Poor fixation of the Mittelmeier hip prosthesis

A clinical, radiographic, and scintimetric evaluation

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We have evaluated 30 Mittelmeier hips on an average 3.3 years after the operation. Seven hips had been revised because of severe pain and mechanical loosening and one because of fracture of the threaded ceramic cup. Only five of the remaining 22 hips were asymptomatic. There was radiographic migration of the acetabular and femoral components in more than one third of the hips and increased scintimetric values around the femoral component in all but two hips. Unfavorable design of the Mittelmeier prosthesis may be an important etiologic factor contributing to poor component fixation and inferior clinical results.

The early results of cementless fixation of hip prostheses seem inferior to cemented arthroplasties (1); a primary stability is probably difficult to achieve, especially of the femoral component (2).

We evaluated the clinical results and the fixation of the prostheses according to radiographs and scintimetry in a group of patients operated on with the Mittelmeier prosthesis designed for cementless fixation (3, 4).

Patients and methods

Thirty-four Mittelmeier hip arthroplasties in 30 patients were performed at our hospital between 1977 and 1985. Thirty-one were primary arthroplasties and three were revisions after failed surface replacements. The diagnoses were congenital dysplasia (10 hips), primary arthrosis (8 hips), rheumatoid arthritis (5 hips), ankylosing spondylitis (3 hips), sequelae after fracture of the femoral neck (4 hips), and other causes 4 hips). In five dysplastic hips, autologous bone transplantation was used to obtain a better containment of the acetabular component.

At operation the mean age of the patients (16 men and 14 women) was 40 (21–57) years. The average follow-up time was 3.3 (1–9) years. At the time of follow-up, eight hips had been revised; and 3 patients with one prosthesis each were lost to follow-up. One other patient with bilateral Mittelmeier hip prostheses died of pulmonary embolism following the revision of one of the hips. Eighteen patients with 21 prostheses underwent radiographic and scintimetric examinations. One patient (Case 17, Table 1) refused these investigations and was only examined clinically. In addition, preoperative radiographs of 7 of the revised patients were available at follow-up.

At the clinical examination, presence and location of pain, walking endurance, use of a walking aid, and working capacity were recorded.

The radiographic evaluation was done using standard anteroposterior and lateral radiographs. The migration of the acetabular component was measured using the teardrop and Köhler's line as landmarks (5). Loosening was defined as a migration of 5 mm or more in the proximal and/or medial direction. The migration of the femoral component was measured according to Sutherland et al. (5). Femoral component loosening was defined as a distal migration of 5 mm or more and/or tilting into varus or valgus of 2° or more. Radiolucent lines around the femoral component were measured in seven zones (6). The presence of ectopic bone, cortical hypertrophy, and sclerosis was noted. Bone resorption of the proximal femur was assessed by measuring the height and thickness of the medial cortex above the lesser trochanter.

^{99m}Tc-MDP scintimetry was performed in 18 patients (21 hips), and the distribution of radioisotopic activity in relation to the prosthetic components was

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Table 1. Clinical, radiographic and scintimetric observations in 27 patients with Mittelmeier prostheses

1	2	3	4	5	6	7	8	9	10	11	12	13
1	R	21	F	CD	4	N	<5	<5	2–4	+	C+D	2.4
	L			CD	4	N	>10	5–10	<2	+	C+D	3
2	R	43	F	CD	2	Mi*	<5	<5	<2	+	C	1.8
	L			CD	2	Mo	>10	<5	<2	+	C+D	1.8
3	R	40	F	CD	1	Mi	<5	<5	<2	+	A	1
	L			CD	2	Mo*	<5	<5	2–4	+	A	1.1
4	R	52	F	CD	8	Mo*	<5	>10	<2	+	B	2.1
5	R	47	F	CD	2	N	>10	<5	<2	+	B	2.5
6	R	41	M	CD	3	N	<5	<5	2–4	+	B	1.7
7	L	54	M	OA	2	Mi*	<5	5–10	2–4	+	B	1.4
8	L	47	M	OA	2	Mo*	<5	<5	<2	+	C	1.4
9	L	52	M	RA	2	Mi	5–10	>10	2–4	+	C	1.4
10	R	40	F	RA	2	Mo	>10	<5	<2	+	C+D	1.5
11	R	49	F	RA	1	Mo	5–10	5–10	2–4	+	C	1.5
12	L	38	F	RA	3	Mo	<5	<5	2–4	+	B	1.7
13	L	43	M	AS	9	N	>10	5–10	<2	+	C	1.9
14	L	54	M	AS	8	Mi	<5	5–10	<2	+	B	1.5
15	R	43	F	SFFN	3	Mi*	<5	<5	<2	+	B	1.7
16	L	45	M	SFFN	3	Mo*	<5	5–10	2–4	+	B	1.8
17	R	45	M	SFFN	9	Mo*						
18	L	55	M	PA	2	Mo*	<5	5–10	>4	+	B	1.7
19	R	22	F	GCT	5	Mi*	<5	5–10	<2	+	B	1.4
20	R	50	F	OA	8	S	>10	<5	<2	+		
21	R	54	F	SFA	1	S	>10	<5	<2	+		
22	L	40	M	RA	2	S	5–10	>10	<2	+		
23	R	54	M	OA	2	S	<5	<5	<2	+		
24	L	21	F	CD	2	S	5–10	<5	<2	+		
25	L	40	F	SFFN	2	S	<5	<5	<2	+		
26	R	35	M	FHN	1	S	<5	<5	<2	•		
27	L	57	M	OA	4	S						

