The Egyptian Journal of Hospital Medicine (October 2021) Vol. 85 (1), Page 3425-3430

# Revision of Total Hip Replacement with Acetabular Deficiency

**Malak Nader Yousef Ragheb*, Khaled Mohamed Hassan,**
**Ashraf Abl-Eldayem Mohamed, Ahmed El-Sayed El-Malt**
Department of Orthopedic Surgery, Faculty of Medicine - Zagazig University
***Corresponding authors:** Malak Nader Yousef Ragheb, **Mobile:** (+02) 01228085576, **Email:** dr_malak_josef@yahoo.com

## ABSTRACT

**Background:** The paradigm of revision surgery has been evolving constantly. There is a wide range of surgical options for successful reconstruction.

**Objective:** This study aimed to evaluate the results of reconstruction techniques in acetabular deficiency.

**Patients and methods:** A prospective interventional design included patients with acetabular deficiency who were admitted to Orthopedic Department at Zagazig University Hospitals. We had 10 patients with acetabular deficiency (Three were classified as Paprosky IIIA; one of them was AAOS IIB and two were AAOS III, Two were classified as Paprosky IIIB and AAOS III, Two were classified as Paprosky IIA and AAOS IIA; one was Paprosoky IIB and AAOS IIB and Two patients were classified as Paprosky IIC; one of them was AAOS IIB and the other was AAOS III). The evaluation and follow up of patients depended mainly on the Harris hip score, which evaluates the patient clinically preoperatively and postoperatively.

**Results:** All the patients reached full weight bearing between 7 and 9 weeks after surgery. Revision total hip replacement (THR) was the treatment of choice for patients with severe groin pain and apparent acetabular deficiency. Restoration of the normal center of rotation was essential for the joint biomechanics and survival of the prosthesis.

**Conclusion:** There was no method of reconstruction of acetabulum superior to another method; each method had specific indication, which differs according to the percentage of acetabular coverage and bone stock. Patients with mild to moderate acetabular deficiency (Paprosky I, IIA and IIB) were managed by using acetabular augmentation graft or small acetabular component with medialization.

**Keywords:** Hip replacement, Paprosky, Acetabular deficiency.

## INTRODUCTION

Total hip replacement (THR) is an increasingly performed common surgery. In spite of the fact that most patients have acceptable joint stability, about 17% of these surgeries fail and require surgical correction and revision. Cases that need revision for total hip may have isolated acetabular bone defect (12.7%), isolated proximal femur bone defect (13.2%), combined acetabular and femoral bone defect (41.1%), isolated prosthetic head and liner revision due to component failure (12.6%), arthrotomy and removal without revision (10.9%) and not otherwise specified revision in 9.5% of cases [(1)].

The common causes of revision after primary total hip replacement include instability of the joint (35%), aseptic loosening (30%), osteolysis and polyethylene prosthesis wear (12%), infection (12%), recurrent dislocation (9%) and periprosthetic fracture (2%) [(2)]. Old prostheses such as ceramic biomaterials and polyethylene formulations cause acetabular wear so they were modified during the first decade of the 2000s by introducing thermally stable prostheses with less friction with the acetabulum [(3)].

Mostly in cases of acetabular component revision in total hip replacement (THR) there will be variable degrees of bone loss. Minimal defects with an intact labrum acetabulare are not usually symptomatic. Most of these cases can be managed with an uncemented hemispherical cup [(4, 5)]. Very satisfying results have also been recorded for acetabular component revision with impaction of bone graft and cemented hemispherical cups [(6, 7)].

Revision of acetabular component is a challenging problem when bone stock is severely deficient [(8)]. Reconstruction of this discontinuity has high morbidity and failure rates [(9)]. There are many classifications for assessment of acetabular bone loss such as Paprosky classification [(10)], AAOS "American Academy of Orthopedic Surgery" classification [(11)] and Saleh classification [(12)].

These classifications aim to choose the proper management or to compare different results but often have poor inter- and intra-observer correlation [(13, 14)]. Reviewing and evaluating the current techniques and guide-lines is essential to decrease the need to perform a second revision after this surgery [(15)]. This study aimed to evaluate the results of reconstruction techniques in acetabular deficiency.

