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Research Article

The Use of Impaction Bone Grafting in Total Hip Arthroplasty Following Acetabular Fractures

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Abstract

Purpose

Patients suffering from osteoarthritis of the acetabulum after acetabular fractures often require a total hip arthroplasty. Reconstruction of acetabular bone loss in these cases is challenging. The aim of this work was to evaluate the results of mid-term follow-up using impaction bone grafting (IBG) and a cemented cup.

Patients and Methods

This work included 43 patients with post-traumatic osteoarthritis of the acetabulum and bone loss after acetabular fractures. Two patients were lost to follow-up. The remaining 41 patients consisted of 15 males and 26 females. Mean age was 69 years. The right hip was affected in 21 patients, while the left hip in 20. All patients were treated by total hip arthroplasty using IBG technique, Kerboul ring, and a cemented cup. Patients were evaluated clinically using Harris hip score and radiologically. Mean follow up was 4.1 years (range 3-7).

Results

At an average 4.1 years follow up, there was 100% implant survivorship and no evident risk for revision. The mean postoperative Harris hip score was 92.1 (range 61-95). Bone graft was completely incorporated in the acetabulum in all cases. Two patients had Brooker type I heterotropic ossification.

Conclusion

Acetabular reconstruction with impaction bone grafting using kerboul ring and a cemented cup after acetabular fracture is a reliable technique with acceptable mid-term results.

Introduction

The major cause of failure in total hip arthroplasty is aseptic loosening, which is usually accompanied with bone loss. Bone loss is a major concern of revision total hip arthroplasty (THA). While the problem is easier on the femoral side by passing the defect by long stems, the problem on the acetabular side is more difficult due to the need of restoration of the bone stock and restoration of the hip biomechanics [1]. Acetabular bone deficiencies can be managed with biological techniques (namely bone grafting), and can be managed by modular augments in patients who are unlikely to undergo further revisions [2].

The acetabulum is composed mainly of cancellous bone and impaction bone grafting has been a successful method of restoration of the acetabular deficiencies in revision hip arthroplasty [3-5].

The impaction bone grafting (IBG) technique was introduced for use in the acetabulum by Slooff *et al.* (6) and has proven to be effective in revision surgery. Different series have confirmed excellent results using this technique [7-10].

Cup migration and graft resorption are the main the main complications of this technique as reported by many authors [8-10].

The use of IBG technique for acetabular bone loss after failed management of acetabular fractures is challenging. We therefore evaluated patients undergoing acetabular revision surgery following acetabular fracture using IBG and a cemented cup in large bone defects to determine the ability to restore hip function and biomechanics, and also to report the incorporation of the graft.

Patients and Methods

Between January 1, 2011 and December 31, 2014, 43 patients underwent acetabular revision surgeries using IBG technique. The indication for surgery was acetabular deficiency secondary to failed acetabular fixation or failed conservative treatment of acetabular fractures. All patients were treated with a cemented dual mobility cup and impaction bone grafting which was protected by Kerboul ring. Two patients had died due to causes unrelated to the operation. The remaining 41 patients were available for follow up at a minimum of 3 years (mean: 4.1 years; range, 3-7).

All patients signed written informed consents. The study had been approved by our Menoufia university hospitals ethics committee and had therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

Mean age was 69 years (± 1.1). There were 26 females and 15 males. The right hip was affected in 21 patients, while the left hip in 20. The diagnosis was failed acetabular fixation in 36 patients and osteoarthritis of the hip following conservative treatment of acetabular fracture in 5 patients. The average time between the initial fracture and the revision acetabular surgery was 38 months (range, 11-44) (table 1).

Table 1: *Patients demographic data and type of the acetabular bone defect*

Demographic data	Conservative group	Operative group
Number	5	36
Mean age	66	68
Sex: male/female	3M/2F	29M/7F
Type of bone defect	3 combined, 2 cavitary	36 cavitary
Mean pre-op Harris hip score	44	46

Pre-operative defects were classified according to the American Academy of Orthopedic Surgeons (AAOS) [11]. Type 2 cavitary defects were present in 38 patients and type 3 combined defects in three.

All surgeries were done using a postero-lateral approach. The pervious metallic hardware in the group with previous acetabular fixation was removed when they interfere with the operating field (29 cases). The acetabular margins were defined and bone defects were determined. The acetabular bed was reamed and prepared in a standard fashion. Fresh-frozen femoral heads allograft from the bone bank was used in 31 cases and the patient head of femur was used in the other 10 cases. Bone chips were morselized manually using a rongeur with a size of 0.7 to 1cm^3 and impacted with acetabular reaming in a reverse direction. The acetabulum was cleaned and filled with bone graft to a thickness of at least 5mm. A dual mobility cup was cemented using antibiotic-loaded PMMA in all patients. kerboul ring was used to protect the graft. Cemented femoral prostheses were used in all cases.

All patients received prophylactic antibiotics (cefazolin) for 5 days. Indomethacin 25mg three times daily were given for 7 days to prevent heterotopic ossification. All patients received thrombosis prophylaxis with low-molecular-weight heparin for 35 days.

The postoperative rehabilitation protocol involved early mobilization using a walking frame and partial weight-bearing on the operated side for 3-6 weeks depending on the degree of the bone defect. After that, graduated return to full weight-bearing was allowed as tolerated. The patients used a crutch or a cane for at least 6 months after the operation.

