



Measuring the Impact of Femoral Head Size on Dislocation Rates Following Total Hip Arthroplasty

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Purpose: The purpose of this study was to evaluate if the femoral head's size has an impact on dislocation rates following total hip arthroplasty (THA).

Materials and Methods: Five hundreds forty-three THA performed using a posterolateral approach in our hospital and followed up more than 6 months were included in this study. We evaluated dislocation rates based on the size of femoral head (28 mm vs. over 32 mm) and further investigated the dislocation rates classified into primary and revision surgery. Patient-related and surgical factors were reviewed to evaluate risk factors impacting dislocation rates.

Results: Dislocation occurred in 9.6% of cases (n=52; 32 males and 20 females). Of this dislocation group, 36 were treated with femoral heads 28 mm in diameter (9.8% of all patients treated with 28 mm femoral heads) and 16 were treated with femoral heads 32 mm and over (9.1% of all patients treated with femoral heads of at least 32 mm). The percentages of patients experiencing dislocation were not significantly different among the two groups (i.e., 28 mm vs. ≥ 32 mm). However, after revision surgery, the dislocation rate in the 28-mm group was significantly higher than the ≥ 32 -mm group ($P < 0.05$). In a case-control study comparing dislocation and non-dislocation groups, the risk of dislocation was 6 times higher in patients with habitual alcohol intake, and 9.2 times higher in patients with a neuropsychiatric disorder ($P < 0.05$).

Conclusion: Patient factors are considered to have a more significant impact on dislocation rates following THA than the size of femoral head.

Key Words: Total hip arthroplasty, Complication, Dislocation, Impact of femoral head size

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INTRODUCTION

Many studies have explored dislocations associated with hip arthroscopy and dislocation remains one of the most serious complications following total hip arthroplasty (THA)¹⁾. Time commitments (seeking treatment and/or prevention) and financial losses are great in patients at risk of dislocation due to: i) concerns about recurrent dislocation, ii) prolonged length of hospital stay, iii) required use of assistive devices or distraction until soft tissue stabilization, and iv) others; revision surgery may also be needed. Revision rates vary between operators, ranging approximately between 1-10%¹⁻³⁾. Various factors affecting the incidence of dislocation have been suggested

including patient-related, surgical and implant-related factors¹⁾. The size of the femoral head and acetabular component has been proposed as an implant-related factor associated with dislocation^{2,4-9)}. In particular, femoral head size is an important factor in determining the range of motion of the hip joint. Head size is a critical determinant of range of joint motion, and larger heads are reported to be associated with reduced risk of dislocation compared with smaller head sizes by reducing impingement between prosthetic components^{10,11)}. In recent years, the use of highly cross-linked polyethylene has, to some extent, reduced problems related to wear, and large-diameter femoral heads have been extensively used with bearing surfaces made of ceramic materials. Together, these advances are being reported to play a positive role in reducing dislocations¹²⁾.

The authors investigated whether the use of femoral heads larger than 28 mm in THA had a positive effect on dislocation, and compared the dislocation group with the non-dislocation group to identify other contributors to dislocation.

MATERIALS AND METHODS

This study involved 543 patients who underwent THA and revision hip arthroplasty using the posterolateral approach in our hospital from January 2000 to December 2014 and who had a minimum follow-up of 6 months. The mean age of patients was 59.1 years (range, 18-88 years) and the subjects consisted of 324 males and 219 females. A 28-mm diameter femoral head was used in 367 cases and femoral heads sizes larger than 32 mm were used in 176 cases (32 mm, 37 cases; 36 mm, 149 cases). Primary THA was performed in 407 and revision hip arthroplasty was done in 136. The causes of primary THA were avascular necrosis (n=225), fracture of the proximal femur (n=87), degenerative arthritis (n=84), and others (n=11). In primary THA, femoral heads were either 28 mm in diameter (n=256) or greater than or equal to 32 mm in diameter (n=151). The causes of revision hip arthroplasty were loosening of prostheses (n=85), periprosthetic fracture (n=17), recurrent dislocation (n=15), infection (n=12) and others (n=7). In revision arthroplasty, the femoral head sizes used were either 28 mm (n=101) or greater than or equal to 32 mm (n=35).

In primary THA, short external rotators were fixed to the greater trochanter using non-absorbable sutures. Crutch walking was undertaken for 2 months postoperatively

and there was no restrictions related to body positions except for avoidance of squatting. Postoperative radiographs were taken on a regular basis. Acetabular cup anteversion and inclination and pre- and postoperative leg-length discrepancy were assessed using the method of Woo and Morrey¹⁾. The anteversion of the femoral stem was defined as the angle formed between the femoral stem axis and the axial plane on radiographs using the method proposed by Jolles et al¹³⁾.

