



# Direct Anterior Approach for Total Hip Arthroplasty in the Elderly with Femoral Neck Fractures: Comparison with Conventional Posterolateral Approach

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**Background:** The aim of this study was to determine if it was feasible and safe to perform total hip arthroplasty (THA) using the direct anterior approach (DAA) when compared with the conventional posterolateral approach (PA) in patients with femoral neck fractures. The time required to start walking was investigated to identify advantages of the muscle-sparing approach. Safety of the approach was judged based on the incidence and nature of all complications.

**Methods:** We retrospectively reviewed 67 THA cases due to femoral neck fractures from October 2015 to January 2019. The PA was used in 31 cases, and the DAA was used in 36 cases. The average operative time and amount of bleeding were evaluated. Cup inclination, anteversion, and leg length discrepancy (LLD) were also measured on radiographs. The time to start walking and complications (e.g., intraoperative fracture, infection, and dislocation) were recorded.

**Results:** The mean operative time was  $84.35 \pm 13.95$  minutes in PA group and  $99.22 \pm 20.33$  minutes in DAA group ( $p = 0.010$ ). But after experiencing 20 cases using the DAA, there was no statistically significant difference in the operative time between the groups. The mean volume of bleeding was  $428.73 \pm 207.26$  mL in the PA group and  $482.47 \pm 150.14$  mL in the DAA group. There was no difference in the acetabular cup position between two groups. Ambulation was started at 3.94 days after surgery on average in the PA group and 3.14 days in the DAA group, showing a statistically significant difference. Intraoperative fracture and infection were not observed in either group. The incidence of LLD was 1 in each group. The dislocation rate was 3.2% (1 case) in the PA group and 5.5% (2 cases) in the DAA group.

**Conclusions:** Although the DAA for THA was similar to the PA in terms of operative time, volume of bleeding, and complications, the DAA showed a great advantage in early rehabilitation as a muscle-sparing procedure in the elderly with femoral neck fractures.

**Keywords:** *Direct anterior approach, Femoral neck fracture, Total hip arthroplasty*

Femoral neck fractures occur commonly in the elderly, and the incidence is increasing because of the extension of life expectancy. Concerns associated with osteosynthesis

are nonunion and avascular necrosis, especially complications of nonunion related to age.<sup>1)</sup> In addition, it is difficult for patients to conduct rehabilitation after the procedure. The goal of treatment for the elderly with femoral neck fractures is to facilitate an early return to mobilization in order to avoid risks associated with prolonged bed rest and help them to regain independence. For these reasons, surgeons recently choose total hip arthroplasty (THA) to treat femoral neck fractures in patients with advanced age.

The posterolateral approach (PA) is the most commonly used approach in THA.<sup>2)</sup> However, there is an in-

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creasing incidence of dislocation because of the resection of both posterior capsule and external rotators.<sup>3)</sup> Enocson et al.<sup>4)</sup> reported that the dislocation rate after THA using the PA in displaced femoral neck fractures was 12% and the PA was more related to the increasing risk of dislocation than the anterolateral approach. In the elderly, the PA could delay rehabilitation and increase the incidence of posterior hip dislocation after THA. Rehabilitation could be delayed due to muscular damage, and dislocation can occur because of the lack of patient's compliance with rehabilitation.

The direct anterior approach (DAA) for THA has recently received attention as a minimally invasive surgery.<sup>5)</sup> The DAA for THA takes advantage of the intermuscular and internervous plane. Several studies have announced benefits of the DAA, including early discharge, faster recovery, and decreased dislocation rates.<sup>6,7)</sup> Despite the evidence of several benefits, there are concerns about the safety of DAA. One of the main disadvantages of the approach is its steep learning curve.<sup>3,8,9)</sup> Although many studies on the DAA have been conducted, there are few studies on the DAA performed only in the elderly. We thought that the DAA for THA would have many greater advantages in elderly patients and hypothesized that early outcomes of THA using the DAA would be better than those of THA using the PA in the elderly. The purpose of this study was to compare the early outcomes of the DAA to the PA for the elderly with femoral neck fractures.

## METHODS

This study was approved by the Institutional Review Board of Kwangju Christian Hospital (IRB No. KCH-M-2020-05-006), and all participants provided written informed consent.

This study included a review of data from 67 patients with femoral neck fractures who underwent THA

from October 2015 to January 2019. The inclusion criteria included intracapsular fractures. From October 2015 to March 2017, the PA was used in 31 patients. Since then, the DAA was used in 36 patients. All operations were performed by a senior author (YYC) with vast experience with THA.