1. Case.
2. Side.
3. Age at surgery.
4. Sex.
5. Diagnosis.
6. Years between operation and examination/revision.
7. Pain.
8. Migration of the acetabular component (millimeters).
9. Migration of the femoral component (millimeters).
10. Varus rotation of the femoral component (degrees).
11. Periosteal bone formation at the tip of the femoral stem.
12. Visual evaluation of radionuclide activity.
13. Uptake ratio at the tip of the femoral component.

Column 5

CD. Congenital dysplasia.
OA. Primary osteoarthrosis.
RA. Rheumatoid arthritis.
AS. Ankylosing spondylitis.
SFFN. Sequelae after fracture of the femoral neck.
PA. Psoriatic arthritis.
GCT. Giant cell tumor.
SFA. Sequelae after fracture of the acetabulum.
FHN. Femoral head necrosis.

Column 7

N. None.
Mi. Mild.
Mo. Moderate.
S. Severe.
• Patients complaining of mid-thigh pain.

Column 12

A. Normal radionuclide activity.
B. Increased uptake at the tip of the stem.
C. Diffuse increased uptake around the femoral component.
D. Increased uptake around the acetabular component.

Case 20 to 27 revised at follow-up.

evaluated visually. The uptake ratio at the tip of the femoral component was calculated using the femoral diaphysis on the opposite side for comparison in cases with a unilateral prosthesis and the femoral diaphysis below the tip of the prosthesis in patients with bilateral prostheses.

Results

Complications. Undisplaced fractures of the proximal femur occurred in 2 patients. The fractures healed uneventfully. Two hips dislocated 2 and 15 days postoperatively, and 1 patient had a transient sciatic palsy. Sev-

en hips were revised because of pain (Cases 20–26, Table 1) and one because of fracture of the acetabular component (Case 27). At the revision, both components in two hips and only the acetabular or femoral component in two and four hips, respectively, were found to be loose.

Width of radiolucent line		
Zone	< 2mm	> 2mm
1	12	16
2	23	5
3	28	0
4	27	1
5	14	14
6	14	14
7	26	2

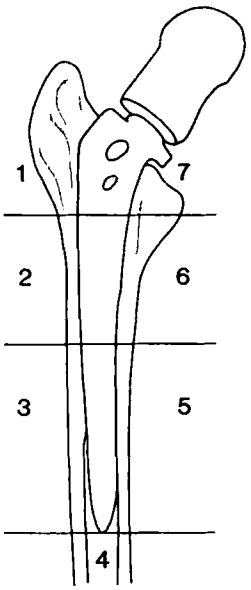
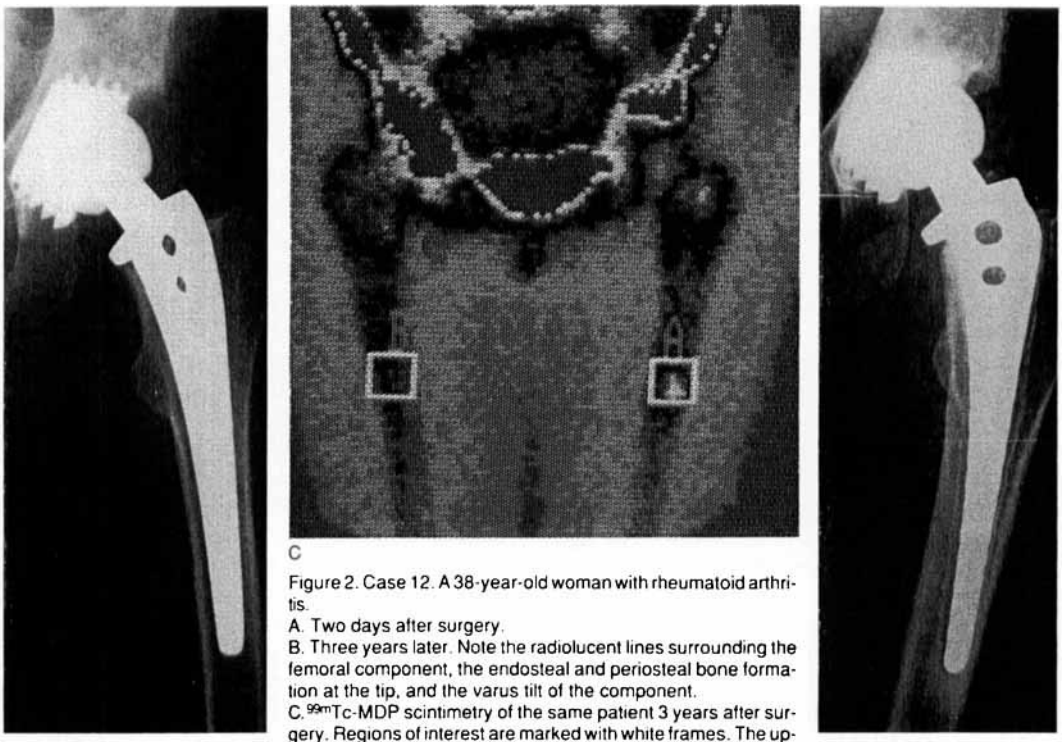


