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Research Article

Massive structural bone allograft in revision total hip arthroplasty

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ABSTRACT

In revision total hip arthroplasty, beside difficult exposure and components removal, the surgeon may experience variable bone defects in femoral and acetabular sides. Managing the deficiencies of each bone has different options. One of them is the use of structural bone graft. All hip arthroplasty or total hip arthroplasty after acetabular fractures or periprosthetic fractures need structural allograft during 2005-2014 were included in this study. According to the results, average follow up period was 5.5 years (1to 9 years). Twenty nine patients met the criteria to be enrolled. Three cases of total hip arthroplasty after acetabular fracture, 2 cases of periprosthetic fracture (B3), 5 cases with conversion of hemiarthroplasty to total hip arthroplasty, 2 cases with conversion of fused hip to total hip arthroplasty, 1 case with conversion of girdle stone to total hip arthroplasty and 16 patients candidates of revision due to loosening and osteolysis formed our study population. Osteolysis is the main cause of allograft usage. Post-operative scores raised dramatically. These results suggest application of structural allograft is a useful way to manage massive bone defect in acetabular and also in femoral side and it prepares excellent primary support for stem and cup.

Keywords: Massive structural, Bone allograft, Total hip arthroplasty

INTRODUCTION

Revision total hip arthroplasty is a challenging operation (1, 2). Besides difficult exposure (3, 4) and previous component removal (5, 6), the surgeon may experience variable bone defects in femoral side and acetabular side (4). In order to manage the deficiencies of each bone, orthopedic surgeon faces different options. There are some classifications for describing the amount and location of deficiency and in this way, the options to overcome this problem. In acetabular side, in Paprosky classification (4, 7, 8), among patients with type 3 and some cases with type 2; there is a huge bone defect which need to be filled with a material. It can be tantallium augments (9, 10) or structural allograft (7, 11, and 12). In femoral side, Paprosky type 4 and 3 and some cases with type 2, bone losses should be considered and one way to overcome this problem is using composite cement allograft (13, 14, 15) for proximal femoral reconstruction. In literature, there are some controversies about clinical and radiological and functional outcomes of using structural allografts (16, 17) in revision total hip surgeries. Also, in type B3 periprosthetic fractures in which bone is not supportive (18, 19, 20) or there is not enough bone stock, proximal femoral allograft is a good choice. On the other hand, in some cases of total hip arthroplasty after previous acetabular fracture surgery, there may be some segmental bone deficiencies in acetabular side which need to be reconstructed with structural allograft (21, 22). So, the aim of the current study was to evaluate the

results of using structural allografts in both acetabular and femoral side in revision total hip arthroplasties.

MATERIAL & METHODS

Twenty nine patients (22 males and 7 females), mean age of the 48±1 years (23-74 year) undergone revision total hip arthroplasty or total hip arthroplasty after acetabular fractures or periprosthetic fractures in Sina hospital, Tehran university of Medical Sciences (Tehran, Iran) during the January 2005 to December 2014 met the criteria to be enrolled to the study. Patients' age, sex, preoperative and postoperative Harris hip scores and VOMAC scores, using of bone cement around cup or stem, type of stem (standard or long stem), conversion of hemiarthroplasty to total hip arthroplasty, type of bone graft (distal or proximal femur), location of bone graft in acetabualar side, length of femoral allograft, using of constrained liner, acetabular reconstruction ring, leg length discrepancy, type and duration of used walking aid after surgery, weight bearing condition after surgery, infection, graft resorption, hip dislocation, type of surgical approach, union of graft to host bone, component failure, and re-operation was registered. All patients visited at least one time preoperatively and in third and sixth and 12th month after surgery and then annually.

RESULTS

Twenty nine patients met the criteria to be enrolled. Average follow up period was 5.5 years (ranged one to nine years). There were 22 males and 7 females with average 46 years of age (24 to 71 year). Three of them died in this period of time. Three total hip arthroplasty after acetabulum fracture, two periprosthetic fracture B3, five conversion of hemiarthroplasty to total hip arthroplasty, two conversion of fused hip to total hip arthroplasty ,one conversion of girdle stone to total hip arthroplasty and 16 loosening and osteolysis were the underlying cause of bone defect.

Allograft was used only in acetabular side among 22 patients whereas it was used only in femoral side and both side among two and five cases, respectively. In acetabular side, there were 24 cases with paprosky type 3 and 3 cases with paprosky type 2 deficiencies. In femoral side, there were two cases of periprosthetic B3 fracture and one case with paprosky type 2 and three cases with paprosky type 3 deficiencies and one girdle stone. Ten proximal femoral allografts and 22 distal femoral allografts were used (three cases with both proximal and distal end). Seven composite cement allografts with long stem and 10 constrained liners and 14 acetabular reconstruction rings (four Ganz and 10 Burck Sneider rings, no Muller) were used.

