Failures after revision hip arthroplasties with threaded cups and structural bone allografts

Loosening of 13/18 cases after 1–4 years

Veijo Hoikka, Dietrich Schlenzka, Jussi Wirta, Timo Paavilainen, Antti Eskola, Seppo Santavirta and T Sam Lindholm[1]

Uncemented threaded, smooth cup acetabular components and structural deep-frozen bone allografts harvested from femoral heads during arthroplasties were used for reconstruction of the acetabulum in 18 revision hip arthroplasties. Autogenous bone grafts were also used in every case. The mean follow-up time was 2.5 (1–4) years. Loosening of the prosthetic component occurred in 13 cases. In 8 cases revision of the acetabular component has already been performed, and 5 cases remain to be reoperated. The use of uncemented, threaded cups in combination with reconstruction of bone defects with structural allografts cannot be recommended in acetabular revisions.

Orthopedic Hospital of the Invalid Foundation, Tenholantie 10, SF-00280 Helsinki, Finland; [1]Tampere University Hospital, SF-33520 Tampere, Finland. Correspondence: Dr. Veijo Hoikka, Snellmanink. 16 A6, SF-00170 Helsinki, Finland
Tel +358-0 1354189. Fax -0 1354386
Submitted 92-07-29. Accepted 93-01-27

Aseptic loosening is a major problem after revision hip arthroplasties (Kavanagh et al. 1985, Murray 1990). Aseptic loosening of a cemented total hip prosthesis is often associated with loss of the bone stock, leading to a need for bone grafting. In cases of multiple revision arthroplasties with massive bone loss, it is not always possible to reconstruct the acetabulum or proximal femur using autogenous bone. Encouraging early results have been obtained after reconstruction of bone defects using allografts during revision hip arthroplasties (McCollum et al. 1980, Harris 1982, Gross et al. 1985, Trancik et al. 1986, Gustke and Grossman 1987, Mallory 1987, Oakeshott et al. 1987, Samuelson et al. 1988).

Since opinions concerning allogenous bone grafting in revision hip arthroplasties apparently still vary, we would like to report our experience with the use of a screw cup in cementless revision hip arthroplasties, in which allogenous bone grafting was used for reconstruction of bone defects in acetabulum.

Patients and methods

17 consecutive patients with 18 hips, requiring bone allografts for reconstruction of acetabular and proximal femoral bone defects during revision hip arthroplasty were included in the study. The operations were performed in the Orthopedic Hospital of the Invalid Foundation, Helsinki, Finland in 1987–1988.

Allograft was used when the bone defects were so extensive that the amount of bone grafts taken from the patient's own iliac bone was not sufficient to reconstruct acetabulum for adequate fixation of a threaded cup. 14 of the patients were women, 3 were men. The mean age was 60 (37–76) years, and the mean follow-up period was 30 (13–50) months. The diagnoses, which had led to primary hip arthroplasty are listed in Table 1. Revision arthroplasty had been previously performed on 10 hips, 3 of which had undergone 2 revision arthroplasties (Table 1). Before the cementless revision arthroplasty, the prosthesis had been removed from 2 of these hips, which were in the Girdlestone state. A lateral approach to the hip, as described by Hardinge (1982), was used during every operation. A titanium smooth screw cup (Biomet) was used in all hips. In all cases, a structural bone allograft was used. The allografts were fixed to host bone with screws or the allograft was wedged between the prosthesis and host bone and no screws were used if the allograft fixation was considered firm (Table 1). The roof of the acetabulum was reconstructed in 18 cases (Table 1, Figure 1). In 4 hips, the medial wall of the acetabulum was defective and a bone allograft was placed at the bottom of the acetabulum (Figure 1). Initial stability of the cup was not tested without allograft, but the stability after reconstruction of the acetabulum with allografts was considered adequate, as there was no detectable motion of the screw cup when tested manually. The allografts were obtained from

Table 1. Details of the patients

A	B	C	D	E	F	G	H	I	J	K	L
1	71	1	21	1	2	3	1,3	1	0	1	21
2	52	1	50	2	1	2	1	1	1	1	50
3	66	1	13	1	1	3	1	1	0	1	13
4	66	1	25	1	1	3	1	1	1	0	25
5	49	1	36	4	1	3	1	0	1	0	0
	50	1	26	4	0	3	2,3	0	1	0	0
6	64	2	28	3	1	3	1	1	1	0	0
7	37	1	25	6	0	3	1	0	1	0	0
8	51	1	39	2	0	3	1	1	1	0	39
9	76	2	28	1	1	2	1	1	1	0	0
10	73	2	33	1	2	3	1,3	1	1	0	33
11	57	1	34	1	0	3	1	1	1	0	0
12	66	1	35	5	2	3	2	1	1	0	35
13	66	1	19	6	0	2	2	1	1	0	19
14	70	1	36	1	0	3	1	0	1	0	0
15	42	1	34	2	1	3	1	1	1	1	0
16	65	1	23	7	0	3	1,3	0	1	0	0
17	65	1	31	2	0	3	1	1	1	0	0