Figure 1. Distribution of radiolucent lines around the femoral component.

Clinical evaluation. Five of 22 hips with the prostheses still in situ at follow-up had no pain (Table 1). Five patients had a walking endurance of more than 1 hour, and 10 less than 20 minutes. Seven patients used walking aids. Ten patients had a reduced working capacity or had retired because of hip disability.

Radiographic evaluation. Eleven of 28 acetabular components had migrated in the medial and/or proximal direction. Migration of three of the acetabular components was associated with fractures of the screws used for fixation of the bone transplanted to the acetabular wall. One threaded cup had fractured after 4 years due to a minor trauma. Distal migration of the femoral component was recorded in 11 hips. At follow-up, eight femoral components had tilted between 2° and 4° and one femoral component more than 4° into varus. Radiolucent lines had developed around all the femoral components. The widest radiolucent lines occurred most often in areas 1, 5, and 6 (Figure 1), consistent with a distal migration and tilting of the femoral component into varus. Hypertrophy of the cortical bone at the level of the tip of the femoral component was recorded in 12 hips. In all the hips, there was sclerosis at the tip of the femoral stem within the bone marrow cavity (Figure 2). Pronounced heterotopic bone formation was recorded in three hips; eight hips had



A C B

Figure 2. Case 12. A 38-year-old woman with rheumatoid arthritis.
A. Two days after surgery.
B. Three years later. Note the radiolucent lines surrounding the femoral component, the endosteal and periosteal bone formation at the tip, and the varus tilt of the component.
C. ^{99m}Tc-MDP scintimetry of the same patient 3 years after surgery. Regions of interest are marked with white frames. The uptake ratio A:B was 1.7.