Twenty patients used walker frame and nine applied axillary crutch with touch weight bearing in all of them for average four months (three to six months) and then partial weight bearing in 21 and full weight bearing in 8 patients. Nine patients needed reoperation due to component failure and graft resorption after three to eight years (average 4.5 years), six of them were in the full weight bearing group.

Table 1. the frequency of injury in patients

Variable	Frequency N (%)
total hip arthroplasty after acetabulum fracture	3
periprosthetic fracture B3	2
conversion of hemiarthroplasty to total hip arthroplasty	5
conversion of fused hip to total hip arthroplasty	2
conversion of girdle stone to total hip arthroplasty	1
loosening and osteolysis	16

Table 2. type of the allograft application in the patients

Allograft application	Frequency N (%)
acetabular side	22
femoral side	2
both side	5
acetabular side with paprosky type 3	3
proximal femoral allografts	10
cement allografts with long stem	7
constrained liners	10
acetabular reconstruction rings	14

Table 3. type of the treatment protocol in the patients

Treatment protocol	Frequency N (%)
walker frame	20
axillary crutch with touch weight bearing	9
partial weight bearing	21
weight bearing	8

Average Harris hip scores rises from 55 to 89 in the first year but decreases to 79 in the 9th year. Cemented cup used in 21 cases (14 inside the cage and other 7 without cage). There was one centimeter leg length discrepancy, averagely (0 to 1.5 centimeters). Two cases of infection were detected which ended to girdle stone in addition to four cases of hip dislocation; half of them responded to closed reduction and the other two required open reduction. There was also one case of disengagement of stem from constrained liner and head inside it that was treated by open reduction. Direct lateral approach (Harding) was used in 11 cases and posterior approach in 18 cases. Acetabular bone graft was inserted mainly in the dome area and for posterior column reconstruction. Femoral allograft length was average 12 centimeters (10 to 15 centimeters).

DISCUSSION

Osteolysis is the main cause of allograft usage (23, 24). It seems that previous generation of poly ethylene which was not highly cross linked was the underlying reason for osteolysis (25, 26). Acetabular side defects were more common than femoral side ones. It seems to be multifactorial. In total hip arthroplasty after acetabular fracture and in total hip arthroplasty after previous hemiarthroplasty, the main pathology was in acetabular side (27, 28) which needs to be reconstructed. In total hip after acetabular fracture, there was no need for femoral stem revision and in total hip arthroplasty after bipolar failure, stems were well fixed (29, 30) whereas in acetabular side there was cartilage and bone destruction especially in superomedial region (31). There were two cases which required femoral side only allograft. One of them was a case of missing proximal femur after failure of dynamic hip screw and the other case was a periprosthetic fracture type B3 without good bony support in proximal femur. There were 5 cases which required both acetabular and femoral side structural allograft. All of them were cases of cemented total hip arthroplasties. It means that poor cement insertion technique may be a major source of bone destruction in total hip arthroplasties (32, 33).

The most common type of acetabular bone defect was paprosky type 3. This type of bone deficiency need to be reconstructed with a space occupying material (34, 35) such as metal augments or structural allograft to restore length and offset of hip joint. Augments are expensive so the major cause of using allograft in our cases was the price. Distal femoral allograft is more useful than proximal femur allograft (36, 37) because it is a good source of both cancellous and cortical bone. We use proximal femoral allograft for proximal femoral bone defects and all of acetabular side defects and some other proximal femoral bone defects were managed with distal femoral allograft.

We used 14 acetabular reconstruction rings (38, 39, 40, and 41) to support the graft because the contact area of trial cup with acetabular host bone was very small and we believed that osseointegration could not be happened; thus in order to gain primary stability and future fusion of allograft to host bone, we preferred to support the allograft with ring. Constrained liners were used more than usual (10 cases) because in some cases such as previous Girdle stone and some cases of osteolysis, we could not find efficient abductors or greater trochanter to be reattached to prosthesis. Approximately one third of cases had bone resorption (42, 43). It was the major disadvantage of allograft in mid-term period which led to component failure (44, 45, and 46) and re-revision. Fortunately, in re-revisions, some parts of allograft were fused to host bone which let us perform another revision without using new allogaraft or augment. It means that the new defect is less than the primary one. From the whole nine cases of graft resorption, six had a history of full weight bearing in post-operative period. It means allograft cannot tolerate weight so we advise a long period of touch weight bearing. With all of precautions, we had 4 cases of hip dislocations. It may be necessary to use constrained liner with lower threshold in order not to have such dislocation rates (approximately 8%). There was also one case of disengagement of stem from the head which remained in the ring of constrained liner. The reason might be severe soft tissue release during revision surgery; soft tissue tension might be compromised and let the limb be distracted for approximately 2 centimeters then the stem jump outside the head which was confined by the supporting ring of constrained liner.

CONCLUSION

Structural allograft is a useful way to manage massive bone defect in acetabular side and also in femoral side and it prepares good primary support to stem and cup but it is necessary to maintain the patient non-weight or touch weight bearing to increase the longitivity of allograft bone.

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