



Comparative Study of Peripheral Rim Fixation Using Jumbo Cup in Revisional Hip Arthroplasty

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Purpose: It is challenging procedure to revise acetabular component in acetabulum with severe bone defect or deformity. The jumbo cup is good option for revisional arthroplasty in large bone defect. The purpose of this study is to compare the prognosis of revisional total hip arthroplasty using jumbo cup with peripheral rim fixation and no rim fixation.

Materials and Methods: We included the patients who had performed acetabular revisional total hip arthroplasty from January 2002 to March 2015 in our institute. Total of 51 hips (51 patients) were included. The mean follow up period was 51 months (range, 12 to 154 months) and mean age was 60.7 years (range, 30 to 81 years). We divided into two groups (peripheral rim fixation group and no rim fixation group) by anteroposterior and lateral plain radiograph. We compared survival rate, hip center change and clinical outcomes between two groups.

Results: There were 37 patients in peripheral rim fixation group and 14 patients in no rim fixation group. There was one patient who had aseptic loosening necessary to re-revision in rim fixation group and 3 patients in no rim fixation group. And one patient had superficial infection in rim fixation group and one patient had periprosthetic fracture in no rim fixation group. Survival rate was higher in the peripheral rim fixation group (97.3%) than no rim fixation group (78.6%, $P=0.028$)

Conclusion: Based on our findings, peripheral rim fixation might be recommended to improve short-term outcome after revision total hip arthroplasty using jumbo cup.

Key Words: Revisional arthroplasty, Jumbo cup, Peripheral rim fixation, Cementless

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INTRODUCTION

As time goes by the revisional arthroplasty of hip is increased as the primary hip arthroplasty is increased. The most common reason for revisional arthroplasty is osteolysis and loosening of implant and it is more common in acetabular component problem than femoral component¹.

Severe segmental defect of acetabulum usually require structural allograft and reinforcement cage², peripheral metal augmentation or bilobed cup³. But when peripheral rim of acetabulum is intact, jumbo cup with bone graft might be good option.

Whaley et al.⁴⁾ defined jumbo cup as minimum 66-mm diameter in male patients and 62-mm diameter in female patients or 10-mm diameter larger than the contralateral hip. Using of jumbo cup with porous coated in revisional arthroplasty make greater host bone contract and peripheral rim fixation^{4,6)}. The survival rate of jumbo cup is relatively high from 80% to 96%^{5,7-9)}. Some authors suggested that for better fixation of jumbo cup, peripheral rim fixation of acetabulum is essential¹⁰⁾. In this study, we compared the implant survival rate of rim fixation group and no rim fixation group using jumbo cup to revisional arthroplasty.

MATERIALS AND METHODS

From January 2002 to March 2015, 60 patients (60 hips) had revisional arthroplasty of acetabular component for any reason in our institute. We only included patients who followed up more than one year after operation. Three patients who died within one year after revisional arthroplasty and four patients who were not followed for minimum one year were excluded. And Paprosky type IIIb and pelvic dissociation patients also excluded. Total of 51 patients (51 hips) were included in our study. The mean follow up period was 51 months (range, 12 to 154 months) and mean age was 60.7 years (range, 30 to 81 years). The mean weight was 60.1 kg (range, 33-85 kg), the mean height was 158 cm (range, 141-187 cm), and

the mean body mass index was 23.2 kg/m² (range, 15.3-36.1 kg/m²). The preoperative diagnosis was mainly aseptic loosening (76.5%), 2nd stage revision as infection (9.8%), acetabular protrusion (9.8%) and recurrent dislocation (3.9%). All operations were performed by two senior surgeons. The posterolateral approach was used in all operation. If medial cavitory bone defect is present, we performed morselized bone graft with autogenic or allogenic bone. The autogenic bone was obtained from ipsilateral iliac crest of pelvis and allogenic bone was fresh-frozen chip bone for commercial use.

To prevent hip center change, we rimmed acetabulum inferiorly. The acetabular prosthesis was varied on the situation but mainly we used cementless porous coated acetabular cup (78.3%, Bencox cup, Corentec, Cheonan, Korea; 8.1%, Becox hybrid cup, Corentec). The articulation was mostly ceramic on ceramic (41 hips). And ceramic on polyethylene (8 hips) and metal on polyethylene (2 hips) used also as femoral stem type. All acetabular component size was more 10 mm larger than templated contralateral hip.

