STRUCTURAL ALLOGRAFT IN TWO-STAGE REVISIONS FOR FAILED SEPTIC HIP ARTHROPLASTY

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We report 11 patients having revision of total hip arthroplasty using massive structural allografts for failure due to sepsis and associated bone loss. All patients had a two-stage reconstruction and the mean follow-up was 47.8 months (24 to 72). Positive cultures were obtained at the first stage in nine of the 11 patients, with *Staphylococcus epidermidis* being the most common organism. The other two patients had draining sinuses with negative cultures.

There was no recurrence of infection in any patient. The mean increase in the modified Harris hip score was 45 and all the grafts appeared to have united to host bone. Two patients required additional procedures, but only one was related to the allograft. Complications included an incomplete sciatic nerve palsy and one case of graft resorption. Our results support the use of massive allografts in failed septic hip arthroplasty in which there is associated bone loss.

It is generally agreed that revision of a hip arthroplasty is a technically demanding procedure. The results of revision for aseptic failure, even with the most modern techniques, are not as successful as those for primary hip arthroplasty (Callaghan et al 1985; Marti et al 1990; Pak et al 1993; Lawrence et al 1994) and are generally poorer when there is underlying sepsis (Salvati et al 1982; Sanzén et al 1988; Schutzer and Harris 1988; Izuquierdo and Northmore-Ball 1994; Lieberman et al 1994; Nestor et al 1994; Went, Krismer and Frischhut 1995). Reports of one-stage revision with antibiotic-impregnated cement have been encouraging (Buchholz et al 1981; Wroblewski 1986; Elson 1993), but there is still confusion with regard to the staging of surgery and most reports do not deal with extensive loss of bone. Furthermore, it is widely accepted that revision surgery will further deplete the bone stock. This may leave the surgeon with no option other than excision arthroplasty; this often relieves pain, but may be functionally disappointing with significant leg-length discrepancy, poor walking ability and some disablement (Bittar and Petty 1982; Bourne et al 1984; Grauer et al 1989). The use of allograft bone in total hip revision for septic failure (Lieberman et al 1994; Loty et al 1994) remains controversial but several authors have reported success without recurrence of infection.

We report the treatment of septic failure of total hip revision with loss of bone stock by massive structural allografts.

PATIENTS AND METHODS

Between 1983 and 1993 we performed 300 revision hip arthroplasties at the Mount Sinai Hospital. From our prospective database for revision arthroplasties, we were able to identify 17 patients with a minimum two-year follow-up in whom allograft bone had been used for reconstruction for septic loosening associated with bone loss. Eleven patients had large structural allografts, four had strut grafts either alone or in combination with morsellised bone, and two had morsellised bone only. The guidelines of the Musculoskeletal Council of the American Association of Tissue Banks had been followed for the procurement and processing of the grafts (Fawcett and Barr 1987; Mowe 1988).

We now report on the 11 patients who had major structural allografts: nine had massive femoral allografts and two had massive acetabular allografts. The mean length of the femoral graft was 14 cm (5 to 22); all except for one 5 cm graft were 10 cm or longer. Allografts of the hemi-pelvis were used for the acetabular reconstructions. Both acetabular grafts had cemented cups inserted (Protek AG, Berne, Switzerland). On the femoral side all nine patients received a long-stem titanium grit-blasted prosthesis (John-son & Johnson Orthopaedics Inc, Raynham, Massachusetts) which was cemented only to the allograft.

There were five women and six men with a mean age at the time of revision of 66.5 years (44 to 83). The underlying diagnoses varied, but osteoarthritis predominated (Table I). The mean number of previous arthroplasty procedures on the affected joint was 2.0 (1 to 6) and the mean...
follow-up was 47.8 months (24 to 72).

Nine of the 11 patients had positive cultures and one (case 7) had a polymicrobial infection. There were two patients in whom no organism could be isolated; both had discharging sinuses and had been on long-term antibiotics. One patient had an incomplete sciatic nerve palsy after the final reconstruction which resolved over 12 months.