To quantify the role that patient-related factors may play in dislocation rates, we examined the potential impact of habitual alcohol intake and neuropsychiatric disorders. Habitual alcohol intake was defined as daily consumption of 2.1 L (72 ounces) of beer or a bottle of soju (20% alcohol)¹⁴⁾, and neuropsychiatric disorder was judged according to diagnostic criteria.

To examine other risk factors associated with dislocation, we included a control group (n=52) of randomly selected patients. The baseline characteristics of this control group (i.e., sex, diagnosis, femoral head size, and surgical timing) were used to match to 52 cases in the dislocation group with similar. The impact of implant-related causes was determined by measuring acetabular cup anteversion and inclination between the two groups. Patient-related factors, including the impact of drinking history and diagnosis with a neuropsychiatric disorder were also examined.

The anteversion and inclination angles were measured twice in each subject by two examiners, and inter-rater agreement was 0.97. For statistical analyses, the chi-square test, Fisher exact test, and *t*-test were performed using IBM SPSS Statistics version 20.0 (IBM Co., Armonk, NY, USA). *P*-values of less than 0.05 were considered statistically significant.

RESULTS

The overall rate of dislocations was 9.6% (52 out of 543 cases). The mean age of all patients was 59.1 years (range, 18-88 years) and 63.2 years (range, 39-83 years) in patients experiencing a dislocation. The incidence of dislocation following THA was statistically significantly higher with increasing age. Dislocations occurred in 35 out of 407 following primary THA (8.6%) and 17 out of 136 following revision (12.5%). The dislocation rate was higher in the revision group; however, this difference was not statistically significant. Dislocation occurred in 36 (9.8%) in the 28-mm head size group and 16 (9.1%) in the group with greater than 32-mm head size; there was

Table 1. Demographic Data and Comparison of Difference by Femoral Head Size

Characteristic	Value		P-value
Dislocation group	52		
Sex (male:female)	32:20		0.882
Femoral head size (28 mm:>32 mm)	36:16		0.877
Primary:revision	35:17		0.182
Age (yr)			
Dislocation (n=52)	63.2 (39-83)		0.014
Non-dislocation (n=491)	58.6 (18-88)		
Femoral head size (mm)	28 (n=367)	>32 (n=176)	
Dislocation	36 (9.8)	16 (9.1)	0.877
Mean age (yr)	64.3	61.5	0.521
Primary THR	20	15	0.469
Revision THR	16	1	0.042

Values are presented as number only, median (range), or number (%) unless specified otherwise.
THR: total hip replacement.

Table 2. Case-control Study: Comparison of Difference between Dislocation and Non-dislocation

Variable	Dislocation group	Non-dislocation group	P-value
No. of case	52	52	
Mean age (yr)	63.2	63.0	0.924
Cup anteversion (°)	15.1 (5-38)	16.2 (7-42)	0.637
Cup inclination (°)	42.3 (25-53)	43.6 (21-56)	0.428
Femoral stem anteversion (°)	18.1 (12-22)	18.8 (13-26)	0.792
Femoral offset (mm)	0.68 (-0.7-1.3)	1.21 (-0.3-1.7)	0.452
Leg length discrepancy (cm)	0.21 (-1.5-1.2)	0.36 (-1.1-1.5)	0.584
Habitual alcohol abuse*	14	3	0.007
Neuropsychiatric disorder ⁺	8	1	0.031
Dementia	6	1	
Psychotic disorder	2	0	

Values are presented as number only or median (range) unless specified otherwise.
Odds ratio (confidence interval): *6.02 (1.83-23.24), ⁺9.27 (1.11-77.1).

no statistically significant difference among these groups. Although no significant difference was observed in dislocation rates according to head size in primary THA, the dislocation rate was significantly higher in the group with greater than 32 mm head size in revision surgery (Table 1).