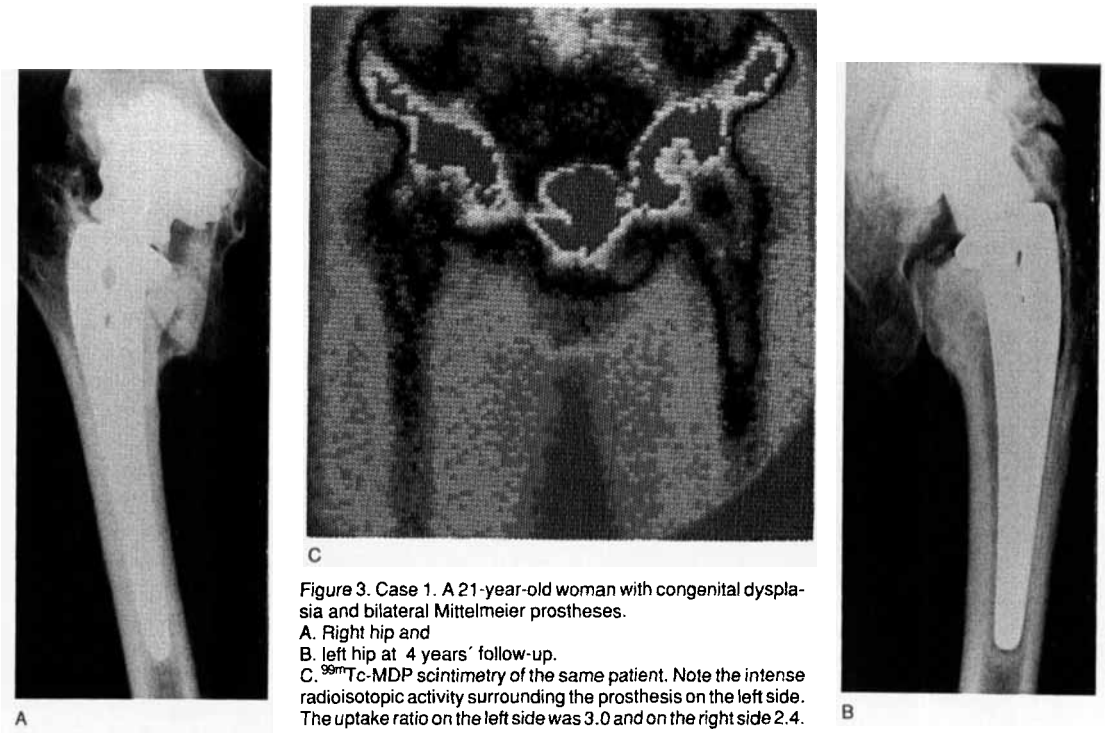


Figure 3. Case 1. A 21-year-old woman with congenital dysplasia and bilateral Mittelmeier prostheses.
A. Right hip and
B. left hip at 4 years' follow-up.
C. ^{99m}Tc-MDP scintimetry of the same patient. Note the intense radioisotopic activity surrounding the prosthesis on the left side. The uptake ratio on the left side was 3.0 and on the right side 2.4.

minor heterotopic bone formation. Bone resorption of the proximal femur between 3 and 5 mm was measured in 5 hips.

Scintimetric evaluation. There was increased uptake in 19 hips (Figure 3). The activity ratio at the tip of the femoral component was increased in 19 hips and close to unity in only two hips.

Discussion

Poor results of the Mittelmeier prosthesis have been reported previously (7, 8, 9, 10) indicating that the design should be blamed rather than the operative technique.

Radiographically, there was poor fixation of the prosthetic components. More than one third of the acetabular and femoral components had migrated more than 5 mm. According to the radiographic criteria of Engh et al. (11), 16 of the femoral components still in situ in our series were unstable, and five femoral components had a"stable fibrous fixation."

Increased radionuclide activity at the tip of the stem in patients with cementless Zweymüller and Lord prostheses have been reported associated with hypertrophy and/or sclerosis within the bone marrow cavity in up to 75 percent of the patients (12, 13). Mittelmeier (4) suggested that the formation of new endosteal and periosteal bone in the lower stem region represents a process of secondary fixation, and should not be interpreted as a loosening of the femoral component. Fernandez-Fayren and Bueno (13) noted that the femoral pain reported by the patients disappeared 12 months after surgery, and they suggested that scintimetric uptake and radiographic changes represented stabilization of the femoral stem. Engh et al. (11), on the other hand, regards periosteal hypertrophy near the tip of his cementless prosthesis as an indication of high load transfer and a poor stress distribution in the proximal femur.

Increased radionuclide activity at the tip of the femoral stem has been shown to be a reliable sign of prosthetic migration of a cemented hip prosthesis (14, 15).

Concerning cementless prostheses, Schicha et al. (12) concluded that scintimetric evaluation should be interpreted differently as compared with cemented prostheses. However, Sonne-Holm et al. (16) found no difference in scintigraphic activity between cemented and cementless Moore prostheses during the first year following operation. In our study, 19 of 21 hips had increased uptake at the tip of the stem. All the hips had a distinct sclerosis within the marrow cavity around the tip of the prosthesis, and 9 of these hips had marked cortical hypertrophy in the same area. Increased radionuclide activity at the tip of the femoral component of a hip prosthesis probably indicates movements caused

by excessive load transfer, and thus poor fixation of the prosthesis. If present more than 2 years after the operation, we believe that increased scintimetric activity around the femoral component has the same implications regardless of the use of bone cement or not. The evaluation of the acetabular component is more difficult mainly because of radionuclide activity in the bladder.

The wedge shape of the femoral component of the Mittelmeier prosthesis should facilitate a proximal fixation of the prosthesis. Consequently, the amount of proximal bone resorption was not so pronounced as previously reported with some other uncemented prosthetic systems (17). However, the design of the Mittelmeier prosthesis does not conform to the medullary cavity of the proximal femur, especially not at the isthmus (11), decreasing its ability to counteract rotatory forces (18, 19, 20).

In conclusion, we cannot recommend the Mittelmeier prosthesis because of poor fixation of the prosthetic components as evidenced by residual pain at follow-up, radiography, scintimetry, and a high frequency of revisions.

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