Acetabular revision using a total acetabular allograft

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ABSTRACT
The most challenging aspect of an acetabular revision is the management of severe bone loss, which compromises implant fixation and stability. We present a case of failed acetabular revision with extensive bone loss (Paprosky Type 3b) in a 50-year-old woman with rheumatoid arthritis, which was treated using total acetabular allograft. At a follow-up of 1 year and 3 months, the allograft had united with the host bone. This is the first report of the use of a total acetabular allograft for revision total hip arthroplasty in India. The total acetabular allograft allows the placement of the component closer to the normal hip center, provides initial stability for the acetabular component, and restores bone stock to the host pelvis.

Key words: Acetabular revision, revision hip arthroplasty, total acetabular allograft, total hip replacement

Total hip replacement (THR) is a highly successful surgery to relieve the pain of an arthritic hip. The failure of total hip arthroplasty, however, often requires major reconstructive surgery. Bone loss often accompanies failed THR and can be the cause as well as the result of the failure. Septic or aseptic osteolysis, infection, wear, and instability are the major causes of bone loss associated with a failed THR. One of the most challenging aspects of an acetabular revision is the management of severe bone loss that compromises implant fixation and stability. The aims of an acetabular revision include the achievement of a stable bone coverage that can support the new acetabular component, restoration of the anatomy and bone stock for future revisions, and equalization of the leg length.

We present a case of failed acetabular revision with extensive bone loss that was treated using total acetabular allograft. This is the first report of the use of a total acetabular allograft for revision total hip arthroplasty in India.

CASE REPORT

A 50-year-old woman underwent a bilateral total hip replacement for rheumatoid arthritis in 1999. Subsequently, a revision total hip replacement on the right side was done in May 2007 using a cemented acetabular component along with a bone substitute. She presented to us 2 months after this acetabular revision with complaints of severe pain in right hip and an inability to bear weight. She was bedridden and had a Harris Hip Score of 4. X-rays [Figure 1a] and CT scan [Figure 1b and c] revealed a failed acetabular component with a Type IIIb acetabular defect according to Paprosky classification. There was a pelvic discontinuity with superomedial migration of the acetabular component, break in Kohler’s line, and complete loosening of the acetabulum at bone–cement interface.

Preoperative workup including bone scan, ESR, and CRP showed no evidence of any infection. The acetabular revision was done in accordance to the technique described by Paprosky et al.Operative procedure
The hip joint was exposed using the posterior approach. The acetabular component was found to be lying loose. A thorough debridement revealed a large combined cavitary and structural defect along with pelvic discontinuity and loose pieces of bone mineral substitute lying in the defect area. After debridement and removal of the components, synovial white blood cell counts, gram staining of specimens of synovial fluid, and histological examination of frozen sections of inflammatory tissues were performed, and these excluded the possibility of infection.

All acetabular membranes were removed until the acetabular rim was completely exposed and bleeding bone encountered. An irradiated (25 kilogray) fresh frozen hemipelvis was procured from the bone bank. This allograft was thawed in povidone iodine and normal saline solution.

The acetabular allograft was shaped to buttress the host bone. The superior pubic and ischial rami of the graft were cut at a point distal to the acetabular confluence with a length remaining to fill the defects in the host pelvis. The iliac crest of the allograft was cut in a curvilinear manner from the greater sciatic notch to the anterior inferior iliac spine.
Repeated fitting and trimming of the graft was performed to ensure the appropriate amount and placement of bone resection.

A tongue was created in the remaining rim of the host acetabulum. A groove was created in the medial aspect of the acetabular allograft using a burr [Figure 2a and b].
such a tongue-in-groove mortise ensures an optimum contact and stability of the construct and also helps in union of the graft to the host. The acetabular allograft was held in a bone vice and reamed to remove the cartilage and minimum amount of subchondral bone. Morselized allograft was harvested from the remaining hemipelvis and packed into the defect.

The acetabular allograft was seated in place and manipulated to ensure that it lay in its most stable position. After further trimming the graft, it was impacted using an acetabular impactor to ensure a press fit in the tongue and groove mortise. Large-fragment, partially threaded cancellous-bone screws were placed in the superior rim of the iliac bone of the allograft to lag it to the thin iliac wing of the host allowing a bicortical purchase.

A Burch Schneider reconstruction cage (Zimmer, USA) was used to augment the fixation of the allograft. The acetabular allograft was then fashioned to ensure the support of cage along the posterior column. A cage with a diameter of 50 mm was chosen, as it allowed intimate contact with the host, and more importantly with the graft without over reaming and possible weakening of the bone.