Clinical evaluation of the patients was performed using Harris hip score [12] preoperatively and at 3 and 6 months post-operative, and then yearly afterwards. Standard AP and lateral radiographs of both hips and pelvis were made for all patients immediately after operation and at every follow up examination. Displacement of the acetabulum component was used to define a definitely loose cup. Impending failure was used to describe acetabular components showing a continuous radiolucent line greater than 2mm thick. The radiolucencies were assessed using the zonal analysis suggested by De Lee and Charnley [13]. The true acetabular position was defined using the method of Ranawat *et al.* [14]. Bone graft incorporation was also assessed by observing trabecular bridging and remodeling in serial follow-up radiographs. Radiographs were also reviewed for heterotopic ossification.

Results

The follow up period ranged from 3 to 7.6 years; with a mean of 4.1. At the latest follow up, the mean Harris hip score was 92.1 (range 61-95), with a mean improvement of 46.4 (range 37-62). Hip pain was relieved in all patients. Only six patients used analgesics (paracetamol 500mg) on long distance walking. Walking ability was improved in all patients. 33 patients were able to walk without aids; and 8 patients used a cane for outside walking. Leg length discrepancy was restored to less than one cm in all patients.

Radiologically, according to the criteria listed above, 39/41 patients had stable implants with no signs of loosening (Figure I). Possible acetabular loosening was found only in two patients; but no revision was required till the end of follow up. Bone graft was completely incorporated in the acetabulum in all cases. Two patients had Brooker type I heterotropic ossification. At an average 4.1 years follow up, there was 100% implant survivorship and no evident risk for revision (Figure 1).

Figure 1: *X ray of 67 years old male patients with failed internal fixation of left acetabular fracture (Heading)*

Figure 1A: *AP view shows massive acetabular defect with avascular necrosis of the head of the femur*

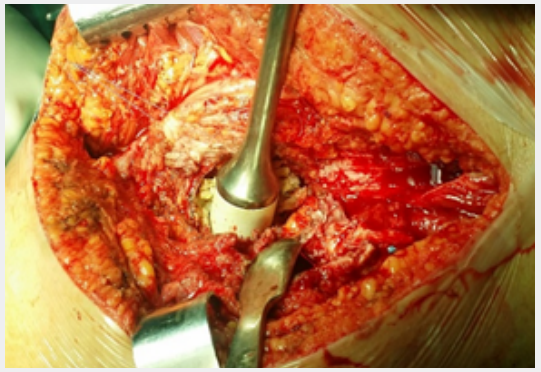

Figure 1B: *Intra-operative picture showing the method of impaction bone grafting.*

Figure 1C: *Intra-operative picture showing Kerboul ring and the cemented dual mobility cup*

Figure 1D: *Immediate post-operative X-ray showing reconstruction of acetabulum using impaction bone graft*

Figure 1F: *6 years post-operative Ap and lateral view x ray shows incorporation of the graft and stable prosthesis*

Regarding complications, one patient had a partial sciatic nerve palsy which was completely recovered by 3 months and two patients had signs of early infection which resolved by early debridement and antibiotics and retention of the components.

Discussion

Acetabular fractures are common fractures especially in elderly patients. Open reduction and internal fixation is the most commonly used method for management of these fractures [15]. Failed management of these fractures leads to significant disabilities and mal-function. Hip arthroplasty after failure of acetabular fracture surgery is challenging, and many problems may be encountered including bone loss in the acetabulum, pelvis deformities, infections, osteonecrosis, heterotopic ossification, old implants, and sciatic nerve palsy [16-18]. The principles of acetabular reconstruction include the creation of a stable acetabular bed, secure prosthetic fixation, bony reconstitution, and the restoration of a normal hip center of rotation with acceptable biomechanics. The type and the extent of acetabular bone loss (segmental or cavitary) determines the method of reconstruction.

Ronmess and Lewallen [16] reported revision and loosening rates for the cemented cups used in posttraumatic hip arthritis after acetabular fractures that were four-fold higher than those in osteoarthritic patients; their data demonstrated a cup revision rate of 13.7% and a loosening rate of 49%, with 27% of those hips having symptomatic loosening

More recently, Hammad *et al* [17] assessed 32 patients undergoing THA after failed dynamic hip screw fixation and found only one periprosthetic fracture and one dislocation. Clinical outcomes were good-excellent in 78% of patients at the final follow-up.

On the other hand, Pereira *et al.* [19] reported excellent results with 100% survivorship of impaction bone grafting in a retrospective review of 23 primary THAs at a mean 7.9-year follow-up. Similarly, Patil *et al.* [20] noted a good clinical outcome and satisfactory consolidation of autografts used for the treatment of protrusio in 30 primary THAs at a mean 4.2-year follow-up. Our results are comparable to those in primary THAs.

The advantage of grafting is that it avoids the need to use mega cups, oblong cups, or metallic tantalum augments to fill bony voids and to decrease the size of the bony socket, allowing the use of cups the same size as the normal contralateral side, thereby restoring the hip center of rotation to its proper site, restoring the normal biomechanics of the hip and improving the durability of the acetabular construct.

Due to the previous procedures the possibility of infection and heterotrophic ossification is high. In spit of applying strict aseptic maneuvers in our series, and using indomethacin, we had 2 cases of early infection and one case of heterotrophic ossification. The limitations of this study are the relatively small number of cases, and mid-term follow up. Longer follow up is needed to assess the longevity of this technique.

Conclusion

In conclusion, results of this research suggest that the conversion of posttraumatic acetabular arthritis after acetabular internal fixation to THA is clinically successful without increased risk of complications, and is a safe option that provides good functional and radiological results.

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