The average age was  $76.45 \pm 6.79$  years in the PA group and  $78.19 \pm 9.44$  years in the DAA group. The mean bone mineral density (BMD) of the femoral neck area was  $-3.35 \pm 0.89$  in the PA group and  $-3.15 \pm 1.03$  in the DAA group. The mean body mass index (BMI) was  $22.18 \pm 5.81$  kg/m<sup>2</sup> in the PA group and  $22.60 \pm 4.26$  kg/m<sup>2</sup> in the DAA group. There was no statistically significant difference in age, sex, BMI, and BMD between the two groups (Table 1).

For assessment of the surgical approaches, the average operative time and the mean amount of bleeding were measured. The total amount of bleeding was defined as the sum of bleeding during surgery and drainage after surgery.

For radiological assessment, an anteroposterior (AP) radiograph and a lateral radiograph of the hip were taken immediately after surgery. Cup inclination of the acetabular component and leg length discrepancy (LLD) were measured on the hip AP radiograph, and anteversion was measured on the cross-table lateral radiograph. LLD was measured using the bilateral ischial tuberosity and the superior margin of the lesser trochanter on the hip AP radiograph. LLD was defined as a difference between the distances greater than 10 mm.

For clinical evaluation, the time required to start walking was investigated. The incidence and nature of both intraoperative and postoperative complications, such as fracture, infection, and dislocation, were examined.

All statistical analyses were performed using PASW Statistics ver. 18.0 (SPSS Inc., Chicago, IL, USA). Chi-square and paired *t*-tests were used to compare the two groups. Statistical significance was defined as  $p < 0.05$ .

**Table 1.** Demographic Data

Variable	Group 1 (n = 36)	Group 2 (n = 31)	<i>p</i> -value
Age (yr)	$78.19 \pm 9.44$	$76.45 \pm 6.79$	0.385
Sex (male : female)	3 : 33	5 : 26	0.345
BMI	$22.60 \pm 4.26$	$22.18 \pm 5.81$	0.738
BMD	$-3.15 \pm 1.03$	$-3.35 \pm 0.89$	0.386

Values are presented as mean  $\pm$  standard deviation.

Group 1: direct anterior approach, Group 2: posterolateral approach, BMI: body mass index, BMD: bone mineral density.

## RESULTS

### Operative Time

The average operative time was  $84.35 \pm 13.95$  minutes in the PA group and  $99.22 \pm 20.33$  minutes in the DAA group ( $p < 0.05$ ). However, after experiencing 20 cases using the DAA, there was no statistically significant difference in operative time between the two groups ( $p = 0.131$ ) (Table 2).

### Blood Loss

The mean amount of blood loss was  $428.73 \pm 207.26$  mL in the PA group and  $482.47 \pm 150.14$  mL in the DAA group ( $p = 0.236$ ). After experiencing 20 cases using the DAA, the mean amount of blood loss was  $370.81 \pm 99.06$  in the DAA group ( $p = 0.298$ ).

### Days to Start Walking Postoperatively

Ambulation was started at 3.94 days ( $\pm 2.00$ ) after surgery on average in the PA group and 3.14 days ( $\pm 0.42$ ) in the DAA group, showing a statistically significant difference ( $p < 0.05$ ).

### Radiological Assessment

The average cup inclination on the hip AP radiograph was  $41.59^\circ \pm 5.66^\circ$  in the PA group and  $40.22^\circ \pm 7.09^\circ$  in the DAA group ( $p = 0.38$ ). The mean anteversion on the cross-table lateral radiograph was  $22.62^\circ \pm 12.54^\circ$  in the PA group and  $15.54^\circ \pm 11.86^\circ$  in the DAA group ( $p < 0.05$ ) (Fig. 1). The incidence of LLD was 1 in each group, but the patients did not have difficulty in walking (Table 3).

### Complications

Intraoperative fracture and infection were not observed in either group. The dislocation rate was 3.2% (1 case) in the PL group and 5.5% (2 cases) in the DAA group. All cases with dislocation underwent closed reduction, and dislocation did not recur.

## DISCUSSION

Fracture healing can be impaired in the elderly due to poor bone quality and low ability to comply with postoperative weight-bearing, so arthroplasty was selected instead of osteosynthesis in this study. Several studies reported primary hip arthroplasty provided great results for the elderly with displaced femoral neck fractures.<sup>10,11</sup> In hip arthroplasty, there has been improvement in long-term survival rates as a result of continuous research on the implants and joint surface. Recently, with the increasing interest in the approaches for THA, there have been several reports on minimally invasive surgery that minimizes soft-tissue damage.<sup>12,13</sup>

In particular, the DAA for THA has increasingly attracted attention. But there is controversy over the safety of the approach for surgeons on the learning curve. The learning curve associated with the DAA has been previously described in 10–200 cases.<sup>14</sup> Regarding the mean operative time, Stone et al.<sup>15</sup> reported that after 500 DAA cases, the operative time was the same or shorter than the mature PA time, and after 850 cases, the DAA time was 14% shorter than the PA time. In contrast, Spaans et al.<sup>9</sup> reported that 46 DAA cases were required to reduce the average operative time. In the current study, the average operative time in the PL group was shorter than that in the DAA group. But after experiencing 20 cases using the DAA, the average operative time in the DAA group was reduced to less than 10 minutes. It is thought that many cases are not needed to reduce the operative time for experienced surgeons.