When comparing the dislocation and non-dislocation groups to identify risk factors, the mean anteversion of the acetabular cup was 15.1° (range, 5° to 38°) in the dislocation group and 16.2° (7° to 42°) in the control group. The mean inclination of the acetabular cup was 42.3° (25° to 53°) in the dislocation group and 43.6° (21° to 56°) in the control group. The mean anteversion of the femoral stem was 18.1° (12° to 22°) in the dislocation group and 18.8° (13° to 26°) in the control group. The mean leg length discrepancy was 0.21 cm (range, -1.5 to 1.2 cm) in the dislocation group and 0.36 cm (-1.1 to 1.5) in the control group. No statistically significant difference

was observed in any of these parameters between the two groups. Since there were 14 cases with habitual alcohol consumption and 8 cases diagnosed with neuropsychiatric disorder in the dislocation group, the risk of dislocation was 6 times and 9.2 times higher respectively in these patients than those in the non-dislocation group (Table 2). The rate of dislocation was significantly higher in those with habitual alcohol intake and neuropsychiatric disorder when compared with those without habitual alcohol intake and neuropsychiatric disorders, respectively ($P<0.05$).

DISCUSSION

Hip dislocation following THA may be caused by the combined effects of multiple factors, and a variety of specific risk factors have been described. Woo and Morrey¹⁾ have suggested that multiple contributing factors work together

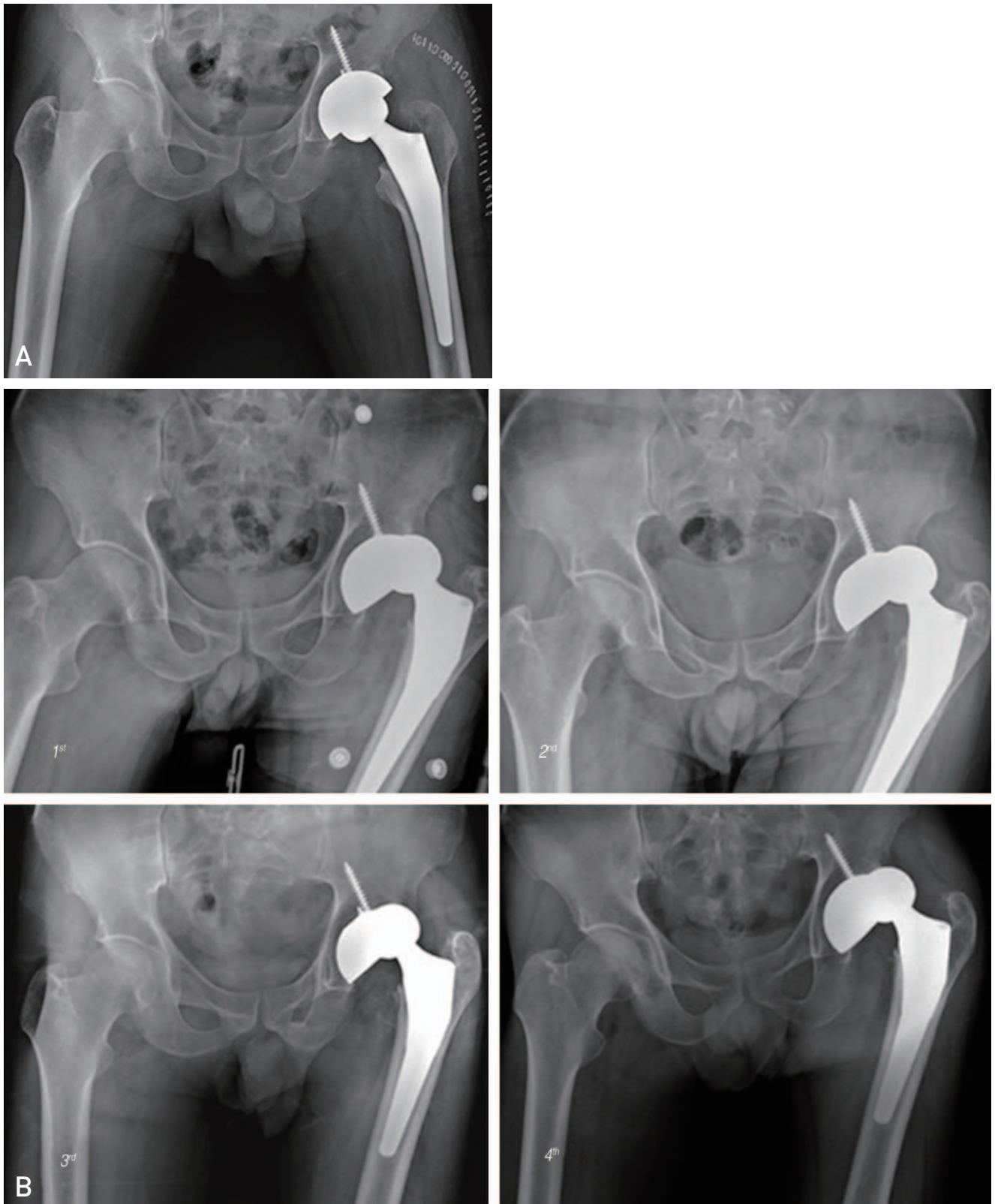


Fig. 1. (A) A 56-year-old male with chronic alcoholism underwent total hip arthroplasty for osteonecrosis of left femoral head. The femoral head size was 36 mm and cup anteversion/inclination was in the safe range. (B) He had recurrent dislocation in four times after drinking.

