Original Article

Acetabular Reconstruction Using a Cage in Complex Primary Total Hip Replacement in a Developing Country: An Assessment of Early Functional Outcome

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Abstract

Background: Acetabular reconstruction following bone loss is a major challenge facing the arthroplasty surgeon. Traditionally, the armamentarium for the treatment of large bone defects (Paprosky Type 2C or 3) included antiprotrusio cages (APC). The aim of this study is to determine the pattern of presentation and assess the early functional outcome of patients who had undergone acetabular reconstruction using APC in complex primary total hip replacement (THR). **Patients and Method:** Between November 2008 and November 2015, 38 THR were carried out in 35 patients who required acetabular reconstruction, at Davidson and Judith Consultants Clinics Enugu, Nigeria. **Results:** There were 25 males and 10 females, with a ratio of 2.5:1. The average age of the patients was 61.33 ± 6.92 with a range of 56 to 72. The mean pre-op Harris score was 49.02 ± 2.3.The mean post-op Harris hip score (HSS) was 88.75 ± 10 ($P < 0.001$) at one year and 92.25 ± 13 ($P < 0.001$) at 5 years. The etiology showed that most (52.63%) of our patients had primary osteoarthritis with Type 3 acetabular defect. Two (5.26%) patients had the following complications: dislocation (2.63%) and screw breakage (2.63%). The minimum follow-up period was 5 years. **Discussion:** After follow-up at 1 year and 5 years, the hips showed significant improvement concerning pain, gait, and mobility based on HHS and were able to return to their various professions. **Conclusion:** APC provides a satisfactory solution for patients who present with acetabular deficiency in complex primary THR.

Keywords: *Acetabular defect, clinical outcome, complex primary total hip replacement, DePuy antiprotrusio cage*

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Introduction

Acetabular reconstruction following bone loss is a major challenge facing the arthroplasty surgeon in the revision surgery.[1] However, there may be a need for acetabular reconstruction in some category of complex primary total hip replacement (THR).[2] The objective of the acetabular reconstruction is to restore the normal center of hip rotation necessary for normal biomechanics as well as restoration of the structural integrity of the acetabulum. Traditionally, the armamentarium for treatment of large bone defects (Paprosky Type 2C or 3) included antiprotrusio cages (APC).[3]

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The use of cages in reconstruction of acetabulum has increased probably because of the mid-term results of cup-cage construction.[4,5] There are various methods of managing massive bone loss in the acetabulum which include resection arthroplasty and reconstruction using acrylic cement to fill the defect, use of bipolar prosthesis, custom prosthesis, massive bulk allografts,

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and uncemented acetabular components.[6–9] Apart from the inherent disadvantage in each of these methods, inventory and cost may be a major restraint in the application of these methods in a developing country like ours, hence our choice of using APC in reconstructing the acetabulum in primary THR when the need arises.

We had reported in our previous study[10] that only less than 3% of our patients reported early for treatment when the symptoms of osteoarthritis (OA) sets in; hence, we are bound to have a lot of patients who require complex primary THR as treatment for OA, many who will need acetabular reconstruction. To our knowledge, comprehensive study of the longer term performance of these devices has not been published in our environment. Therefore, the aim of this study is to determine the pattern of presentation and assess the early functional outcome of patients who had undergone acetabular reconstruction using APC in complex primary THR.

Patients and Method

This study was carried out at Davidson and Judith Consultants Clinics, Enugu, Nigeria. A total of 38 primary THR, in 35 patients, were carried out between November 1, 2008, and November 30, 2013. All patients who had acetabular reconstruction with APC were included while patients who did not need the APC were excluded from this study.

