

Comparison of Bipolar Hemiarthroplasty and Total Hip Arthroplasty using Large Heads in Patients with Femoral Neck Fractures

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대퇴 경부 골절 환자에서 큰 대퇴 골두를 이용한 인공 고관절 전 치환술과 이극성 반치환술의 비교

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Purpose: To compare the short-term clinical outcomes of total hip arthroplasty (THA) with a large diameter femoral head (36 mm) and bipolar hemiarthroplasty (BA) in physiologically active elderly patients with femoral neck fractures.

Materials and Methods: This non-concurrent clinical trial included 169 patients with femoral neck fractures, who had been treated with prosthetic replacement from February 2004 and June 2007. Eighty-nine and 80 cases underwent BA and THA, respectively. The mean follow-up period was 36 months (18-52). The clinical outcomes were analyzed, and the latest follow-up radiographs were assessed to determine the number of complications.

Results: The mean operation time was longer in the THA group. The pain, mobility, and walking ability factors were better in the THA group than in the BA group. There was no limitation in the range of motion in the early post-operative period and no dislocations were encountered in either group.

Conclusion: THA with a large diameter femoral head is recommended for the management of patients with femoral neck fractures.

Key Words: Femur, Neck fracture, Bipolar hemiarthroplasty (BA), Total hip arthroplasty (THA), Large head (36 mm)

INTRODUCTION

Intracapsular femoral neck fractures are common orthopedic injuries. However, there is some controversy regarding the optimal surgical treatment for these injuries.¹⁾ Prosthetic replacement of the femoral head is one of the options for treating a displaced intracapsular femoral neck fracture in elderly patients.²⁾ The proponents of arthroplasty suggest that replacing the femoral head eliminates

the risk of revision surgery due to serious complications such as head necrosis, nonunion of the fracture site, etc.³⁾ However, there is some controversy regarding the choice of prosthesis for the joint replacement in patients with intracapsular femoral neck fractures. Bipolar hemiarthroplasty (BA) has a higher incidence of groin pain secondary to acetabular erosion, as well as increased probability of revision arthroplasty.⁴⁾ Even though

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total hip arthroplasty (THA) provides good functional results and long-term survival compared with BA, it has several disadvantages such as component dislocation and decreased functional activity due to a limitation in extreme motion.^{5,6)} Larger diameter femoral heads (≥ 36 mm) have a larger range of motion and believed to be a valuable tool for preventing a dislocation in THA.⁷⁻⁹⁾ Based on this data, it was hypothesized THA with a 36 mm-femoral head will produce superior results without any serious complications compared with BH. We already reported on clinical data on the performance of THA using a large head in patients with a intracapsular femoral neck fracture.^{10,11)} However, it has limited statistical power because of the small sample size. We extended the sample size and analysed the result. The aim of this study was to evaluate the short-term clinical outcomes of THA with large diameter of head and BA in physiologically active elderly patients with displaced intracapsular femoral neck fractures.

MATERIALS AND METHODS

The relevant ethics committee at each participating study center reviewed and approved the study protocol, and all patients provided written informed consent before undergoing the screening procedures. This non-concurrent clinical trial (THA was performed at the first regular period of the time, and BA performed at the following

regular period of the time) included 169 patients with displaced unilateral intracapsular femoral neck fractures, who had been treated with prosthetic replacement from February 2004 and June 2007. One hundred sixty-nine patients underwent either THA or BA. The inclusion criteria were a normal cognitive function (a mini-mental score¹²⁾ of >6), an ability to be independent and ambulant prior to the injury, no pre-existing hip disease, age range of the patient between 65 and 90, femoral head more than 44 mm in diameter (If femoral head less than 44 mm can't use large femoral head (36 mm) component), and a fitness for surgery. The mean follow-up period was 36 months (18–52). For the THA group, the mean age of the patients was 75.5 (range, 66–85; 14 male and 66 female). The postoperative leg length discrepancy was -3.6 mm (SD, ± 2.4), and the difference in the abductor offset was 3.8 mm (SD, ± 2.1) shorter than contralateral normal side. For the BA group, the mean age of the patients was 77.6 (range, 60–85; 16 male and 73 female). The postoperative leg length discrepancy was -4.0 mm (SD, ± 2.6), and the difference in the abductor offset was 4.0 mm (SD, ± 2.0) (Table 1). A cementless metal shell with a porous coating (Trilogy[®], Zimmer Inc., Warsaw, IN) and 36 mm Cobalt–chrome femoral head and a highly cross-linked polyethylene liner with an inner diameter of 36 mm (Longevity[®], Zimmer Inc., Warsaw, IN) were placed in all patients undergoing THA. Based on the surgeon's preference,