The cage was then manipulated into position and fixed to the allograft bone and the remaining host bone using screws in the dome and iliac flange of the cage to ensure close approximation of the host bone and the allograft. An acetabular liner (size 47 mm) was then cemented into the cage. The morselized allograft was also impacted into the remaining defects and into the junction between the host and the allograft.

The femoral stem was not revised as it was found to be well fixed. A 28-mm femoral head with short neck length was implanted on the stem and a stable reduction was achieved [Figure 3a and b].

Postoperatively, the patient was kept from weight-bearing for 6 weeks. The patient was then mobilized toe-touch weight-bearing for another 6 weeks and progressive weight-bearing was started thereafter.

At a follow-up of 1 year and 3 months [Figure 3c], the allograft had united with the host bone and there is no evidence of any loosening, osteolysis, or resorption around the allograft. The patient is walking unaided and has a Harris Hip Score of 88.

Discussion

The treatment options of pelvic discontinuity and major acetabular defects in the setting of a revision total hip arthroplasty are use of a plate with cage and structural allograft, trabecular metal augments, custom-made implants, triflange implants, and whole acetabular allograft.

The total acetabular allograft allows the placement of the component closer to the normal hip center. These grafts provide initial stability for the acetabular component and also restore bone stock to the host pelvis. These grafts unite with the host bone and provide a scaffold for future revisions.

The use of a reconstruction cage improves the union of the graft to the host bone, as it dissipates the forces through the remaining pelvis, thereby preventing excessive transmission of force through the avascular graft. However, the use of acetabular reconstruction ring in isolation cannot be used to span a structural defect, as the cage will have no columnar support and repetitive loading would cause the cage to flex and lead to metal fatigue or pull out of screws. A structural acetabular allograft is required in conjunction with this cage to provide biological support to the cage and prevent fatigue fractures of the cage over the long term.

It has been shown that the acetabular allografts unite at an average of 11 months (range, 6-16 months). Paprosky reported a success rate of 82% in cases where a cage was used along with total acetabular allograft as compared with 38% in cases without the use of cage. Garbuz also advocated the use of cage along with acetabular allograft for better results. A survival of as long as 20 years with an excellent functional outcome with radiographic evidence of graft incorporation and no signs of loosening has been shown by Gul et al. The acetabular allograft showed evidence of union at a follow-up of 15 months in our case; however, a longer follow-up is needed to evaluate the tendency of some of these massive allografts to resorb in the long term. [Table 1] provides the summary of the results of various reports on acetabular reconstructions using acetabular allografts.

A higher incidence of dislocation has been reported in these cases because of the difficulty in achieving a proper acetabular orientation. Although some acetabular components fail because of loosening, the restoration of bone stock by an acetabular allograft makes a revision operation much easier.

In spite of the concerns of graft resorption, collapse, and the transmission of infection, the use of acetabular allograft in acetabular revision surgery is useful to restore bone stock especially when the expectations are low.

Patients with a Type 3B Paprosky acetabular bone defects were previously considered to be unreconstructable and
Table 1: Summary of various reports on the use of acetabular allografts

| Authors                  | Mode of reconstruction                        | No. of patients | Follow-up | Results                      | Complications                                      |
|--------------------------|-----------------------------------------------|-----------------|-----------|------------------------------|----------------------------------------------------|
| Macdonald\(^d\)          | Whole acetabular allograft and cemented cup without cage | 17pts           | 31 months | 13 grafts successful         | Infection-4 Migration-1 Dislocation-6 Loosening-2   |
| Steihl\(^\text{10}\)     | Pelvic graft with plate and stabilization of anterior column | 12              | 14-84 months | 8 grafts successful       | Mean resorption of 17% in 6 patients, 4 patients revised |
| Schelfaut\(^\text{11}\)  | Deep frozen periacetabular graft with cemented cup without cage | 14              | 42 months | Good results in 9           |                                                   |
| Gul\(^\text{12}\)        | Acetabular allograft with cementless cup without cage | 1               | 20 years   | Excellent results            | None                                               |
| Paprosky\(^6\)          | Acetabular allograft and cemented cup without a cage | 16              | 10 years   | No loosening in 6 hips       | 6 hips revised due to loosening at 2.9 years         |
| Paprosky\(^6\)          | Acetabular allograft and cemented cup with a cage   | 48              | 2-8 years  | 20 cups had no loosening     | 9 hips revised for aseptic loosening, 9 cups had radiographic loosening |
| Saleh\(^\text{13}\)      | Pelvic allograft with cemented cup and cage      | 9               | 10.5 years | 77% satisfactory results     | 3 revisions; 1 for graft resorption, 2 for recurrent dislocation |
| Piriou\(^\text{14}\)     | Hemipelvic transplant with cemented cup without cage | 20              | 4-10 years | 65% good results             | 7 failures (5 aseptic loosening and 2 deep infections). Two dislocations |
| Garbuz\(^\text{15}\)     | Acetabular allograft with cage with cemented cup  | 8               | 5-11 years | 7 (88%) successful           | One failed due to infection                         |
|                          | Acetabular allograft with cemented cup without cage | 14              | 5-11 years | 12                            | 2 failed                                           |
|                          | Acetabular allograft with cemented cup           | 7               | 5-11 years | 4                             | 3 failed                                           |