A Case number
B Age at operation
C Sex
  1 female
  2 male
D Follow-up time (months)
E Primary diagnosis
  1 arthrosis
  2 congenital dislocation of the hip joint
  3 femoral neck fracture
  4 rheumatoid arthritis
  5 acetabular fracture
  6 old hip tuberculosis
  7 old purulent coxitis
F Number of previous revision arthroplasties
G Type of loosening of the acetabular component (Gustilo and Pasternak, 1988)
H Site and fixation of the allograft in the acetabulum
  1 roof, screws
  2 roof, prosthesis
  3 medial wall, prosthesis
I Radiographic loosening of the acetabular component
  0 no
  1 yes
J Union of the allograft with host bone
  0 no
  1 yes
K Massive resorption or collapse of the allograft
  0 no
  1 yes
L Revision of the acetabular component during the follow-up time
  0 no
  months to revision

femoral heads during previous hip arthroplasties. The donors met the criteria recommended by the American Association of Tissue Banks (1984). No tissue typing was performed. No special thawing procedures were performed, but the deep frozen allografts were left to thaw in the operation theater during the revision operation after the need for allograft was recognized. Blocks of the size and shape of the defect in the host bone were cut out from the allograft with an oscillating saw and bone nibbler. Autogenous bone from the posterior iliac crest was also used in all cases to augment the host/allograft interface. Smaller bone defects were filled with autogenous bone. The mean intraoperative blood loss was 3380 (1200–7500) mL. The duration of operation averaged 253 (95–375) minutes. Prophylactic antibiotic therapy (flucloxacillin or clindamycin hydrochloride) was given 2 hours before surgery and was continued for 48 hours. Subcutaneous Orstanorm-Heparin was administered for 1 week to prevent thromboembolic complications. Patients were allowed to stand up on the day after surgery and to take some steps, using crutches. Progressive flexion, extension and abduction exercises were also started. Full weight-bearing was allowed 2–9 months (mean 5 months) postoperatively. An anteroposterior and a lateral projection radiograph of the hip were taken with the patient in the supine position 1–3 days after operation. Erect posture and Lauenstein projection radiographs were taken 2, 4, 6, and 12 months postoperatively, and thereafter at each follow-up visit. Host-donor unions and any resorption or collapses of the allografts were evaluated. The radiographic criterion of union between the allograft and host bone was obliteration of the interface between the graft and host bone (Figure 1). The criteria for aseptic loosening were resorption of the allograft or host bone and a progressive radiolucent zone around the cup, and migration of the cup. Migration of the acetabular component was measured via serial radiographs, using the tear drop as a reference point. The severity of the bone loss was graded according to preoperative radiographs and intraoperative evaluation of the hip according to Gustilo and Pasternak (1988): Type 1, minimal enlargement of the acetabular wall; Type 2, marked enlargement and thinning of acetabular wall, but no wall defect; Type 3, local quadrant wall defects of acetabulum; Type 4, massive and global collapse or defect involving 2 or more acetabular walls.

Results

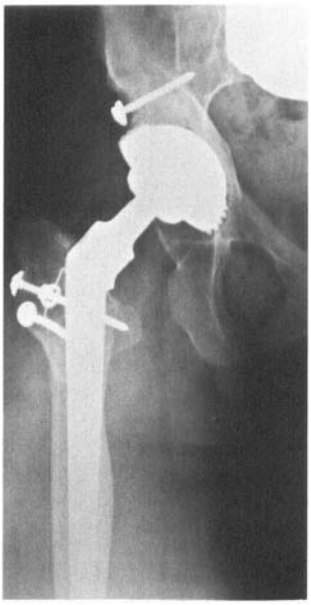
Complications occurred in 1 hip during the operation: the greater trochanter fractured. It was refixed with vitallium screws (Figure 1). The fracture did not interfere with stability of the prosthesis, and it united in 2 months.