Preoperative assessment was carried out which included a radiological laboratory to determine the extent of acetabular defect as well as to rule out infection. Only patients with an erythrocyte sedimentation rate (ESR) <20 mm/hr and C-reactive protein (CRP) <10 mg/dL were operated. All patients had a preoperative X-ray of the affected hip showing anterior–posterior, lateral,and Judet's view [Figure 1]. Where there was doubt on the information concerning the integrity of the acetabular walls, a computerized tomography scan was required with a request on comments of the configuration of the acetabular walls from the radiologist. The preoperative Harris hip scores (HHS) were assessed, and the average pre-op hip score was 49.02 ± 2.3 with a range of 47 to 51. The average pre-op packed cell volume (PCV) was 38.24. The average blood transfusion rate was 2 units with a range of 0 to 2 units. The surgeries were carried out under general and regional anesthesia based on the indication using the lateral approach. After femoral neck osteotomy at the appropriate level, the configuration of the acetabulum was defined and classification of the acetabular wall defect was done using the Paprosky classification.[7] [Figures 2 and 3].

The acetabular cage trial was applied to the acetabular defect to determine the size of cage to be used [Figure 4]. The acetabular cage was contoured to fill in the defect which is filled with morselized bone graft from the femoral head and held with screws proximally and distally at the Ilium and Ischium, respectively. Polyethylene cup (DePuy Elite Cup) was now cemented in 45° abduction using the transverse acetabular ligament as a guide to the anteversion independent of the position of the cage [Figure 5]. The Corail stems (DePuy) were used for the replacement of femoral head and neck.There was no remarkable blood loss and the average loss was 800 mL. Patients had the normal protocol of rehabilitation: sitting out, walking with Zimmer frame, walking with crutches, and discharged in 2 weeks after removal of the staples/sutures. Patients had initial post-opradiographs [Figure 6] within 24 hours and subsequent ones taken at the time of assessment of the functional outcome. The post-op Harris scores were done by the first author at 6 weeks, 3 months, 6 months, 12 months, 24 months, 36 months, 48 months, and at 5 years.

Results

There were 35 patients with 38 hips replaced. Three (8.57%) patients were bilateral. There were 25 males and 10 females, with a ratio of 2.5:1. The average age of the patients was 61.33 ± 6.92 with a range of 56 to 72 [Table 1]. Eight (26.67%) patients were businessmen, seven (20.00%) civil servants, 10 (28.57%) traders, and 10 (28.57%) retirees [Table 2].

Table 1: General information

Characteristics	Value
No of patients	35
No of hips	38
Bilateral	3 (8.57%)
Males	25
Females	10
Male:Female ratio	2.5:1
Mean age of the patients (years)	61.33±6.92
Age range (years)	56-72
Minimum follow-up period	5
The mean pre-op Harris hip score (HHS)	49.02±2.3
Mean post-op HSS (1 year)	88.75±10 (P<0.001)
Mean post-op HSS (5 year)	92.25±13 (P<0.001)
Regional anesthesia	30 (85.71%)
General anesthesia	5 (14.29%)

Table 2: Occupation of patients

Occupation	No	Percentage
Businessman	8	26.67
Civil servants	7	20.00
Trader	10	28.57
Retiree	10	28.57
Total	35	100

Figure 1: Pre-Op xray of the index patient.Old dislocation of the left hip with united fracture of the acetabular floor with complete absence of the posterior column and shallow acetabular depth.

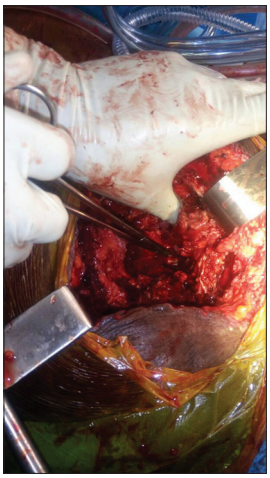

Figure 2: Showing the defect in the medial wall, acteabular dome and complete absence of anterior column

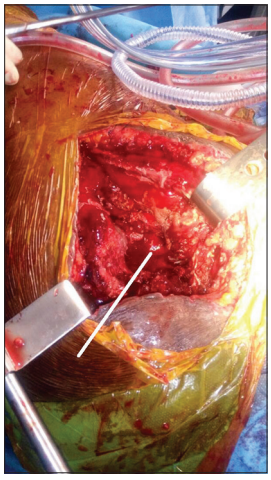

Figure 3: Acetabular Defect: Paprosky Type 3A- Arrow pointing to complete defect in the acetabular floor.Note also the absence of posterior and anterior walls of the acetabulum.