Table 1. Data on the Total Hip Arthroplasty (THA) and Bipolar Hemiarthroplasty (BA) Group

	THA group*	BA group [†]
Average age (year, range)	75.5 (66–85)	77.6 (60–85)
Gender	Male (14), female (66)	Male (16), female (73)
Body weight (kg)	54.3	55.8
Femoral stem	Cementless (38), Cement (42)	Cementless (42), Cement (47)
Leg-length (\pm SD)	-3.6 mm (± 2.4)	-4.0 mm (± 2.6)
Abductor offset (\pm SD)	3.8 mm (± 2.1)	4.0 mm (± 2.0)
Cases (number)	80	89

*THA, total hip arthroplasty; [†]BA, bipolar hemiarthroplasty.

one or two screw augmentations were performed. Acetabular component was the Multipolar[®] (Zimmer Inc., Warsaw, IN) in BA. Versys (Zimmer Inc., Warsaw, IN) was used as components in the patients who underwent cemented femoral fixation (42 cases in group 1 and 47 in group 2) and FMT (Zimmer Inc., Warsaw, IN) was used as components in the patients who underwent uncemented femoral fixation (38 cases in group 1 and 42 in group 2). All the surgical procedures were performed by the single surgeon using a modified Hardinge's approach with the patient in the lateral position. All the patients had a capsular repair closure. Prophylactic antibiotics were administered to all patients. The post-operative protocol was the same in all patients. The patients were allowed to sit on the first post-operative day. They were allowed to stand with support when they were able to do so. There was no limitation in the ROM, and an abduction pillow was not used. The clinical and radiographic examinations were assessed by an independent surgeon, who had a few experience in the orthopedic department, and was blinded to the treatment method. The clinical outcomes of the two groups of hips were analyzed using the Harris Hip Score¹³⁾ and the Merle d'Aubigne and Postel method¹⁴⁾. The Harris hip score was classified as excellent (91–100), good (81–90), fair (71–80), and poor (61–70). The Merle d'Aubigne and Postel classification was categorized to six levels according to the level of pain, mobility, and ability to walk. The radiographic examinations included an anteroposterior (AP) view of the pelvis centered over the pubis, and a shoot through lateral of the hip. The femoral components were assessed using Engh's method¹⁵⁾ in the case with uncemented fixation, and Barrack's method¹⁶⁾ with cemented fixation at the postoperative radiographs. The patients were followed at 6 weeks, at 3 months, 6 months and then 1 year after the index operation.

The latest follow-up radiographs were assessed and compared with the original postoperative radiographs to determine the number of complications such as osteolysis, loosening, fracture, dislocation, etc. We also focused on the development of the early complications such as dislocation and infection. The relationship between the two groups in terms of the operation time and intra-operative bleeding volume was assessed using a Mann-Whitney test.

RESULTS

The Harris hip score of the THA group was excellent in 56 cases (70%) and good in 17 cases (21%). The Harris hip score of the BA group was excellent in 51 cases (57.3%) and good in 30 cases (34%)(Table 2). However, the difference was not statistically significant ($p=0.11$). From the Merle d'Aubigne and Postel classification, the level according to the pain factor was 4 in 4 cases (6%) in the THA group. The pain level of the BA group was 3 in 6 cases (7%) and level 4 in 10 cases (11%). The difference was statistically significant ($p=0.04$). The level according to the mobility factor was 6 in 72 cases (90%) in the THA group. The mobility level of the BA group was 6 in 63 cases (71%). The difference was statistically significant ($p=0.05$)(Fig. 1). The level according to the walking factor was 4 in 4 cases (5%) in the THA group. The walking level of the BA group was level 3 in 2 cases (3.4%) and 4 in 10 cases (11%)(Table 3). The difference was marginally significant ($p=0.06$). The

Table 2. The Harris Hip Score on the THA and BA Group

	THA group*	BA group [†]
Excellent	56 (70%)	51 (57.3%)
Good	17 (21.3%)	30 (33.7%)
Fair	7 (8.7%)	6 (6.7%)
Poor	0	2 (2.2%)

*THA, total hip arthroplasty; [†]BA, bipolar hemiarthroplasty.