## PATIENTS AND METHODS

A prospective interventional design included ten patients with acetabular deficiency who were admitted to Orthopedic Department at Zagazig University Hospitals.

### Inclusion criteria:

Patients with primary THR in age > 18 years old of both gender. Post-traumatic fracture acetabulum. Healed infectious disease.





Received: 14 /6 /2021
Accepted: 10 /8 /2021

**Exclusion criteria:**

Patient with persistent inflammatory disease, patients with active infected transplant and neurological disease as cerebral palsy.

**Operative Assessment:**

History had been taken from the patient, including the date of the complaint. Physical examination had been documented by Harris hip score, which is responsible for assessment of patients preoperatively and postoperatively. The patients will have the following radiological examinations: An antero-posterior (AP) view of plevis and lateral view of hip and computed tomography (CT) in 6 cases.

Successful revision surgery can be achieved by proper planning, which can be divided into three major steps: preoperative planning, surgical technique, evaluation and prevention of postoperative complications.

We had 10 patients with acetabular deficiency (Three were classified as Paprosky IIIA; one of them was AAOS IIB and two were AAOS III, Two were classified as Paprosky IIIB and AAOS III, Two were classified as Paprosky IIA and AAOS IIA; one was Paprosoky IIB and AAOS IIB and Two patients were classified as Paprosky IIC; one of them was AAOS IIB and the other was AAOS III).

**Surgical Technique**:

The skin and subcutaneous fat were incised to the fascia, the fascia was incised over the mid trochanter in line with the femoral shaft then the gluteus maximus was split along its fibers proximally then fascia was retracted to expose abductors beneath this layer. Refreshment of the edges can be done to ensure better healing chances. The dissection is facilitated by external rotation and flexion, the assistant on other side of the table gently rotates the limb by placing the leg as hip externally rotated and knee flexed. The labrum was incised at the proximal extent of the flap to aid in dislocation of the hip joint. A bone hook was placed around the femoral neck anteriorly and the femoral head was dislocated by traction on the bone hook while externally rotating the leg. Dislocation of the hip prosthesis by flexion, adduction and external rotation simultaneously with traction of the neck of the femoral component. After socket removal, the cement can be excised under direct visualization. Osteotomes or high-speed burrs can be used to fractionate the cement, and curets are used to remove cement fragments and underlying fibrous and inflammatory tissue. The amount of intrapelvic cement is often larger than the exposed tunnel and should be left in situ. Curved gouges were then used to follow the contour of the implant as the bone-implant interface is disrupted. This proceeds circumferentially from the periphery to the dome.

Leg length can be determined by bringing both legs together and directly palpating the medial malleolus clinically and radiographically can be determined by measuring the distance between the teardrop and the lesser trochanter and comparing the result with the opposite side. The wound and the hip joint were irrigated thoroughly, a deep suction drain can be utilized, and then the anterior flap (gluteus medius, gluteus minimus and the anterior capsule) was returned to its anatomic position at the greater trochanter by heavy absorbable suture. Then, the fascia of Gluteus maximus and the fascia lata were closed interrupted heavy with by absorbable suture. Finally, the subcutaneous tissue was closed with absorbable suture and the skin was closed with skin staples.

**Postoperative management and follow up:**

The affected limb was placed in abducted and neutral position. Rehabilitation of active flexion and extension of the hip joint began a week post-operatively. Patients are encouraged to walk initially with crutches a six to eight weeks after surgery and eventually to give up the stick 12 weeks after surgery. In the outpatient clinic, evaluation by Harris hip score and serial x-ray evaluation after two weeks, a month, three months and six months was done.

**Ethical approval:**

**The study was approved by the Ethical Committee of Zagazig Faculty of Medicine. Informed consents were obtained from all patients in this research. Every patient received an explanation for the purpose of the study. All given data were used for the current medical research only. This work had been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.**

***Statistical analysis***

Data were collected and analyzed using Microsoft Excel software. Data were then imported into Statistical Package for the Social Sciences (SPSS version 20.0) software for analysis. According to the type of data; qualitative were represented as number and percentage, while quantitative continues data were represented by mean ± SD. Differences between quantitative independent multiple by ANOVA. P value was set at $\leq$ 0.05 for significant results & $<$ 0.001 for highly significant result.

