathys, Switzerland) were employed only for Pagetic pelvic bone (except in 1 patient, because the H.A. was not available). 2 cups were cemented (Müller, Switzerland) and 6 uncemented without hydroxyapatite coating (Morsher, Musingen-Berne, Switzerland). At St. George Private and Bankstown-Lidcombe Hospitals, the stems (Osteonics, Allendale, New Jersey) and sockets (Omnifit press-fit Osteonics, Allendale, New Jersey) for 7 patients were hydroxyapatite-coated in all cases (Table 1). Both stem designs had hydroxyapatite coating on their proximal third. This hydroxyapatite coating of all components has a of 50 mm, a porosity of <3%, purity of 97% and crystallinity of 65% after spraying.

Radiographic and clinical follow-ups were at 3, 6 and 12 months and then once a year. The mean follow-up time was 5.7 (4–8) years. The patients were evaluated clinically with the Harris Hip Score and thigh pain score. The patients were asked about the severity of thigh pain. A grading system was used in which a score of 1 point meant no pain; 2 points, mild pain; 3 points, moderate pain; 4 points, occasionally severe pain and 5 points, persistently severe pain.

An anteroposterior view of the lower pelvis was taken at each follow-up with a lateral view of the hip involved. The hydroxyapatite cups and stems were evaluated for subsidence while fixation and stability were assessed with the scale proposed by Engh et al. (1990).

Stem subsidence was calculated by drawing a line along the long axis of the femur. Another two lines were drawn perpendicularly to this—one through the center of the femoral head and the other to the tip of the lesser or greater trochanter. The subsidence was measured as a reduction in the distance between the two perpendicular lines. Subsidence was regarded as significant if it exceeded 5 mm (Malchau et al. 1995).

A reactive line was indicated by a thin, dense line of 1 mm away from the implant metal, with identical bone density on either side of the line. Bone condensation or cancellous condensation was indicated by streaks or spots of bone that bridged the space between the implant and the endosteal surface of the femoral cortex. Cortical hypertrophy or "cortical thickening" was indicated by a smoothly bordered "bump" that disrupted the contour of the femur.

Table 2. Radiographic assessments at last follow-up

Patient No.	Femoral aspect				Acetabular aspect		Heterotopic bone formation (Brooker)
	Calcar atrophy	Osteolysis [a]	Radiolucent line		Radiolucent line (Gruen)	Bone condensation (Gruen)	
			Length, mm	(Gruen)			
1	Mild	+	80	2B,3,4		I	
2	None		65	4,5,6B		I,II	I
3	Mild	+	70	3,4		I	
4	Moderate		85	3,4,5		I,II	
5	Moderate					I	III
6	Mild		55	4,5		I	
7	None		75	2B,3,4		I	III
8	Mild		70	4,5,6B		I	III
9	None		10	4	II	I	
10	Mild	+	65	3,4		I,II	IV
11	None		50	3,4		I	II
12	None	+	40	2B,3	II	I	
13	None		30	4,5		I,II	
14	None		10	4		I	
15	Mild					I	IV
16	None	+	10	4		I	
17	None	+	25	2B,4	II	I	II
18	Mild		75	4,5,6B		I	
19 [b]	Occ. severe [c]		70	3,4		I	III
20	None		10	4		I	I

[a] Calcar cavitation/osteolysis up to 3 mm.
[b] Subsidence more than 5 mm occurred in case 19.
[c] Occ. occasionally

Radiographic evaluation of the acetabular components was made using the method of DeLee and Charnley (1976). Acetabular migration was evaluated by the method of Nunn et al. (1989), using the center of the femoral head and the interteardrop line as references. All measurements were made with a pencil and ruler. Correction for magnification was done by using the diameter of the femoral head.

Prophylaxis for heterotopic bone formation was given to 8 patients. There was no protocol to decide which patient should be given prophylaxis. 5 patients had preoperative treatment with calcitonin and 3 with diphosphonate (EHDP).

