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11-Year Mean Follow-Up of Acetabular Impaction Grafting With a Mixture of Bone Graft and Hydroxyapatite Porous Synthetic Bone Substitute

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ABSTRACT

Background: We report an 11-year mean follow-up of the effectiveness of bone impaction grafting with bone and hydroxyapatite (HA) for large, uncontained acetabular defects in primary and revision hip surgeries.
Methods: Over 5 years, 47 total hip arthroplasties with uncontained acetabular deficiencies were performed by augmentation using an impaction graft with 50:50 mixture of freeze-dried bone allograft and HA. Ten were primary total hip arthroplasties and 37 revision procedures. X-rays were taken postoperatively, 6 weeks, 3 months, and then annually to assess incorporation of the graft, radiolucent lines, resorption, or migration of components. Functional outcomes were assessed by annual pain and function parts of the Harris Hip Score.
Results: At a mean follow-up of 10 years, the survivorship was 100%. All patients were accounted for; 6 had died. The Harris Hip Score for pain improved from 9 and 17 (primaries and revisions, respectively) to 39 and 41. For function, there was an improvement from 20 and 19 to 32 (both groups). There were lucent lines in 8 cases, 3 cups had minor/stable migration, and one cup had significant migration (>15 mm). Graft incorporation had occurred in 20 hips.
Conclusion: This is the longest survivorship of bone impaction grafting with morcellised bone and HA substitute.
Although 11-year survivorship, function and pain are excellent, radiological findings of lysis in 8 and migration in 4 cases may be of concern for the immediate future and will need close monitoring. Even in these cases, revision may be easier because of restoration of bone stock.

Acetabular bony deficiencies, whether in primary or revision surgery [1], present a problem for the hip surgeon [2]. Although different techniques have been proposed to reconstruct the defect or offer component support (including mesh and bone grafting, large/bilobed cups, and large metal augments [3–11]), few of these have published data beyond the first decade.

Our unit has previously published the early results of reconstruction of acetabular bone deficiencies with the use of impaction bone grafting using 1:1 mixture of frozen, ground irradiated bone graft, and ApaPore 60 (ApaTech Ltd, Elstree, United Kingdom; pure-phase hydroxyapatite [HA] bone substitute) in combination with a cemented acetabular component at a mean of 5 years (3.4-7.6) [12]. However, data beyond the first 5 years are limited and this study provides an update on the outcome of this series of patients at a mean follow-up of 11 years (range 9-13.5 years).

The survivorship of both bone and ceramic substitute at this length of time is yet not known. The aims of this paper are to assess

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As this procedure was part of recognized management and treatment protocol, the Research Ethics Board did not require formal review.

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not only the longest survivorship assessment, but also the function and radiological outcomes.

Materials and Methods

Study Design and Setting

Our study design was previously described at the mean 5-year point [12], but an abbreviated explanation is given here again.

This is a prospective case series with no control group. All patients presenting between 2003 and 2008 with uncontained acetabular defects were drafted into a database. They were operated on by 3 surgeons (80% performed by MJLP) using standard posterior approach and standardized bone impaction grafting technique using a mixture of irradiated and frozen bone graft and ApaPore 60, a phase-pure HA with 60% porosity. It has both a microporosity (<20 μm) and a macroporosity (>50 μm). The combination of the pure-phase HA and this porous structure may improve osteoconductivity and hence encourage bone ingrowth and remodeling. ApaPore 60 was available in 2 sizes (2-5 mm and 5-10 mm). In this institution, the 5-10 mm granules were used [13]. In vitro [14–18] and Rabbit models confirmed the success of this mixture, which then led to human clinical trials [19]. Although these research studies using bone graft and synthetic graft exist, this study is the longest in vivo study. ApaPore 60 is no longer commercially available as it was deemed commercially unviable by the mother company, Baxter Healthcare (Thetford, United Kingdom), after a takeover of ApaTech. However, there are still many commercially available HA bone substitutes on the market [20–22]. Bone substitute is used to theoretically integrate better and because of the limitation of availability of bone donors [23] (essentially bone expanders).