**RESULTS**

The present study showed that the mean of preoperative Harris Hip Score (HHS) was 28.3 (Table 1). The cup presented at the time of revision was shown in (Table 2). The current study illustrated the analytical results of pain, limp, support, distance walked and sitting. There was highly significant improvement in pain ($P < 0.001$) from average 10 points (10-20) preoperatively to average 40 points postoperatively (30-40). There was highly significant improvement in limp ($P < 0.001$) from average 0 points (0 -5) preoperatively

to average 8 points (5 -8) postoperatively. There was highly significant improvement in support (P < 0.001) from average 2 points preoperatively (0 -11) to average 7 points (3 -11) postoperatively. There was highly significant improvement in distance walked (P < 0.001) from average 2 points (0 -5) preoperatively to average 8 points (8-11) postoperatively. Furthermore, there was highly significant improvement in sitting from (P < 0.001) average 3 points (0-3) preoperatively to average 5 points (3-5) postoperatively (Table 3). The relation between support preoperatively & postoperatively was shown in (Figure 1).

There was highly significant improvement in public transportation (P < 0.001) from average 0 points (0-1) preoperatively to average 1 points postoperatively (0-1). There was borderline improvement in stairs (P < 0.67) from average 1 points (1-2) preoperatively to average 2 points (2-4) postoperatively. There was significant improvement in put on shoes and socks (P < 0.24) from average 0 points preoperatively (0-4) to average 2 points (2-4) postoperatively. There was highly significant improvement in absence of the deformity (P < 0.001) from average 4 points (0-4) preoperatively to average 4 points (0-4) postoperatively. Moreover, there was highly significant improvement in range of motion (P < 0.001) from average 1 points (0-2) preoperatively to average 4 points (2-5) postoperatively. Furthermore, total points of the Harris hip score showed highly significant improvement in total hip score points (P < 0.001) from average 25 points (15-57) preoperatively to average 83 points (60- 94) postoperatively. At the same time, the qualitative results reported by the patients and the surgeons were excellent (90 – 100) in one case, good (80 -89) in three cases, fair (70 – 79) in four case and poor < 70 in two cases (Table 4). The relation between absence of deformity preoperatively & postoperatively was shown in (Figure 2). The relation between the ability of putting shoes preoperatively & postoperatively was shown in (Figure 3).

**Table (1):** The preoperative HHS in the studied group

| HHS | Studied group (n=10) |
|---|---|
| **Mean HHS** | 28.3 |
| **Min – Max** | 15 – 45 |

**Table (2):** The cup presented at the time of revision in the studied group

| Type of prosthesis present | Studied group (n=10) | |
|---|---|---|
| | No | % |
| **Cemented THA** | 3 | 30% |
| **Cement less THA** | 3 | 30% |
| **Bipolar** | 4 | 40% |

**Table (3):** Pre and postoperative analytical results of patients regarding pain, limb, support, distance walked and sitting

| Variables | Preoperative Median (Range) | Postoperative Median (Range) | Wilcoxon sign rank test | P Value |
|---|---|---|---|---|
| Pain | 10.00 (10.0-20.0) | 40.00 (30.0-44.0) | -4.15 | <0.001 (S) |
| Limb | 0.00(0.0-5.0) | 8.00(5.0-8.0) | -3.25 | <0.001 (S) |
| Support | 2.00(0.0-11.0) | 7.00(3.0-11.0) | -3.82 | <0.001 (S) |
| Distance walked | 2.00(0.0-5.0) | 8.00(8.0-11.0) | -4.04 | <0.001 (S) |
| Sitting | 3.00(0.0-3.0) | 5.00(3.0-5.0) | -3.93 | <0.001 (S) |