Union of the allograft and host bone was observed in 16 out of the 18 cases (Table 1). Resorption of the allograft or host bone, migration of the prosthesis (4–18 mm) and a progressive radiolucent zone around the cup indicating aseptic loosening were seen in 13 hips. Massive resorption and collapse of the allograft occurred in 4 hips (Table 1, Figure 1). 8 cups have already been replaced by a cementless porous-coated press-fit cup. On reoperations, no bone allografts were used and the bone stock was considered better than at the previous revision operations in which allografts were used. In all cases, adequate initial fixation of the press-fit cup was obtained.

Figure 1. Case 8. A 51-year old woman with a loosened cemented total hip prosthesis.

The loosened cemented total hip prosthesis 13 years after replacement for congenital dislocation of the hip joint.

During reoperation, a cementless acetabular screw ring was placed in the cotyloid area. The roof was reconstructed using a bone allograft fixed with a vitallium screw. The medial wall was reinforced with autogenous cancellous bone chips. The greater trochanter was fractured and was fixed with 3 vitallium screws.



1 year after the revision arthroplasty, the bone allograft has united with the host bone and the acetabular screw ring seems firmly fixed. The fracture of the greater trochanter has healed well.

3 years after the operation, the allograft has been resorbed, the acetabular component has migrated proximally, and revision of the cup had to be made again.

Discussion

In our clinic, a cementless technique is almost invariably used for revision hip arthroplasties, especially in cases with major bone loss, as it offers good possibilities for reconstruction of bone defects during the operation. Cementless techniques for revision arthroplasties have also been suggested by other authors (Gustke and Grossman 1987, Jones and Maale 1987, Mallory 1987, Samuelson et al. 1988). Cemented rearthroplasties may provide long-term satisfactory results in less severe cases, but massive bone defects should be additionally reconstructed, using bone grafting and cementless prostheses (Gustilo and Pasternak 1988).

In the cases described here, all hips had major bone loss, which necessitated the use of large structural allografts to enable screw-cup fixation. During the early follow-up, union of the allograft and host bone was seen radiographically in most cases. However, resorption of the allograft and aseptic loosening of the acetabular component was later seen in 13 (72 percent) of the acetabula, 8 of which have at present already been revised. It is probable that the 5 remaining cases have to be revised later. Despite loosening, the bone stock was considered better than at the previous revision operations in which allografts were used, and adequate initial fixation of the press-fit cup was obtained.

The main reason for failures in the present series was probably the use of smooth-threaded acetabular components, which have been shown to loosen frequently both after primary and revision hip arthroplasties (Emerson et al. 1989, Engh et al. 1990, Shaw et al. 1990, Morscher 1992). Frequent failures have been shown in revision hip arthroplasties also with noncemented porous-coated acetabular components when allograft is used (Pollock and Whiteside 1992). Accordingly, although the failures in our patients were mostly due to poor cups, failure of the allograft also seems to play a role in loosening of the cup.

The reasons why the allografts failed remain partly unclear. It is possible that primarily the acetabular components were excessively supported by the allografts, which cannot withstand the load caused by weight-bearing. Large autogenous grafts have been shown to fail in a similar manner (Mulroy and Harris 1990). The allografts we used were obtained from femoral heads during previous total hip arthroplasties. The quality of bone in these grafts may not be good enough for bone transplantation, as most often they have been taken from old patients with sclerotic or osteoporotic femoral heads. Immunological factors are probably important in relation to bone allografts (Burchardt 1987, Horowitz and Friedlaender 1987, Verburg et al. 1988). An immune response could lead to failure of union and resorption of the allograft. Such a response could be inhibited by immunosuppressive agents (Heiple et al. 1987). Immunosuppression was avoided, however, because of the potential hazards (Jasty and Harris 1987). One possible reason for failure following bone grafting is unstable fixation of the allograft (Emerson et al 1989, Young et al. 1991, Huo et al. 1992). Harris (1982) suggested that bolts are far more secure than screws. Screw fixation has been favored by others, and bone grafts can also be wedged against the host bone through use of threaded cups (Gustke and Grossman 1987, Mallory 1987). Our view is that neither the screw fixation nor the wedging of the allograft between the host bone and prosthesis was unstable in the patients described here, because no signs of allograft migration, resorption of bone around the screws or other signs of instability were seen.

The rate of loosening after arthroplasties with threaded cups has proved to be unacceptably high (Engh et al. 1990, Shaw et al. 1990, Morscher 1992). Frequent failures after primary and revision hip arthroplasties have been observed also in our clinic and we have abandoned threaded smooth acetabular components and started to use press-fit porous-coated cups.

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