In all cases, a two-stage reconstruction was undertaken. The first stage consisted of an excision arthroplasty, thorough debridement, insertion of an antibiotic-impregnated cement spacer and conventional parenteral antibiotic therapy for six weeks. Two of the patients had been referred from other centres after having excision arthroplasties (Fig. 1).

Second-stage revision arthroplasty was then undertaken on the basis of satisfactory resolution of clinical, laboratory and radiological evidence of sepsis. Our surgical technique for revision arthroplasty has been described previously (Allan et al 1991; Gross 1992). The need for allograft bone was assessed preoperatively on radiological evidence of bone loss and confirmed at operation. Intraoperative Gram stains performed on tissue taken at the second stage were negative in all cases. All components were cemented into the allograft with antibiotic-impregnated cement.

The patients remained on parenteral antibiotics for five days and then on oral antibiotics for three months, according to known sensitivities.

The patients remained non-weight-bearing until host-allograft union had occurred. Clinical assessment was based on a modified Harris hip score (HSS). Radiographs were assessed for evidence of allograft-host union, prosthesis or prosthesis-graft-composite migration or loosening, and resorption of the allograft. Success was defined as a stable allograft-prosthesis composite with no clinical recurrence of infection. Reinfection or failure of the graft-prosthesis-composite which required further surgery was considered a failure. An operation for loosening of the non-grafted component was not considered to be a failure.

RESULTS

At a mean follow-up of 47.8 months no patient had suffered recurrence of infection. The mean time between excision arthroplasty and reconstruction was 26.2 months (2 to 210), but excluding one patient with a delay of 210 months this mean is reduced to 5.5 months.

Two patients required additional procedures. One with a proximal femoral allograft (case 8) had recurrent disloca-
tion because of excessive retroversion of the acetabulum. Five months after the arthroplasty, at revision of the acetabular component, the femoral graft was found to be intact and united to host bone.

The second patient (case 11) had mechanical loosening of the acetabular component nine months after reconstruction with an acetalabular allograft, with no evidence of recurrent infection. At revision the acetalabular allograft was united to host bone, and the failure was at the allograft-cement junction. A Müller ring (Protek AG, Berne, Switzerland) and a cemented cup were inserted.

The mean modified Harris hip score before surgery was 27.0 (10 to 52). After surgery this was 72.1 (63 to 80), and all patients were independent with regard to activities of daily living. Three had mild pain which required intermittent analgesia and four used a walking stick. No patient had a leg-length discrepancy exceeding 3 cm.

Radiologically, all structural allografts appeared to have united to host bone (Fig. 1). There was no migration of components, no fracture of grafts and no radiolucency in the prosthesis-cement-graft composite of the nine femoral reconstructions. One cemented acetalabular cup developed early progressive radiolucency and was revised. One patient had complete resorption of a small 5 cm calcar graft. In two of the nine patients with proximal femoral allografts there was some minor focal periosteal resorption (less than 1 cm in length and partial thickness) in relation to the cerclage wires around the graft.

DISCUSSION

We could find no reports dealing specifically and only with the use of structural allografts in the revision of septic hip arthroplasty. Berry, Chandler and Reilly (1991) in their retrospective review of 18 patients, included 12 cases with morsellised graft. There were only six large femoral grafts in their series but they were in favour of the use of massive allografts for revision of septic cases. Other reports of the use of massive allografts are found only as part of larger series of hip revisions (Pak et al 1993; Lieberman et al 1994; Loty et al 1994; Nestor et al 1994) and emphasis has usually been placed on the eradication of the infection rather than on the durability of the grafts.