Results

Clinical outcome

The preoperative mean Harris hip score was 31 (7–40) points. 1 year postoperatively, the average score was 88 (74–100) points and it was unchanged at the last follow-up. 80 points and over was achieved in 18 patients, including the one with postoperative dislocation (Table 1). No patient had fewer than 74 points.

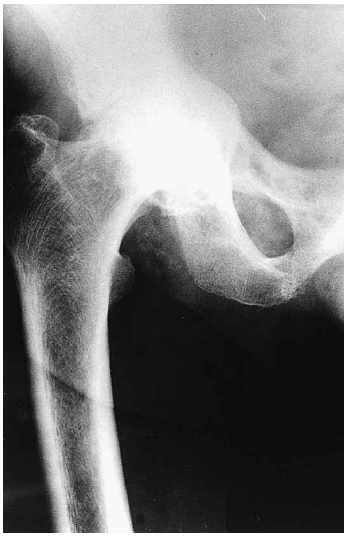
The average thigh pain score was 1.7 points. 10 patients reported no thigh pain, 7 mild, 2 moderate and 1 occasionally had severe pain. None of the patients complained of disabling pain at the last follow-up examination.

Complications

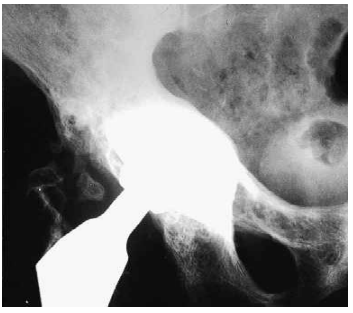
1 patient had 2 postoperative hip dislocations during the first 2 weeks. The first was treated with closed reduction and the second was treated with open reduction and resection of an osteophyte. The prosthesis was left unchanged and the hip has remained stable during the 3-year follow-up.

There were no intraoperative fractures, deep infections or revisions. Heterotopic bone formation was seen in 10 hips. It was marked (Brooker III or IV) in 6 patients (Table 2). Despite this, all patients showed a good range of movement. Only 1 of 8 patients treated with prophylaxis had heterotopic bone formation (Brooker III).

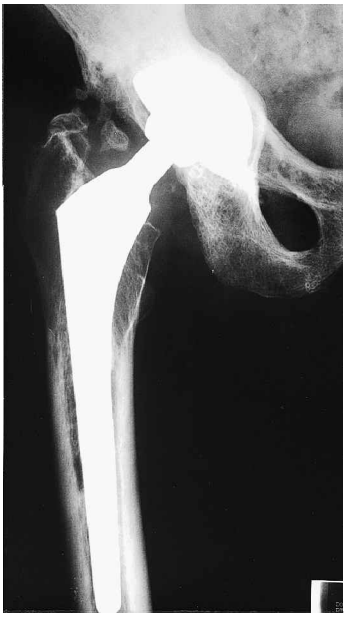
Patient No. 5.



A. Preoperatively, Pagetic femoral and acetabular bone. Note the impressive acetabular protrusio.



B and C. 2 years postoperatively. Bone formation around the socket component in zone 1 without evidence of a radiolucent line. On the femoral aspect, bone formation shown by "bony bridges" around the stem in Gruen zones 2, 3, 4 and 6. Whiteness of the pelvic bone prevents accurate assessment of bone-implant interface.



Radiographic outcome

Femoral stem. 18 stems were in the neutral position and 2 in slight varus. According to the Engh classification, all stems were thought to have proximal bony fixation (Figure and Table 2).

Bone formation, which was shown by "bony bridges" in the space between the implant and the endosteal surface of the femoral cortex, developed after 3–5 months on the medial side of hydroxyapatite-coated stems (Gruen zone 6). At 18 months all the patients had "bony bridges" on medial and/or lateral parts of the hydroxyapatite area (Gruen zones 1, 2, 6 and 7) (Figure).

Reactive lines were seen on the distal part of the stem. None were present around the upper hydroxyapatite-coated part of the stem (Gruen zones 2A and 6A). The reactive line became visible after 2–6 months on the distal parts (Gruen zones 3 and 5) and after the appearance of proximal bone. After 1 year, the reactive lines, in 7 patients, extended proximally up to the lower hydroxyapatite-coated parts (Gruen zones 2B and 6B). At the last follow-up, the reactive lines were present in 16 stems with mean length of 45 mm (Table 2).