We divide the patients into two groups by acetabular rim fixation on initial postoperative anteroposterior and lateral plain radiograph. The rim fixation group is defined as superior and inferior rim is fitted with acetabular component on anteroposterior radiograph and anterior and posterior rim is fitted on lateral radiograph. The acetabular component position could not satisfy the above

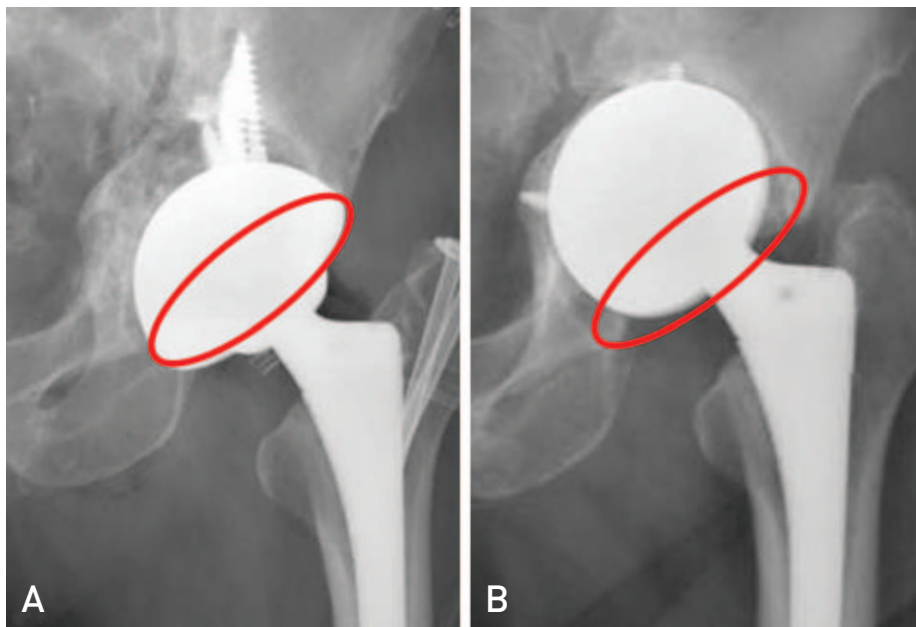


Fig. 1. The acetabular component is well fixed in the peripheral rim of acetabulum (A) but the acetabular component is medially protrude with not fixed in peripheral rim of acetabulum (B).

condition defined as no rim fixation group (Fig. 1). And we evaluated early complication like aseptic loosening, injection, and osteolysis according to the criteria of Engh et al.^{11). As jumbo cup can cause hip center elevation, we evaluated hip center change between groups^{12). The clinical outcomes were evaluated using Harris hip score (HHS)^{13).}}}

After discharge, routine follow-up visits were scheduled for 6 weeks, 3, 6, 9, and 12 months, and every 6 months thereafter. At every visit, we took radiographs and detail physical examination was done. The design and protocol of this retrospective study were approved by the institutional review board of our hospital.

Chi-square test was used for categorical variables, and Student's t-test for continuous variables. Survival curve was obtained by Kaplan-Meier methods. A P-value less than 0.05 was considered statistically significant. IBM SPSS Statistics 20.0 for Windows release ver. 20.0 (IBM Co., Armonk, NY, USA) was used for all statistical calculations.

RESULTS

The rim fixation group was 37 and no rim fixation group was 14. There was no significant difference of characteristics between rim fixation group and no rim fixation group (Table 1).

The demographics are not statistical different between two group except gender. Six patients were Parosky classification type 2A, 12 patients were type 2B, 10

patients were type 2C, and 9 patients were type 3A in rim fixation group. Two patients were Parosky classification type 2A, 7 patients were type 2B, 3 patients were type 2C, and 2 patients were type 3A in no rim fixation group. The preoperative diagnosis and Paprosky classification are not different statistically.

There is one patient who had aseptic loosening necessary to re-revision in rim fixation group and 3 patients in no rim fixation group (Fig. 2). And one patient had superficial infection in rim fixation group and one patient had periprosthetic fracture in no rim fixation group (Table 2). We defined end-point of implant survival as any condition that need re-revision. All cause of implant failure was aseptic loosening in our study. The overall prosthesis survival rate was 97% in rim fixation group and 79% in no rim fixation group (P=0.028) (Fig. 3). The 3 patients of rim fixation group had osteolysis lesion in DeLee and Chanley Zone 1 and two patients of rim fixation group in Zone 2 during follow up. No patients had osteolysis in no rim fixation group.

We evaluated hip center change as using jumbo cup hip center might be change after operation. The radiologic superior migration of hip center is 12.1±4.5 mm in rim fixation group and 11.3±5.6 in no rim fixation group (P=0.532). Lateral migration of hip center is 3.0±1.3 mm in rim fixation group and 2.3±1.5 mm in no rim fixation group (P=0.212).

The HHS of no rim fixation group was lower (75±7.6) than rim fixation group (85±8.5; P=0.045).

