Bank bone grafts in revision hip arthroplasty for acetabular protrusion

Denis A. Dartée, Jaap Huij and Alfons J. Tonino

In 23 revision hip arthroplasties in which acetabular protrusion was encountered, homologous bone grafting was used to reconstruct or reinforce the medial wall of the acetabulum. Loosening of the acetabular component was the cause of the protrusion in all the cases. Postoperative follow-up showed a solid bone socket around the acetabular cup in all the cases and no signs of loosening at 3-years' follow-up.

Crowninshield et al. (1983) published a stress analysis of acetabular reconstruction in acetabular protrusion. In this study, they showed that a more medial placement of the acetabular cup will increase the stress at the medial part of the pelvic wall. By placing the cup more laterally, the stress in the medial part of the pelvis will decrease and thus improve fixation. Azuma (1985) compared the use of cement and bone as means of fixation in patients with congenital hip dysplasias or failed total hip replacements. The incidence of radiographic loosening of the socket was 28 percent in the group with bone grafts and 72 percent in the group without bone grafts. He concluded that the most effective method to prevent socket loosening after total hip replacement in these patients with a deficient acetabulum is to reconstruct the acetabulum with a bone graft instead of bone cement.

In arthroplasty in cases with acetabular protrusion, the use of bone grafting to reinforce the medial wall has proved valuable (Mc Collum et al. 1980, Augereau and Postel 1980, Heywood 1980, Johnsson et al. 1984). In primary hip arthroplasties, autologous bone can be used, but in revision arthroplasties the femoral head is not available for bone grafting. Grafts from the iliac bone have many disadvantages, such as longer operation time, more bleeding, longer postoperative rehabilitation time, and poor quality in elderly and in rheumatoids.

We report on the use of deep-frozen homologous bank bone for reconstruction of the acetabulum, minimizing the use of acrylic cement.

Department of Orthopedics and Traumatology, De Wever Hospital, Heerlen, The Netherlands

Correspondence: Dr. D. A. Dartée, Department of Orthopedics, Ziekenhuis De Goddelijke Voorzienigheid, Walramstraat 23, 6131 BK Sittard, The Netherlands

Patients and methods

Between November 1980 and October 1983, in a group of 22 patients, 23 revision hip arthroplasties were performed (1 patient bilaterally). The group comprised 19 females and 3 males with an average age of

Table 1. Preoperative and postoperative clinical and radiographic observations in 22 patients operated for acetabular loosening with protrusion

A	B	C	D	E	F	G	H	I	J	K	L
1	F	71	a	L	25	38	78	7	Th	MÜ+ER	–
2	F	74	a	R	24	18	80	12	MÜ	Mi	+
3	M	73	a	L	33	39	52	22	MÜ	MÜ+BS	+
	M	75	a	R	26	32	66	10	MÜ	MÜ+BS	+
4	F	60	r	R	58	53	78	4	MÜ	MÜ+BS	+
5	F	84	a	L	35	40	74	7	MÜ	MÜ+MR	–
6	F	67	a	R	32	10	44	27	Mc	MÜ+ER	+
7	F	79	a	R	26	24	44	12	MÜ	MÜ+BS	+
8[a]	F	63	a	R	39	35	30	19	MÜ	MÜ	–
9	F	66	a	R	56	05	44	14	MÜ	MÜ+MR	+
10	F	53	a	L	21	42	62	21	Wa	MÜ+MR	–
11	F	67	a	L	40	23	50	18	MÜ	MÜ+BS	+
12	F	69	a	R	56	41	76	23	MÜ	MÜ+BS	+
13	M	45	r	R	42	28	51	6	Mi	MÜ	+
14	F	69	a	L	35	22	82	9	MÜ	MÜ+BS	–
15	F	61	a	R	29	05	52	13	MÜ	MÜ+BS	+
16	F	68	a	L	35	40	62	10	MÜ	MÜ+ER	+
17[b]	F	77	a	L	38	34	57	38	Mc	MÜ	–
18	F	71	a	L	38	27	79	16	Wa	MÜ+BS	+
19	F	67	a	R	52	45	62	14	MÜ	MÜ+MR	+
20	F	73	a	R	34	11	74	12	MÜ	MÜ+ER	+
21	M	84	r	R	39	22	62	2	MÜ	MÜ+BS	–
22	F	65	a	L	41	34	64	–6	MÜ	MÜ+MR	+

A case number; B sex; C age at revision; D a arthrosis, r rheumatoid arthritis; E side; F months follow-up; G Harris hip score (0–100) preop; H hip score postop; I protrusio (mm); J first prosthesis; K revision prosthesis (Th Thompson, MÜ Müller, Wa Wagner, Mc McKee, Mi Mittelmeier uncemented cup, BS Burch Schneider Ring, MR Müller ring, ER Eichler ring; L trochanteric osteotomy.

[a] Because of deep infection, a Girdlestone resection arthroplasty was required after 3 years.

[b] Follow-up radiographs in this patient show a 2.5-mm radiolucent line without signs of loosening.

69 years. The first arthroplasty occurred at an average age of 60 years. All the patients had protrusion and loosening of the acetabular component; 11 patients also needed revision of the femoral component. In 3 cases, rheumatoid arthritis had been diagnosed (Table 1). Preoperatively, the protrusion was estimated according to the method of Hubbard (1969) by measuring the distance between the Köhler line and the line of the inner base of the acetabulum.

Operation technique

The operation was performed through an anterolateral incision in the supine position. In 16 cases a trochanter osteotomy was performed. The loose acetabular cup with all the cement and debris was carefully extracted until sound cancellous bone was reached. In most of the patients the cement was still adherent to the extracted cup. Swabs were taken for culture. Then, the acetabulum was reamed. In all the cases, there was a medial acetabular wall defect of at least 2 centimeters in diameter. This was filled with a 1–2-cm-thick layer of homologous bone grafts obtained from patients undergoing primary hip arthroplasty for arthrosis or hemiarthroplasty for hip fracture.