in the occurrence of dislocation, instead of a single cause. Therefore, since dislocation is not likely caused by a single reason, it is not easy to clarify the exact cause of dislocation. Deciding on the optimal treatment for patients with recurrent dislocation is very challenging because the mechanisms of dislocation remain unknown. Surgeons continue to pay careful attention when choosing the appropriate surgical approach in patients at high risk for dislocation in order to lower the incidence of dislocation after THA. Several studies have shown that the anterior approach is associated with a lower dislocation rate than the posterior approach^{1,15}.

In addition to the choice of surgical approach, surgeons can easily reduce the incidence of dislocation following THA by using large diameter heads. Femoral head size is an important factor that determines the range of joint motion. Larger diameter heads are more stable than smaller diameter heads because they allow for a greater range of motion until impingement occurs. Femoral neck diameter is another factor recognized as influencing artificial joint range of motion¹⁶. Supposing that the shape of the femoral neck is consistent, head size has a substantial effect on the stability of the hip joint. However, this conclusion is grounded on biomechanical theory, and studies on dislocation rates according to head size have been insufficiently performed in Korea. For this reason, we retrospectively reviewed 543 cases that underwent THA in our hospital, and found no statistically significant difference in the dislocation rate based on head size. However, a statistically significantly lower dislocation rate was shown in the large-diameter femoral head group after revision surgery. This outcome is thought to be attributable to: i) education of those patients at high-risk for dislocation and their guardians, ii) thorough postoperative rehabilitation, and iii) the use of the hip-abduction orthosis with care education, leading to lower rates of dislocation caused by patient-related factors. The use of larger diameter heads is expected to produce favorable results in patients with the risk factors of revision and dislocation. Based on the outcomes of primary THA, we have considered that the occurrence of dislocation may be more greatly influenced by factors other than femoral head sizes, and assumed that dislocation cannot be prevented by increasing the femoral head size in patients with poor compliance due to alcohol abuse, dementia and others in postoperative rehabilitation.

A variety of factors have been mentioned as causes of dislocation following THA. Although age has been reported not to be a risk factor for dislocation^{17,18}, Paterno

et al.¹⁹ have asserted that increasing age acts is a critical factor for dislocation. Berry⁴ has addressed that the high dislocation rate in elderly patients is associated with fall, weakening of soft tissues, stupor, lack of compliance and others. The authors have identified that aging is an important factor for development of dislocation. In our study, the mean age (59.1 years) of patients who received THA was about 6-8 years higher than the mean ages (range, 51-53 years) in other studies²⁰. We think that this explains why a higher dislocation rate (8.6%) was shown in the current study compared to the dislocation rates (range, 3-5%) in other studies.

Suh et al.²¹ have reported that habitual alcohol intake is a major cause of dislocation and suggest that this is the result of: i) reduced concentration due to long-term alcohol consumption, ii) reduced muscle strength, iii) deficiency on position sense, and iv) others. In our study, the incidence of dislocation was statistically significantly higher in patients with habitual alcohol consumption (Fig. 1). Previous studies have proposed that the risk of hip dislocation is higher in patients with neuropsychiatric disorders, and comparable results have been obtained in our study. It appears that patients with neuropsychiatric disorders such as dementia were more prone to dislocation because of inappropriate postures relating to a lack of understanding of and decreased compliance to the artificial hip joint. Dislocations occurred more frequently after alcohol consumption in patients with habitual alcohol use. Since dislocation cannot be prevented solely by using larger femoral heads in the high-risk group with habitual alcohol intake and neuropsychiatric disorder, surgeons should be careful when choosing the optimal surgical approach and procedure and comprehensive postoperative education on the risk and prevention of dislocations is warranted for patients and their families.

CONCLUSION

The use of a 32-mm or 36-mm diameter femoral head in THA using the posterolateral approach did not significantly reduce dislocation rate compared to a 28-mm diameter femoral head. Patient-related risk factors were shown to have a greater impact on the incidence of dislocation.

CONFLICT OF INTEREST

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

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