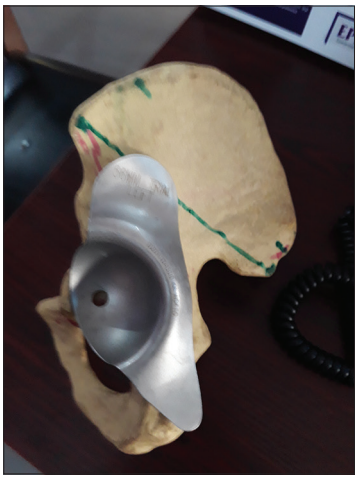

Figure 4: Trial Cage in a model of the pelvis

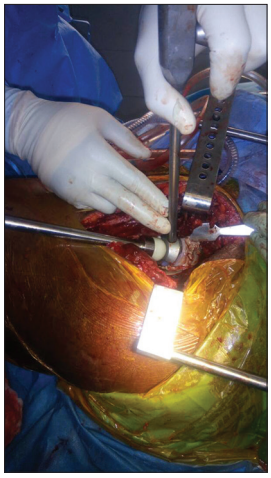

Figure 5: Polyethylene cup(Depuy Elitecup) is now cemented in 40˚ abduction using the transverse acetabular ligament as a guide to the anteversion independent of the position of the cage

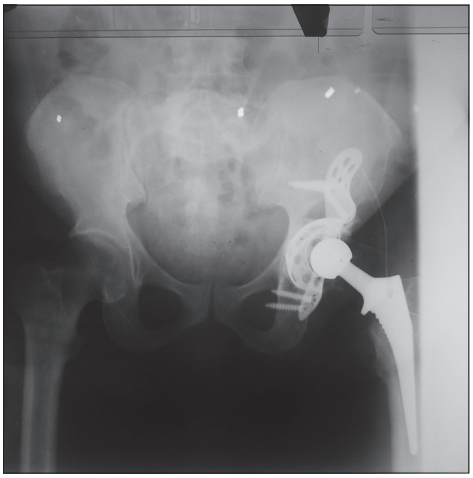

Figure 6: Post -Op x-ray of the index patient showing APC application.

The mean pre-op Harris score was 49.02 ± 2.3. The mean post-op hip score was 88.75 ± 10 ($P < 0.001$) at 1 year and 92.25 ± 13 ($P < 0.001$) at 5 years. Thirty (85.71%)

Table 3: Etiology

Diagnosis	No of Hips	Percentage
Primary OA	20	52.63
Old acetabular fracture	8	21.05
Unreduced posterior dislocation of the hip	7	18.42
Central dislocation of the hip	2	5.27
Dysplastic hip	1	2.63
Total	38	100

Table 4: Acetabular defects classification

Paprosky classification	No of Hips	Percentage
Type 3A	17	44.74
Type 3B	14	36.84
Type 2C	7	18.42
Total	38	100

Table 5: Implant dimensions

Implant	Range (mm)
Acetabular cage size (outside diameter)	48-56
Acetabular cage size (inside diameter)	45-53
Elite cup size (outside diameter)	40-43
Elite cup size (inside diameter)	28
Head circumference	28
Stem size	9
Average no. of screws	8

patients had regional anesthesia while five (14.29%) had general anesthesia. The etiology showed that 20 (52.63%) patients had primary osteoarthritis, eight (21.05%) old acetabular fracture, seven (18.42%) unreduced posterior dislocation of the hip, two (5.27%) central dislocation of the hip, and one (2.63%) dysplastic hip [Table 3]. Acetabular defect classification showed that 17 (44.74%) participants had Type 3A, 14 (36.84%) Type 3B, and 7 (18.42%) Type 2C defects [Table 4]. The dimensions of the implant used were as follows: acetabular cage size (outside diameter), 48 mm to 56 mm; acetabular cage size (inside diameter), 45 mm to 53 mm; elite cup size (outside diameter), 40 mm to 43 mm; elite cup size (inside diameter) 28 mm; head circumference, 28; stem size, 9; and average number of screws, 8 [Table 5].