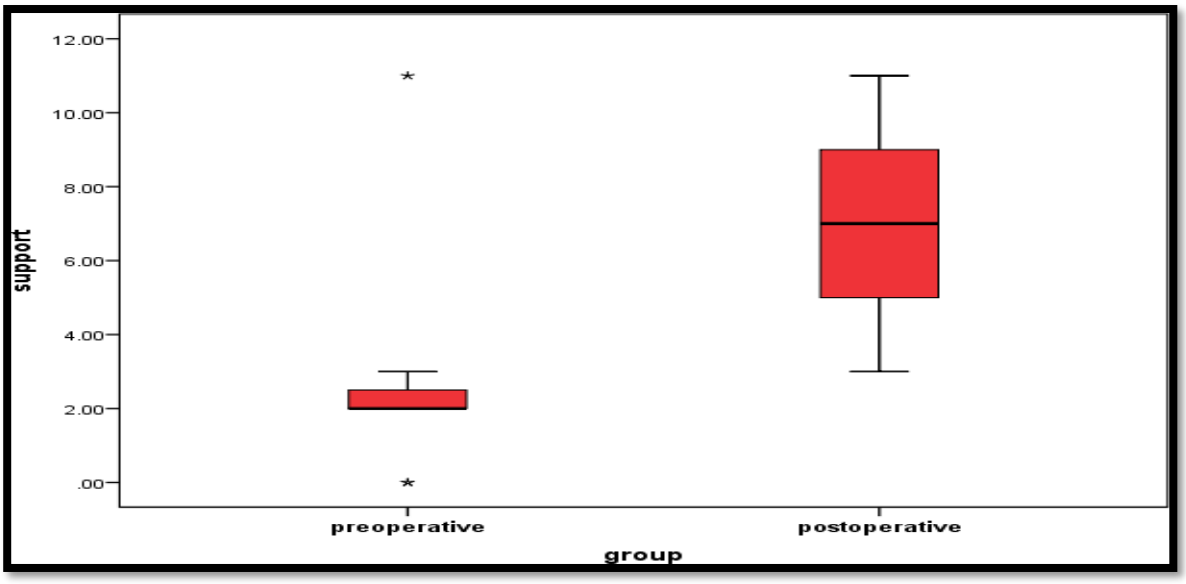


**Figure (1):** Relation between support pre- & post-operatively

**Table (4):** Pre and postoperative analytical results of patients regarding entrance of public transportation, stairs, put in shoes & socks, absence of deformity, range of motion and total hip score points

| Variables | Preoperative | Postoperative | Wilcoxon sign rank Test | P value |
|---|---|---|---|---|
| | Median (Range) | Median (Range) | | |
| Enter public transportation | .00 (0.0-1.0) | 1.00 (0.0-1.0) | -4.12 | <0.001 |
| Stairs | 1.00 (0.0-2.0) | 2.00 (1.0-4.0) | -4.32 | 0.67 |
| Put on shoes & socks | .00 (0.0-4.0) | 2.00 (0.0-4.0) | -1.17 | 0.24 |
| Absence of deformity | 4.0 (0.0-4.0) | 4.00 (4.0-4.0) | -3.99 | <0.001 |
| Range of motion | 1.00 (0.0-2.0) | 4.00 (2.0-5.0) | -3.06 | 0.002 |
| Total hip score points | 25.00 (15.0-57.0) | 83.00 (60.0-94.0) | -4.11 | <0.001 |