In some cases, also the lateral wall of the acetabulum had diminished, and had to be reconstructed with homologous bone grafts. On the medial side of the acetabulum, no metal mesh was used. To keep the bone grafts in place, a metal ring was used in 19 patients (5 Müller, 10 Burch Schneider, and 4 Eichler rings). In all but one, a Müller high-density polyethylene cup was cemented in with Palacos® cum gentamicin. In one patient an uncemented Mittelmeier cup was used. When a trochanter osteotomy was performed, full-weight bearing was not permitted until 6 weeks after the operation. Soon after the revision, pain decreased radically. The patients were seen at regular intervals for radiography and physical evaluation using the Harris hip score.

Results

Case 8 has had a postoperative hematoma after the primary hip arthroplasty followed by a subcutaneous infection, which resolved. Four years later, a revision hip arthroplasty was performed because of loosening of the acetabular component. Peroperative cultures were negative. The patient did very well for 3 years, and the homologous bone grafts were well incorporated. Then, she developed a deep infection. The prothesis had to be removed, resulting in a Girdlestone resection arthroplasty.

No other complications occurred. All the cultured swabs were negative. The mean hospitalization was 36 (14–90) days. In all but 1 case, radiographs showed a

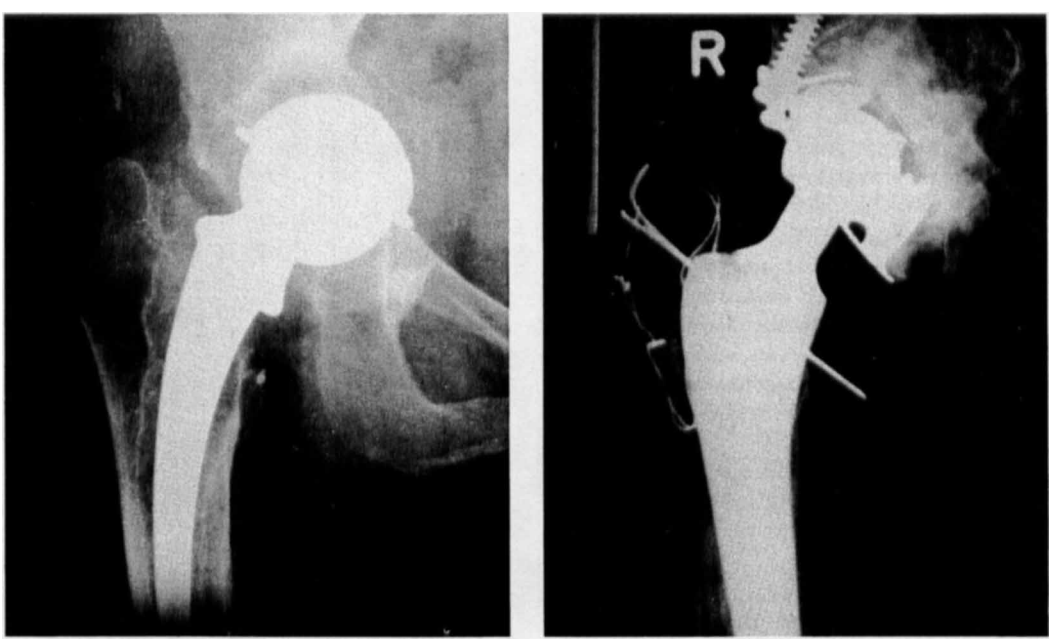

Figure 1. Case 7. Before and after revision hip arthroplasty for acetabular protrusion.

showed a firm bone socket around the acetabular cup - without radiolucent lines at the mean follow-up of 3 years.

Discussion

As seen in practice, the polyethylene cup and the cement mostly form one unit, so that loosening nearly always occurs between cement and bone. Due to movements made by this unit, a mechanically induced bone resorption will commence encouraged by a host versus graft reaction against the cement. The resorption will take place in the whole acetabulum, but mainly on the medial side due to mechanical forces, which eventually cause protrusion. Once protrusion has started, it will increase because of the unfavorable stress conditions. Many methods to reinforce the medial wall in patients with acetabular protrusion have been described. Sotelo-Garza and Charnley (1978) reported successful results using only cement. However, a thick layer of cement will cause more thermal bone injury at polymerization than a thin one (Huiskes 1980, Mjöberg 1986). Moreover, when a large quantity of cement is used, the shrinkage of the cement, a destabilizing factor, will be greater, jeopardizing cup anchorage. In a computer analysis of the stress on the Wagner prothesis, Huiskes et al. (1985) could confirm that these local failures of cup anchorage by thermal bone injury or cement shrinkage are the reason for long-term loosening. A long-lasting result can only be expected when bone is used instead of cement in the reconstruction of the medial wall of the acetabulum (Azuma 1985).

The stress on the medial wall of the pelvis can be reduced by placing the acetabulum more laterally with or without the aid of a metal ring. By fixation of the protrusion ring on the lateral side with screws, as was done in our patients, the stress on the medial wall is decreased even more; Crowninshield et al. (1983) showed that stress could be further diminished by using a metallic protrusion cup or a metal-backed acetabular cup.

These rings have yet a second purpose: viz., the fixation of the homologous bone grafts used in restoring the acetabulum. Harris and Jones (1975) advocated a wire mesh to keep the bone grafts in place. This method probably does not reduce the stress on the medial wall of the pelvis.

We conclude that deep-frozen homologous bone grafts are useful for anatomic reconstruction of the acetabular wall and supplementation of bone stock in patients with acetabular protrusion.

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