Two (5.26%) patients had the following complications: dislocation (2.63%) and screw breakage (2.63%). The minimum follow-up period was 5 years.

Discussion

Acetabular deficiency in primary and revision THR remains a difficult clinical problem, which has not been fully solved in spite of the interest it has generated over the last three decades.[11–15] However, the group of primary THR which will require acetabular reconstruction with modular implants and/or bone grafting similar to that used in revision arthroplasty is known as complex primaries.[16]

Such complex cases fall into the categories of dysplastic hip, ankylosed hip, fractures about the hip, protrusio acetabuli, neuromuscular conditions, skeletal dysplasias, and previous bone procedures about the hip.[17] Most of our patients presented as primary osteoarthrosis which is at variance with this categorization.[18,19] The reason for this may not be unconnected to delay in seeking medical attention in our environment. The other group of patients are those who had old acetabular fractures, unreduced posterior dislocation, and central dislocation of the hip which is in keeping with the findings of some authors.[20–23] There are various methods available to deal with bone deficiency in the joint replacement, and each of these methods has advantages and disadvantages. These methods which may be used in different circumstances include the following: (1) changing the planned position of an implant to compensate for the bone loss like placing the socket higher or more medially than usual in a case of hip dysplasia,[24] (2) changing the size of the implant to compensate for the deficiency like using an extra-large socket during revision of a failed acetabular component,[25,26] (3) filling the bone defect with metal like a calcar replacement prosthesis for medial proximal femoral bone deficiency,[26] and (4) use of bone graft to fill the bone deficiency. Jasty and Harris[6] had opined that though massive bulk allografts provide structural support which can heal to host bone, their long-term durability remains uncertain. We had initially tried to reconstruct the acetabular defects with massive autograft from the femoral head and one out of the two cases we did at the early beginning had component migration, hence our decision to use APC as our reconstruction method. We had used the DePuy APC to reconstruct our acetabulum. The APC provides a large contact area between the implant and the remaining pelvic bone, thereby distributing joint forces over a large area. This theoretically decreases the chances of implant migration. The bone graft placed deep to it is thus protected from these forces that are responsible for graft failure. This protection helps in consolidation and reconstitution of the acetabular bed.[27,28]

Most of our patients had type 3 defects in their acetabulum. D'Antonio classification[2] describes this type as a combined segmental and cavitary loss which leaves the acetabulum with unsupportive structures. This makes it difficult to place a cup with proper cup orientation.

Although the use of bulky femoral head allografts and cemented sockets to reconstruct acetabular defects has given short-term success, Jasty and Harris have reported

a 32% failure rate in 38 hips at a mean follow-up of 6 years, and there was a 58% failure rate of those whose acetabulum required more than 66% grafting. Although their patient population have a similar characteristic with ours, the outcome of our patients was better even though we were dealing with patients who had primary THR. We had a complication rate of 5.2%. One of our patients had a dislocation 12 weeks post operation which we managed conservatively by closed method of reduction under sedation and muscle relaxation. The other complication was that of broken screws which did not in any way affect the stability of the implant. There was no aseptic loosening even at 5 years which is contrary to the findings of Taylor *et al*.[29] who had a 12% aseptic loosening, and we believe that this variance may be due to the difference in the patients' cohorts as they postulated. After follow-up at 1 year and 5 years, the hips showed significant improvement concerning pain, gait, and mobility based on HHS and were able to return to their various professions.

We have assessed the performance of the use of APC for acetabular construction of the acetabulum during primary THR, and we found it very useful in our environment considering the prevailing economic situation which obviously affects our inventory. Apart from the other options not being available, not many patients can afford a reoperation if they fail taking into consideration the high failure rate associated with it.

Conclusion

Complex THR resulting from either failed treatment of traumatic fracture and dislocation of the hip or painful neglected congenital dislocation of the hip is technically demanding and presents a difficult surgical problem. APC provides a satisfactory solution for patients who present in this category with acetabular deficiency.

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Conflicts of interest

There are no conflicts of interest.

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