As previously described [12], all the bone grafts were obtained from a national UK bone bank and had undergone washing [24] and irradiation at 25 kGy [25–27] to limit the risk of infection transmission [28]. Although frozen, it was thawed at the time of surgery. There is little evidence reported that irradiation affects the function and incorporation of the graft [29].

Table 1
"The Patients' Preoperative Deformities" and Postoperative Results.

	Primary Surgery	Revision Surgery
Acetabular defect type (AAOS classification)		
I	3	13
II	3	11
III	4	13
Volume of graft (units bone + ApaPore 60)	2 (1-4.5)	4 (2-10)
Implants used:		
Acetabulum		
Mesh reconstruction	9	22
Ring reconstruction	1	3
Corin	6	28
Ogee	4	9
Femur		
Exeter stem (Stryker)	10	9
Revitan stem (Zimmer)		12
Cannulok (Orthodynamics)		4
Cone lock (Biomet)		2
Dall cables (Stryker)		12
Postoperative radiological findings		
Graft incorporation	8	23
Migration	1	4
Radiolucency	2	6
Failure	0	1
Unable to assess	1	1

AAOS, American Academy of Orthopaedic Surgeons.

Table 2
Patients' Demographics.

	Primary Surgery	Revision Surgery
Number of patients	10	36
Number of hips	10	37
Gender		
Male:Female	3:7	19:17
Left:Right	7:3	19:18
Mean BMI, kg/m^2 (range)	25 (17-42)	27.5 (22-32)
Mean age, y (range)	74 (48-88)	75 (59-90)
Indication for surgery		
Osteoarthritis	10	
Aseptic loosening		31
Second-stage revision for infection		4
Erosion after hemiarthroplasty		2
Mean follow-up, y (range)	10 (8-12)	9 (7-12)
Mean preoperative HHS (range)		
Pain	9 (0-20)	17 (0-44)
Function	20 (15-31)	19 (3-36)
Mean postoperative HHS (range)		
Pain	39 (20-44)	41 (40-44)
Function	32 (10-47)	32 (16-47)

BMI, body mass index; HHS, Harris Hip Score.

Segmental defects were initially reconstructed by a mesh and screws. Sclerotic bone was drilled or reamed to allow some bleeding before impaction of the 1:1 mixture of bone graft and ApaPore 60 to which blood was mixed into. This graft was impacted into the mesh and acetabulum using X-change acetabular impaction grafting instruments (Stryker/Howmedica Osteonics, Limerick, Ireland).

Once satisfied with the reconstructed defect, cement (PALACOS R+G, Heraeus, Wehrheim, Germany) was pressurized and followed by a polyethylene acetabular component with an inner diameter of 28 mm until cement polymerization [30].

Most cases were encouraged to partial weight-bearing for 6 weeks and then progress to full weight-bearing thereafter. Patients were seen at 6 weeks and then annually with Harris Hip Score (HHS) and x-rays.

Pelvic plain radiographs, clinical assessment, and functional and pain scores were performed on an annual basis. Radiological assessment was performed by analysis of routine anteroposterior and lateral pelvic films postoperatively, 6 weeks, 3 months, and then annually. Functional outcomes were assessed by annual pain and function parts of the HHS [31].

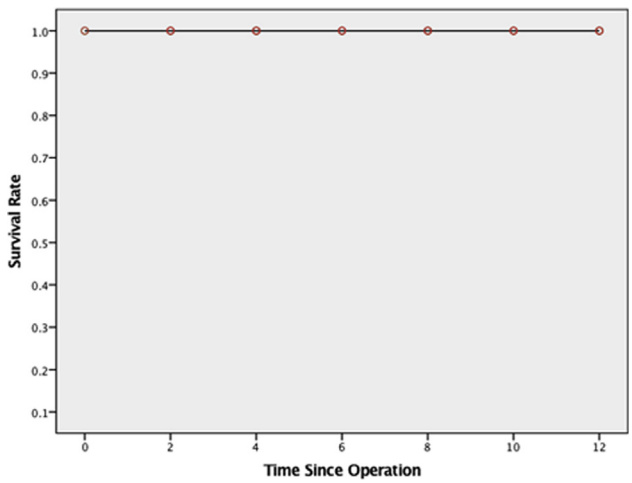

Fig. 1. Kaplan-Meier (K-M) curve of implant survivorship.