We report the results of the revision of 123 acetabular components for aseptic loosening treated by impaction bone grafting using frozen, morsellised, irradiated femoral heads and cemented sockets. This is the first large series using this technique to be reported. A survivorship of 88% with revision as the end-point after a mean of five years is comparable with that of other series.

One of the major surgical challenges of revision hip arthroplasty is the management of loss of acetabular bone stock. Available options for reconstruction include massive cement mantles, custom implants and bone grafting. In acetabular reconstruction good results using fresh-frozen impacted allograft have been reported after a mean follow-up period of 11.8 years (10 to 15), but there is considerable debate as to the best type of graft to use. There is good evidence for the use of fresh-frozen\(^1\,\text{2}\) and freeze-dried bone,\(^3,4\) but we have found in the literature only one small series with a short follow-up which used irradiated allograft.\(^5\)

We, therefore, present our clinical and radiological findings in 123 acetabular reconstructions using morsellised irradiated bone allograft.

**Patients and Methods**

In 1987, we started to use morsellised bone allograft to restore acetabular bone stock during revision hip arthroplasty. Between 1987 and 2000, 148 revision arthroplasties were performed in 128 patients for aseptic loosening using morsellised allograft bone for acetabular reconstruction. Complete clinical and radiological records of 123 hips in 110 patients were available for review. The radiographs of the remainder were lost because of a storage accident in the hospital.

Each operation was performed by one of four consultants (AJH, RMK, IS, RE). The initial diagnoses are shown in Table I. The indication for revision was aseptic loosening in 128 patients for aseptic loosening using morsellised allograft bone for acetabular reconstruction. Complete clinical and radiological records of 123 hips in 110 patients were available for review. The radiographs of the remainder were lost because of a storage accident in the hospital.

All failed hips, which had had an implant within ten years, were aspirated to exclude infection. At revision, a posterior or transstrochanteric approach was used. After thorough debridement during which multiple microbiological samples were taken for analysis, all patients received parenteral prophylactic cefuroxime (750 mg for three doses at eight-hour intervals). The acetabular defects were assessed and classified by the AAOS system\(^6\) (Table II). All the allograft used was in the form of surgically-retrieved femoral heads, gamma-irradiated with 2.5 Mrad and frozen at -70°C until used. The heads were prepared in theatre to give cancellous chips between 0.5 and 1 cm in diameter. Smaller bone defects were contained by mesh and screws (Stryker-
RESULTS

Nine patients (nine hips) died between one and 66 months after surgery at which time all their acetabular components were functioning well. Five died within 24 months of surgery and were excluded since the minimum period for radiological follow-up was 24 months. Data from the last clinic visit and radiographs of the remaining four were included.

The mean follow-up period was 60 months (24 to 145) and median 51 months. Nine patients lived outside the area and were unable to attend review. One of these had a follow-up period of less than 24 months and was excluded. Data from the most recent clinic review in the remaining eight were analysed and follow-up to that time used.

The number of patients in our series was reduced at the outset by the loss of radiographs because of a storage accident in the hospital. Without full radiological follow-up it was impossible to assess the outcome of the whole series. Of the 123 operations reviewed the rate of loss to follow-up was 7% (9 of 123) which is acceptable.

Clinical findings. The overall rate of re-revision was 11.3%. Thirteen acetabular components have been re-revised and one awaits revision. Of these, eight revisions were for deep sepsis, two for persistent early dislocation and four for aseptic loosening. Life tables were constructed and the survivorship calculated as seen in Table V.

In 2002, 100 hips in 86 patients were still in place. Clinically, 62 were excellent, 34 acceptable and four poor. In the remaining 18 patients, there were 13 re-revisions, four deaths and one was awaiting revision.

Radiological findings. The socket had migrated more than 5 mm in four hips of which two had been revised. One of the other two was rated excellent by the patient despite early migration of 10 mm and the other as acceptable although with migration of 7 mm. Five acetabular components had circumferential progressive radiolucent lines. Four of these patients had good function and one rated the hip as poor.

There was union of the graft in 84 of the 100 intact sockets.

DISCUSSION

The optimum method of preparation of bone allograft is unclear. Current methods include the use of allograft which is either fresh-frozen, freeze-dried with ethylene-oxide ster-
ilisation or frozen and gamma irradiated. The potential for transmission of disease after allografting procedures is an indication for secondary sterilisation. Fresh-frozen bone relies only on the screening of donors to confer safety. Freeze-dried ethylene-oxide-sterilised bone is probably safe but does not have the structural strength for grafting in weight-bearing areas although it has good survivorship in acetabular defects. The strength of cortical grafts is reduced after irradiation but this may not be relevant to impacted cancellous bone. In one study, irradiated bone has been shown to demonstrate rates of graft incorporation and consolidation which are comparable with those of fresh-frozen bone but the series had a short follow-up of only 15 months.

Bankes, Allen and Aldam recently presented the results of a study using irradiated bone in femoral revision which
compared fresh-frozen and irradiated frozen bone at a mean of 47 months. No difference was shown clinically or radiologically in the outcome between the two groups.

The best results to date of acetabular grafting are with fresh-frozen allograft with survivorship of 90% after 11.8 years and of 98.6% after 6.8 years with freeze-dried bone. One small series of seven patients reported one failure because of infection after seven years and another of three re-revisions in 29 acetabulae with survivorship of 89.6% at a mean of four years.

Irradiated bone for acetabular reconstruction in the medium term (mean of five years) appears to be effective, and probably reduces the risk of transmission of bacterial and viral disease. Our survivorship of 87.8% compares favourably with that of studies using non-irradiated bone.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

References