9 patients had cortical hypertrophy on one side (asymmetrical type). In 5 patients, the thickenings were seen on the lateral side (Gruen zone 5) in whom 2 had varus stem position. 1 patient had cortical hypertrophy on both sides (symmetrical type).

There were no changes in the interface parts facing the hydroxyapatite-coated part of the stem. Early stem subsidence (>5 mm) occurred in 1 undersized femoral stem, which seemed to stablize. Multifocal or extensive osteolysis was not seen, but moderate cavitation up to 3 mm occurred at the calcar level in 6 patients. No marked calcar atrophy was present.

Acetabular cup. Bone condensation around zone I was seen in all patients after 1–2 years. The hydroxyapatite cup also showed condensation of bone in zone II in 4 patients (Figure and Table 2). After 2.5 years, radiolucencies were found in zone 2 in 3 patients, in whom the cups were cemented. Acetabular component migration did not exceed 3 mm. All cups were placed without bone grafting even in patients with protrusion.

Discussion

Merkow et al. (1984) reported that there is no difference in failure rates after hip arthroplasty in

patients with or without Paget's disease. However, in femoral Paget's disease, radiographic signs of stability and fixation and clinical outcome do not always correlate. The radiographic scores are lower for Pagetic bone than in normal bone, which would predict failure (Merkow et al. 1984, Lewallen 1999). However, the rate of failure for acetabular cups is higher in Pagetic than in non-Pagetic bone (Lewallen 1999).

The outcome of hip replacement in Paget's disease may depend on the type of implant fixation (Merkow et al. 1984, Merkow and Lane 1985, Ludkowski and MacDonald 1990, Lewallen 1999). On the acetabular side, a cemented cup may be indicated because of poor bone quality. In other cases, the uncemented cup may be better because of the inability to achieve a dry bed for cementation. If an uncemented socket is to be used in cases with a high risk of cup migration, it should be fixed by an oversized hemispherical cup, with or without multiple screws (Lewallen 1999). In a protruded acetabulum, an antiprotrusion cage and bone graft are recommended either with cemented or uncemented cups.

On the femoral side, the cementless stem may encounter a biologic problem, since the quality of the sclerotic bone may prevent osteointegration and mechanical problems due to the deformity which prevents a satisfactory fit. In hypervascular Paget's disease, the cementation process may be impaired. Thus, cementless porous-coated implants give a better grip on femoral bone and should be considered as an alternative to a cemented stem.

Reports published in the 1970s, on cemented total hip replacement in Paget's disease with short-term follow-up, were encouraging. Stauffer and Sim (1976) reported on 35 replacements. After a mean follow-up of 2.1 years, the clinical outcome was excellent. Merkow et al. (1984) reported on cemented implant failure in 21 hips after 5 years of follow-up. 2 patients needed revision and 3 had poor or fair results. Ludkowski and Wilson-MacDonald (1990) reported on 49 cemented hip replacements, with a mean follow-up of 8 years. They presented excellent or good results in only two thirds of the patients. Poor results were associated with preoperative radiographic risk factors, including coxa vara, protrusio of the acetabulum and femoral bowing. Long-term follow-up studies of a large number of patients with Paget's disease treated with porous implants are not available.

To the best of our knowledge, no study has reported on hydroxyapatite-coated prostheses in patients with Paget's disease. Hydroxyapatite coating has been shown to facilitate osseous integration in normal bone (Geesink 1990, Bauer et al 1991, D'Antonio et al 1992, Capello et al. 1997). Our series demonstrated no sign of loosening and all patients with femoral and acetabular Paget's disease had evidence of bony ingrowth comparable to data in the literature for non-Pagetic bone with either femoral stems or acetabular cups. The clinical outcome is similar to previous reports on cemented hip replacements. Furthermore, the radiographic evaluation suggests satisfactory long-term outcome. Our series, however, is small and the true long-term performance of hydroxyapatite-coated implants in Paget's disease is unclear.

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