Table 1. Demographics of rim fixation group and no rim fixation group

	Rim fixation group (n=37)	No rim fixation group (n=14)	P-value
Gender			0.014
Male	18	4	
Female	19	10	
Age (yr)	60.9±11.5	60.2±8.7	0.354
Follow up (mo)	51±43.5	52±37.1	0.253
Diagnosis			0.085
Aseptic loosening	27	12	
2nd stage revision due to infection	3	2	
Acetabular protrusion	5	0	
Recurrent dislocation	2	0	
Paprosky classification			0.128
2A	6	2	
2B	12	7	
2C	10	3	
3A	9	2	
Cup size (mm)	63.5±6.9	63.9±6.2	0.246

Values are presented as number only or mean±standard deviation.

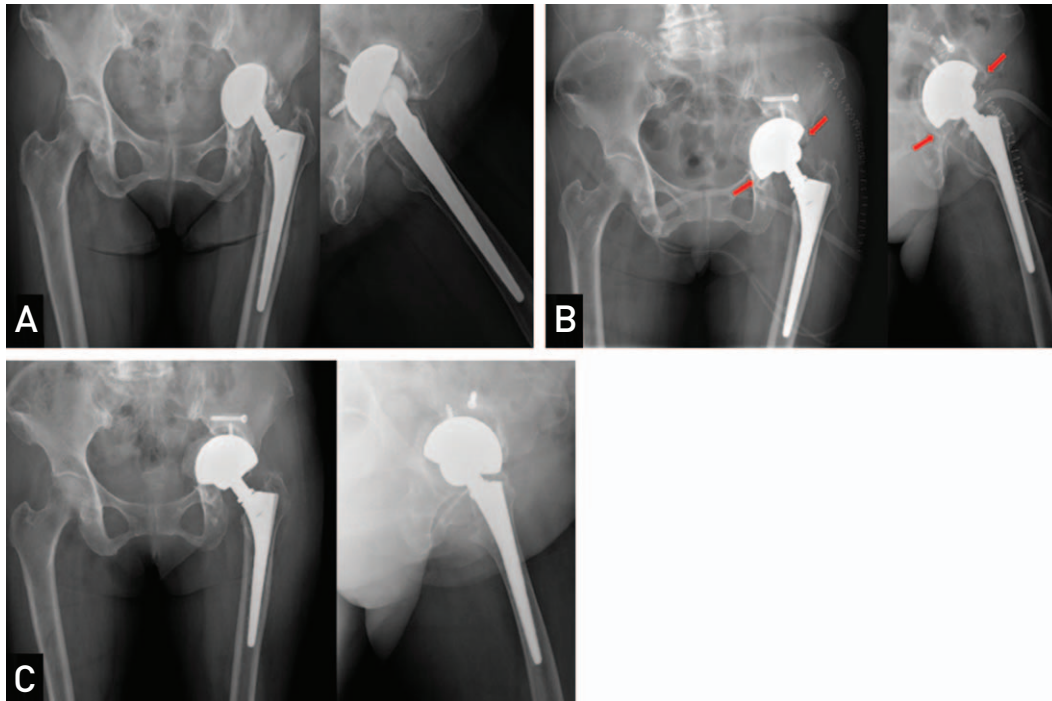


Fig. 2. (A) A female aged 71 years had acetabular protrusion of previous acetabular component. (B) Acetabular revision shows insufficient peripheral rim fixation (red arrows) with jumbo cup. (C) In postoperative 3 months, the acetabular component is rotated medially.

Table 2. Result of rim fixation and no rim fixation with using jumbo cup

	Rim fixation group	No rim fixation group	P-value
Aseptic loosening	1	3	0.026
Infection Superficial	1	0	0.544
Periprosthetic fracture	0	1	0.105
Osteolysis	3	0	0.281
Hip center change (mm)			
Superior	12.1±4.5	11.3±5.6	0.532
Lateral	3.0±1.3	2.3±1.5	0.212
Survival rate (%)	97	79	0.028

DISCUSSION

Acetabular bone defect in revisional arthroplasty is still challengeable. There are many ways to fix acetabular component in large acetabular defect. But if peripheral rim is intact, using jumbo cup and cavitory bone graft may excellent option. Gustke et al.¹⁴⁾ reported 196 hips had revisional arthroplasty with jumbo cup and mean followed for 10 years, the survival rate was 96%. The other study report the survival rate of jumbo cup is from 80% to 96%.^{5,7-9)}

For the better fixation of acetabular component, peripheral

firm fixation is more required than polar contact though there are not mechanical study as we know¹⁵⁾. In this study, we find more good result in using of jumbo cup with peripheral rim fitting manner. As the cementless jumbo cup has large area to contract host bone, we can expect more host bone ingrowth¹⁴⁾. One patient had aseptic loosening in rim fixation group in 31 months after operation and three patients in no rim fixation group in 1, 1 and 30 months after operation. The three cups were protruded into more medial side and rotated in one cup in no rim fixation group. The no rim fixation group had much weak fixation power than rim fixation group, so initial asepti-