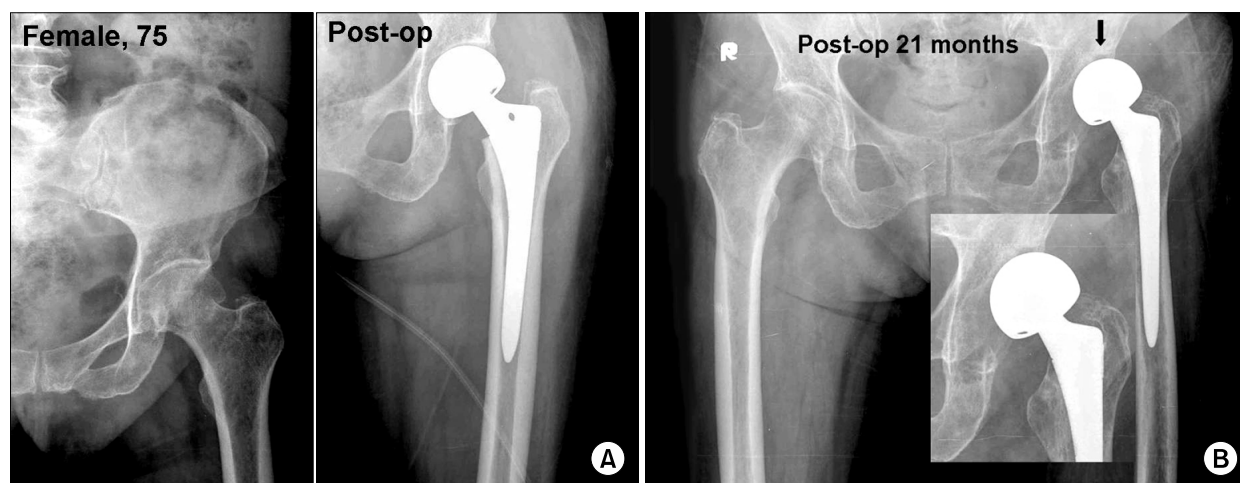


Fig. 1. (A) AP radiograph of the pelvis of a 75-year-old woman with Bipolar hemiarthroplasty in left hip. Postoperative radiograph shows 18 months, the Harris hip score was excellent. (B) AP radiograph of the pelvis at postoperative 21 months shows the upward migration of the bipolar cup. The Merle d'Aubigne and Postel classification was 3 in the pain factor and 3 in the walking ability factor.

Table 3. The Merle d'Aubigne and Postel Classification on the THA and BA Group

	THA group*			BA group [†]		
	Pain	Mobility	Walk ability	Pain	Mobility	Walk ability
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	6 (6,7%)	2 (2,3%)	2 (2,3%)
4	4 (5%)	2 (2,5%)	4 (5%)	10 (11,2%)	6 (6,7%)	10 (11,2%)
5	16 (20%)	6 (7,5%)	14 (17,5%)	18 (20%)	18 (20%)	20 (22,5%)
6	60 (75%)	72 (90%)	62 (78%)	55 (62,1%)	63 (71%)	57 (64%)

*THA, total hip arthroplasty; [†]BA, bipolar hemiarthroplasty.

mean operation time was 72.5 and 61.5 minutes in the THA and BA groups, respectively. The difference was statistically significant ($p=0.02$). The mean intraoperative blood loss was 470 ml and 455 ml in the THA and BA groups, respectively. The difference was not statistically significant ($p=0.096$). No complications including dislocations and infections developed in the two groups. The radiographic exams showed stable fixation in all patients with the uncemented femoral components, and Barrack type A or B in the cemented femoral components. There were no cases of osteolysis, loosening, and fracture in the pelvis or proximal femur.