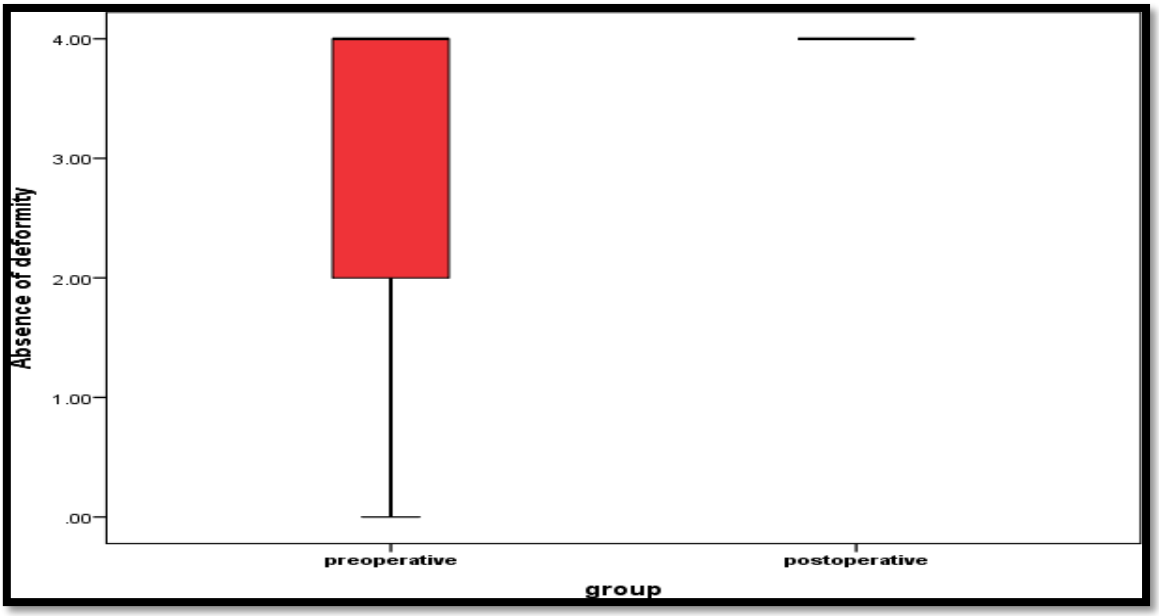


**Figure (2):** Relation between absence of deformity

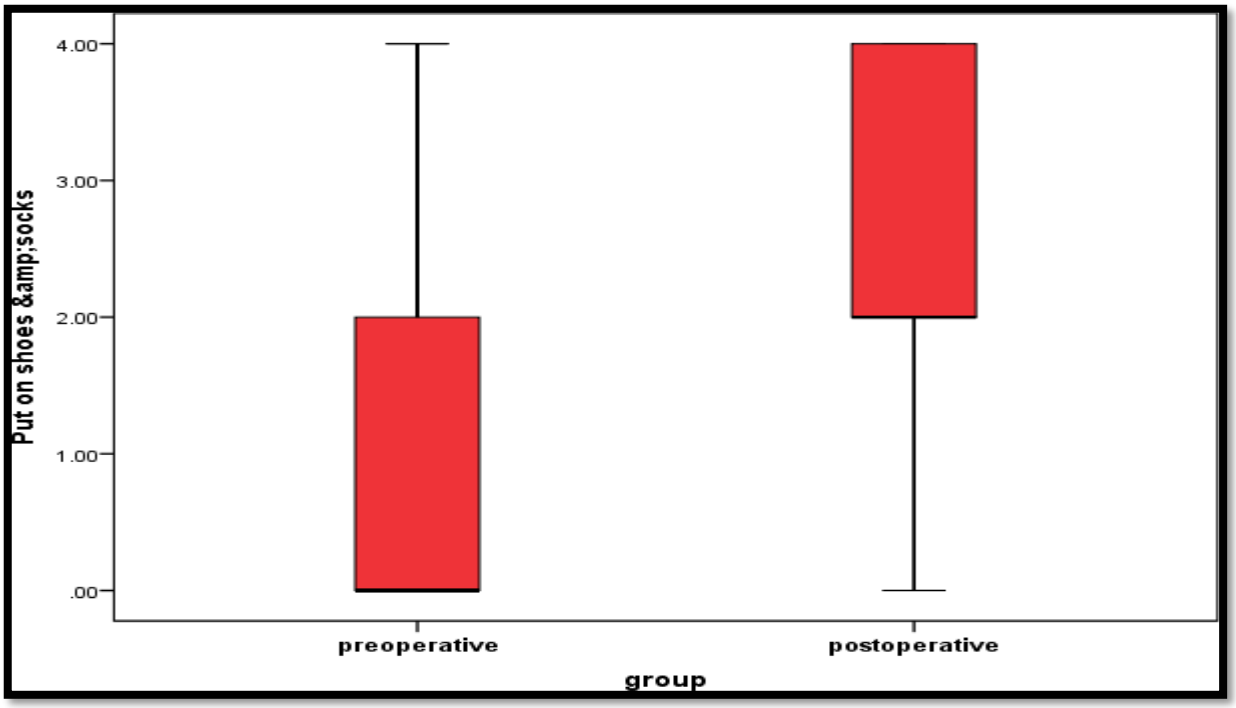


**Figure (3):** Pre- & post-operative relation between the ability of putting shoes

## DISCUSSION

In revision total hip arthroplasty, reconstruction of acetabular defect is a considerable technical problem to the surgeon. There are many causes of acetabular deficiency as aseptic loosening, polyethylene wear infection, inflammatory disease as rheumatoid arthritis, acetabular protrusion and direct trauma. Inadequate acetabular bony coverage leads to unstable fixation of acetabular component and early aseptic loosening [(11)].

There are many classifications for acetabular deficiency as Paprosky classification and AAOS classification, which determine the method for reconstruction depending on the site and size of the defect. These include using of a small acetabular component, implantation of acetabular component at high hip center within 5 mm of anatomical site, impaction of bone graft and structural bone grafting, using of trabecular metal augmentation and reinforcement ring [(7)].

The goals of reconstruction of the acetabulum in the present study were to reconstitute acetabular bone stock, ensure the fixation of the acetabular component, restore the hip center and restore the leg length.

The pain following revision total hip arthroplasty may be due to acetabular erosion or loosening of the prosthesis. The pathology here may be caused by impaction, or incongruence between the acetabulum and femoral head. In this study patients had no severe groin pain postoperatively. Two patients (20% of patients) who had moderate pain that responded only to strong analgesics preoperatively experienced no pain postoperatively. Five patients (50% of patients) with severe pain preoperatively had only mild affordable pain postoperatively. Only three patients (30% of patients) who had severe pain preoperatively experienced moderate pain responding to analgesics postoperatively. At the end of follow-up, 6 (60%) of the patients were using cane only for long walks, 3 (30%) patients were able to walk without support, and 1 (10%) needed cane most of time. These results are in agreement with **Saleh *et al.* [(12)], Johanson *et al.* [(14)]** and **Reid *et al.* [(15)].** The classification of **Paprosky *et al.* [(10)]** is extremely useful because there is a direct relationship between the acetabular migration and early mechanical failure. We have no case with incidence of cup loosening until the last follow up.