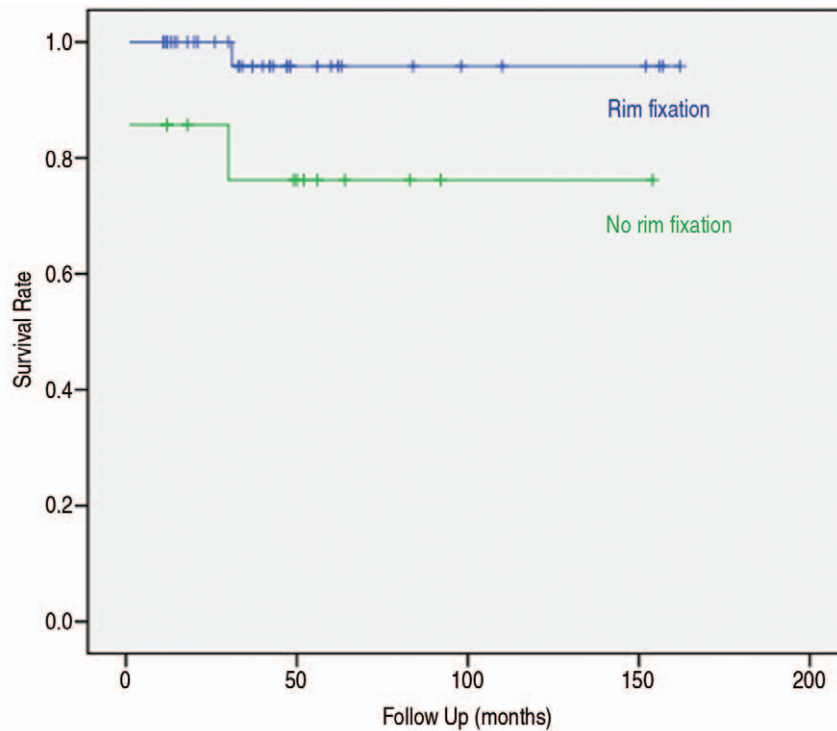


Fig. 3. Kaplan-Meier survival curve of rim fixation group and no rim fixation group.

loosening occurred more than in rim fixation group.

There were three patients who had osteolysis around cup in rim fixation group during follow up period. But these lesions was small size and made no difference in results. As we think, no progressing small osteolysis lesion is frequent in normal primary arthroplasty and this is because rim fixation group is three time more than no rim fixation group in this study.

But we could not use jumbo cup in large acetabular defect like lacking of superolateral defect, the posterior column defect or pelvic discontinuity for example Paprosky type IIIb¹⁶⁾. And jumbo cup might elevate of hip center than contralateral hip joint. Nwankwo and Ries.¹⁷⁾ published radiologic study of jumbo cup. Radiologic analysis showed a mean hip center elevation of 11 mm and average 1 mm of the measured hip center elevation than planned position at the interteardrop line. The elevated hip center may associated with hip instability, altered biomechanics and limb shortening¹⁸⁾. To prevent this problem, careful reaming starting with inferior acetabulum is required and if hip center elevation is detected during operation, adequate femoral stem and neck is necessary to compensate limb shortening.

The implant survival rate is more superior in rim fixation group than no rim fixation group (97%>79%). The main

problem of no rim fixation is rotation and medial protrusion of acetabular component because of weak medial support of bony structure. And if morselized bone graft is excessive in medial defect, the acetabular component is not well fixed withing peripheral rim, rim is protrude out of acetabular peripheral rim. We think this is also cause of fixation failure. The small size cup to fix within peripheral rim can cause also medial protrusion.

The identification of rim fixation during operation is situationally difficult due to restricted visual field and sometimes bone graft may be confused as peripheral rim. Occasionally results of plan radiograph shows no rim fixation even we confirmed rim fixation during the operation. The postoperative radiograph shows more exactly whether rim fixation or not.

We note several limitations in our study. This study is retrospective review and relatively small cases to statistical analysis and compare the survival rate between two groups. Radiologic evaluation of peripheral rim fixation or not is subjective. But for more objectivity security, 1 radiologist and 2 orthopaedic board certificants participate in radiologic evaluation. Screw fixation, cup position may also influence initial stability of implant, we did not took consider in this study. Lastly, the acetabular component is no single production. But all acetabular component are cementless

porous coated type and we did not use conventional polyethylene liner.

CONCLUSION

Although we need more follow period, using jumbo cup with peripheral rim fixation improves survival rate by acquiring maximal host bone contact in Paprosky 2A, 2B, 2C, 3A acetabular defect.

CONFLICT OF INTEREST

The authors declare that there is no potential conflict of interest relevant to this article.

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