DISCUSSION

The prosthetic replacement of the femoral head in the active elderly patients with intracapsular femoral neck fractures eliminates the concern regarding the re-operation due to fixation failure, nonunion, and avascular necrosis of the femoral head.^{2,3} However, the best choice of the prosthesis for joint replacement in patients with femoral neck fractures is controversial. BA has the advantages of a lower probability of dislocation and being a simple surgical technique. However, the main concern is the possibility of occurrence of the protrusio acetabuli from the acetabular erosion, groin and thigh pain, less survival at the long-

term follow-up than THA, and the higher probability of a second operation.⁴⁾ Even though the total hip arthroplasty (THA) provides good functional results and long-term survival compared with BA, it can develop serious complications such as a dislocation in the early post-operative period.^{5,6)} Patients with the intracapsular femoral neck fractures have a high risk of a post-operative dislocation. The size of the replaced head is a contributing factor to incidence of dislocation.¹⁷⁾ Larger diameter femoral heads are believed to have less chance of dislocation and further more facilitates increased ROM. There is limitation in the widespread use of larger diameter femoral head against conventional polyethylene because of the risk of accelerated wear and resulting osteolysis. The development of new polyethylene with improved wear characteristics in the early laboratory and clinical studies could be reduce the this risk. In this series from the Merle d'Aubigne and Postel classification categorized to six levels according to the level of pain, mobility, and ability to walk, the THA group had better results. Despite there being no limitation of ROM in the early post-operative period, no dislocation was encountered in either group. However, there is some controversy regarding the use of highly cross-linked polyethylene. Even though a few edge fractures of the highly cross-linked polyethylene were attributed to the component mal-position,⁹⁾ the possibility of fatigue failure due to the decrease in yield strength and ultimate tensile strength from high dose radiation emphasize the need for long-term *in vivo* studies in young active patients.^{10,11)} However, the patients with intracapsular femoral neck fractures caused by osteoporosis often have coexisting medical problems with limited life expectancy, which means that the demands for daily livings are low. Early post-operative complications such as a dislocation are more important factors in their

management. From this point of view, a THA with large diameter femoral head is recommended for the management in patients with intraarticular femoral neck fractures because THA produces a better result than BA. However, it should be noted that this study has limited statistical power because of the sample that was not prospectively randomized. Even though a highly cross-linked polyethylene shows good short and mid-term results *in vivo* and long-term *in vitro* study, a long-term *in vivo* study will be needed to justify its continued use. Given the relatively decrease in life expectancy of patients with intracapsular femoral neck fractures, it would be possible to study on the clinical and functional outcomes in the early post-operative period.

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= 국문초록 =

목 적: 대퇴 경부 골절에서 큰 대퇴 골두를 이용한 인공 고관절 전 치환술과 이극성 반 치환술 군의 초기 추시 결과를 비교 조사하였다.

대상 및 방법: 2004년 2월에서 2007년 6월까지 전위성 관절 내 대퇴 경부 골절 환자 169명을 대상으로 하였다. 89예는 이극성 반 치환술을, 80예는 고관절 전 치환술을 시행하였다. 평균 추시 기간은 36개월(18-52)이었다. 임상적인 결과와 수술 후 골 용해, 탈구, 이완, 골절, 탈구 등의 합병증에 대하여 최근 방사선 사진을 바탕으로 면밀히 관찰하였다.

결 과: 평균 수술 시간은 이극성 반 치환술 군에서 유의하게 짧았다. 동통, 운동성, 보행 능력은 이극성 반 치환술보다 전치환술에서 좋았다. 수술 후 초기에 환자의 고관절에 운동 제한을 두지 않은 상태에서도 탈구의 예는 없었다.

결 론: 상기 소견으로 큰 대퇴 골두를 이용한 고관절 전 치환술은 이극성 반 치환술보다 우수한 결과를 보여 대퇴골 경부 골절 환자의 치료에 권장된다.

색인 단어: 대퇴골, 경부 골절, 이극성 반 치환술, 고관절 전 치환술, 큰 대퇴 골두(36 mm)