In our study we used allograft augmentation for 2 patients with Type IIA acetabular deficiency. Müller ring was the choice in three patients with Type IIB and IIC deficiency. Patients with type III deficiency were surgically revised by using Kerboull plate (2 patients) and Burch Schneider ring (3 patients). By using femoral head extrusion index, we can determine if there is need for acetabular reconstruction or not. If acetabular component is covered by the bony host acetabulum by 75% - 80 %, there is no need for method of reconstruction. These results are in agreement with studies of **Paprosky *et al* [(16)]** and **Sculco and Tate [(17)].**

From the results obtained, it was demonstrated that there was marked improvement in relieveing pain, decreasing the severity of limping, increasing the duration of walk, increasing the ability of walk without crutches, increasing the abilities in using public transportation, using the stairs and putting the shoes alone and finally increasing the range of motion of the hip joint. Additionally, there was highly significant improvement in the total points of the Harris hip score ($P < 0.001$) from average 28.3 points (15-45) preoperatively to average 80.1 points ( 69-92) postoperatively.

## CONCLUSION

There is no method of reconstruction of acetabulum is superior to another method, each method has specific indication, which differs according to the percentage of acetabular coverage and bone stock. Patients with mild to moderate acetabular deficiency (Paprosky I, IIA and IIB) were managed by using acetabular augmentation graft or small acetabular component with medialization. Larger acetabular deficiency (Paprosky IIB, IIC, IIIA and IIIB) could be managed by large acetabular shells with multiple holes fixed with postero-medial cancellous screws or acetabular reinforcement ring with hooks (either superior or both superior and inferior).