Major bone loss presents a difficult problem for the reconstructive surgeon and, in the presence of sepsis, it is still usual to recommend resection arthroplasty for pain relief despite the usually poor functional outcome (Bittar and Petty 1982; Bourne et al 1984; Grauer et al 1989). Reconstruction should attempt to improve function but there are still concerns about the use of large allografts and the risk of infection (Tomford et al 1990). The customised implants which are used for tumour and revision surgery are available, but they do not replenish bone stock.

The use of structural allografts has several advantages; these include the restoration of depleted bone stock, the correction of leg-length discrepancy and the ability to use conventional revision prostheses. The restoration of bone stock makes it possible to perform subsequent surgical procedures for aseptic loosening. The preservation of the soft-tissue envelope including the greater trochanter and its reattachment to the allograft allows restoration of abductor function.

Our results with this more biological approach to revision arthroplasty for failed septic hip arthroplasty are encouraging. Staging the reconstruction is important because it allows meticulous debridement of the infected bed. Repeated debridement has been advocated if there is positive evidence that infection is still present (Colyer and Capello 1994; Nestor et al 1994) but we have not found this to be necessary. Further staging of the bone grafting to allow healing before the definitive insertion of the prosthesis has also been described, but this extra stage is unnecessary for a structural allograft (McDonald, Fitzgerald and Ilstrup 1989).

Some authors advise a single-stage or exchange arthroplasty for some septic revisions (Buchholz et al 1981; Wroblewski 1986; Elson 1993; Izquierdo and Northmore-Ball 1994). Exchange arthroplasty is an appealing concept, but the presence of deficient bone stock which requires a structural allograft makes this a risky procedure. Even the use of morsellised or strut allografts is not without risk, and most authors suggest a three- to 12-month period of delay. Our results confirm this and we advocate at least a three-month delay for Gram-positive organisms with a minimum of six months for Gram-negative or polymicrobial infection.

The only graft failure in our series was in an early patient (case 1), who had a short femoral graft in 1983 which completely resorbed. We have since reported that small calcar allografts undergo early graft resorption even in aseptic revisions; we no longer advocate this technique (Allan et al 1991). Despite this, the patient has done well and has a modified Harris hip score of 69 six years after operation.

In two patients we found some partial periosteal resorption in relation to cerclage wires and continue to monitor this closely. These findings raise some concern about the long-term survival of these grafts but this is not a consistent finding and to date no patient has required further surgery for graft resorption.

The acetabular failure in case 10 (Table I) was due to failure of the cement mantle at the graft-cement junction. It does not represent failure of the allograft which was united and free from infection. The augmentation of acetabular allografts with a roof ring may provide a better cement interface than a smooth unreamed large acetabular graft (Garbuz et al 1995).

Conclusions. Our findings support the use of massive structural allograft to restore bone stock for failed septic total hip arthroplasty using a two-stage technique. In our series of 11 patients there has been no recurrence of infection at a mean follow-up of 47.8 months.
Table I. Details of 11 patients who had two-stage reconstruction with massive structural allografts

<table>
<thead>
<tr>
<th>Case</th>
<th>Age (yr)</th>
<th>Sex</th>
<th>Primary diagnosis</th>
<th>Graft</th>
<th>Staging time (mth)</th>
<th>Length of follow-up (mth)</th>
<th>Infection organism</th>
<th>HHS Preop</th>
<th>Postop</th>
<th>Complication</th>
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<tr>
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<td>F</td>
<td>Trauma</td>
<td>PFA†</td>
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<td>OA</td>
<td>PFA</td>
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<td>PFA</td>
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<td>OA</td>
<td>PFA</td>
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<tr>
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<td>12</td>
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<td>Staph. epidermidis</td>
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<tr>
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<td>PFA</td>
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<td>72</td>
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<tr>
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<td>24</td>
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<td>None</td>
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</tbody>
</table>

* OA, osteoarthritis; RA, rheumatoid arthritis; CDH, congenital dislocation of the hip
† proximal femoral allograft

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REFERENCES