were subjected to salvage procedures like girdlestone arthroplasty.\(^5\) A total acetabular allograft provides a viable alternative to treat these formidably challenging reconstructions. The availability of newer materials such as trabecular metal may facilitate the reconstruction in such cases minimizing the use of allografts.\(^5\) However, this option is at present neither easily affordable nor available in India.

**REFERENCES**

1. Dorr LD, Wan Z. Ten years of experience with porous acetabular components for revision surgery. Clin Orthop Relat Res 1995;319:191-200.
2. Paprosky WG, Perona PG, Lawrence JM. Acetabular defect classification and surgical reconstruction in revision arthroplasty: A 6-year follow-up evaluation. J Arthroplasty 1994;9:33-44.
3. Pettera P, Rubash HE. Revision total hip arthroplasty: The acetabular component. J Am Acad Orthop Surg 1995;3:15-21.
4. Silverton CD, Rosenberg AG, Sheinkop MB, Kull LR, Galante JO. Revision total hip arthroplasty using a cementless acetabular component: Technique and results. Clin Orthop Relat Res 1995;319:201-8.
5. Paprosky WG, Sekundiak TD. Total acetabular allograft. J Bone Joint Surg Am 1999;81:280-91.
6. Sporer SM, Paprosky WG, O'Rourke MO. Managing bone loss in acetabular revision. Instr Course Lect 2006;55:287-97.
7. Gross AE, Duncan CP, Garbuz D, Elsayed MZ. Revision arthroplasty of the acetabulum in association with loss of bone stock. Instr Course Lect 1999;48:57-66.
8. Gross AE, Blackley H, Wong P, Saleh K, Woodgate I. The use of allografts in orthopaedic surgery part II: The role of allografts in revision arthroplasty of the hip. J Bone Joint Surg Am 2002;84:655-67.
9. MacDonald SJ, Bradford M, Paprosky WG, Krishnamurthy A. Acetabular transplants in revision total hip arthroplasty: When there are no alternatives. Orthop Trans 1996;20:95.
10. Steihl JB. Extensile anterior column acetabular reconstruction in revision total hip arthroplasty. Semin Arthroplast 1995;6:60-7.
11. Schelfaut S, Cool S, Mulier M. The use of structural periacetabular allografts in acetabular revision surgery: 2.5-5 years follow-up. Arch Orthop Trauma Surg 2008;129:455-61.
12. Gul R, Jeer PJ, Oakeshott RD. Twenty-year survival of a cementless revision hip arthroplasty using a press-fit bulk acetabular allograft for pelvic discontinuity: A case report. J Orthop Surg (Hong Kong) 2008;16:111-3.
13. Saleh KJ, Jaroszynski G, Woodgate I, Saleh L, Gross AE. Revision total hip arthroplasty with the use of structural acetabular allograft and reconstruction ring: A case series with a 10-year average follow-up. J Arthroplasty 2000;15:951-8.
14. Piriou P, Sagnet F, Norton MR, de Loubresse CG, Judent T. Acetabular component revision with frozen massive structural pelvic allograft: Average 5-year follow-up. J Arthroplasty 2003;18:562-9.
15. Garbuz D, Morsi E, Gross AE. Revision of the acetabular component of a total hip arthroplasty with a massive structural allograft: Study with a minimum five-year follow-up. J Bone Joint Surg Am 1996;78:693-7.
16. Hooten JP Jr, Engh CA, Heekin RD, Vinh TN. Structural bulk allografts in acetabular reconstruction: Analysis of two grafts received at post-mortem, J Bone Joint Surg Br 1996;78:270-5.
17. Pollock FH, Whiteside LA. The fate of massive allografts in total hip acetabular revision surgery. J Arthroplasty 1992;7:271-6.

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