**Financial support and sponsorship:** Nil.

**Conflict of interest:** Nil.

## REFERENCES

1. **Lohmander L, Engesaeter L, Herberts P *et al.* (2006):** Standardized incidence rates of total hip replacement for primary hip osteoarthritis in the 5 Nordic countries: similarities and differences. Acta Orthop., 77: 733-740.
2. **Bozic K, Durbhakula S, Berry D (2005):** Differences in patient and procedure characteristics and hospital resource use in primary and revision total joint arthroplasty: a multicenter study. J Arthroplasty, 20: 17–25.
3. **Kurtz S, Patel J (2016):** The UHMWPE biomaterials handbook: ultra-high molecular weight polyethylene in total joint replacement and medical devices. 3rd ed. Oxford, UK: Elsevier, Inc., Pp: 57. https://www.elsevier.com/books/uhmwpe-biomaterials-handbook/kurtz/978-0-12-374721-1
4. **Hallstrom B, Golladay G, Vittetoe D *et al.* (2004):** Cement less acetabular revision with the Harris-Galante porous prosthesis. Results after a minimum of ten years follow-up. J Bone Joint Surg., 86: 1706-11.
5. **Templeton J, Callaghan J, Goetz D *et al.* (2001):** Revision of a cemented acetabular component to a cementless acetabular component. A ten to fourteen year follow-up study. J Bone Joint Surg., 83: 1706- 11
6. **Schreurs B, Bolder S, Gardiniers J *et al.* (2004):**

Acetabular revision with impacted morsellised cancellous bone grafting and a cemented cup: A15- to 20- year follow-up. J Bone Joint Surg., **86-B**: 492-97

7. **Schreurs B, Keurentjes J, Gardeniers J *et al.* (2009):** Acetabular revision with impacted morsellised cancellous bone grafting and a cemented acetabular component: A 20- to 25-year follow-up. J Bone Joint Surg., 91: 1148-53.
8. **Fernandez-Valencia J, Gallart X, Tomás X *et al.* (2015):** Radiography versus multidetector computed tomography in assessing graft integration after acetabular reconstruction. J Orthopaedic Surg., 23: 370-4.
9. **Berry D, Muller M (1992):** Revision arthroplasty using an antiprotrusio cage for massive acetabular bone deficiency. J Bone Joint Surg., 74: 711-15.
10. **Paprosky W, Perona P, Lawrence J** (**1994):** Acetabular defect classification and surgical reconstruction in revision arthroplasty. A 6- year follow-up evaluation. J Arthroplasty, 9: 33-38.
11. **D'Antonio J (1992):** Periprosthetic bone loss of the acetabulum: Classification and management. Orthop Clin North., 23: 279-83.
12. **Saleh K, Holtzman J, Gafni A** (**2001):** Development, test reliability and validation of a classification for revision hip arthroplasty. J Orthop Res., 19: 50-55.
13. **Campbell D, Garbuz D, Masri B** (**2001):** Reliability of acetabular bone defect classification systems in revision total hip arthroplasty. J Arthroplasty, 16: 83-86.
14. **Johanson N, Driftmier K, Cerynik D *et al.* (2010):** Grading acetabular defects. The need for a universal and valid system. J Arthroplasty, 3: 25-28.
15. **Reid C, Grobler G, Dower B *et al.* (2012):** Revision total hip arthroplasty: addressing acetabular bone loss. SA Orthopaedic Journal, 11: 34:46.
16. **Paprosky W, Perona P, Lawrence J (1994):** Acetabular defect classification and surgical reconstruction in revision arthroplasty: a 6 year follow-up evaluation. J Arthroplasty, 9:33--44.
17. **Sculco T, Tate D (1999):** Blood Management in Revision Total Hip Arthroplasty. In: Bono J, McCarthy J, Thornhill T, Bierbaum B, Turner R, editors. Revis Total Hip Arthroplast. New York: Springer, Pp: 118–23. https://www.springer.com/gp/book/9781461271314.