A large amount of bleeding has been reported to be a disadvantage of the DAA compared to the PA for THA.<sup>16,17</sup> However, Martin et al.<sup>18</sup> reported the mean amount of bleeding in 41 DAA cases was lower than that in 47 PA cases. Spaans et al.<sup>9</sup> examined 46 DAA cases and reported that 41.3% had a total blood loss of less than 500 mL and the mean volume of bleeding was 704 mL. In the current study, the mean amount of bleeding in the DAA group was greater than that in the conventional PA group.

**Table 2.** Comparison of Mean Operative Time

Operative time	Group 1 (n = 36)	Group 2 (n = 31)	p-value
Total (min)	$99.22 \pm 20.33$	$84.35 \pm 13.95$	0.010*
After experiencing 20 cases (min)	$91.06 \pm 14.55$	-	0.131

Values are presented as mean  $\pm$  standard deviation.

Group 1: direct anterior approach, Group 2: posterolateral approach.

\* $p < 0.05$ .



**Fig. 1.** (A, B) A 88-year-old female patient was diagnosed with a femoral neck fracture. (C, D) Total hip arthroplasty using the direct anterior approach was performed. On the postoperative radiograph, cup inclination was 45.5 and anteversion was 14.5. (E, F) No abnormal findings on radiographs were observed for 9 months since the operation.

**Table 3.** Radiological Data—Cup Inclination & Anteversion

Variable	Group 1 (n = 36)	Group 2 (n = 31)	p-value
Cup inclination	40.22 ± 7.09	41.59 ± 5.66	0.383
Anteversion	15.54 ± 11.86	22.62 ± 12.54	0.021*

Values are presented as mean ± standard deviation.

Group 1: direct anterior approach, Group 2: posterolateral approach.

\* $p < 0.05$ .

However, after experience with 20 cases, the average bleeding in the DAA group was less than that in the PA group. It is thought that the amount of bleeding will decrease as experience with the surgery using the DAA increases.

As the DAA THA is usually performed in a supine

position, this approach makes it easier to predict and control the position of the acetabular cup and femoral stem for correct placement and facilitates intraoperative fluoroscopy during surgery.<sup>19)</sup> Although fluoroscopic imaging was not used in the DAA group, the anteversion of the

DAA group was included in the Lewinnek safe zone more than that of the PA group. Kim et al.<sup>20)</sup> (53 cases in the early DAA THA) reported that after the first 20 DAA THA cases, variation in the anteversion, which was outside of the Lewinnek safe zone, was reduced.

Especially in the elderly, long-term immobilization increases the risk of comorbidities involving deep vein thrombosis, pulmonary embolism, pneumonia, pressure sore, and muscle weakness. Due to the characteristics of the DAA, such as the soft-tissue preserving nature, early rehabilitation and early discharge are recommended.<sup>21-24)</sup> Bremer et al.<sup>25)</sup> reported soft-tissue damage after total hip replacement using the DAA was less than that using the PA on postoperative magnetic resonance imaging. In comparison to the PA, the DAA offers theoretical advantages by preserving the short external rotators, which are important for stability after THA. Patients who underwent THA using the DAA started walking earlier than those who had THA using the PA in the current study. Considering that early ambulation is more important in elderly patients than in young patients, the statistical differences demonstrated in this study are of great significance. The DAA can be considered more necessary for the elderly.

In other studies, intraoperative fractures were one of the most common complications of the DAA for THA. Intraoperative fractures were documented in studies using uncemented implants with DAA with an incidence of 0.9% and 6.5%.<sup>26,27)</sup> On the other hand, no intraoperative fracture occurred in our study. When inserting the femoral stem, the use of a specialized fracture table, a femur-elevated hook, and sufficient exposure of the trochanter can prevent intraoperative fractures. It is also encouraging that there were no intraoperative fractures in elderly patients with osteoporosis. We think that the DAA could be one of surgical approaches that can be safely performed even in elderly patients.

Several studies reported that there were lower dislocation rates with use of the DAA. In previous studies, the incidence of dislocations ranged from 0.6% to 1.2%.<sup>28)</sup> Unlike previous studies, there was no significant difference in

dislocation between the DAA group and PA group in the current study. Two cases of dislocation occurred in cases performed by a relatively inexperienced surgeon. Dislocation is thought to be caused by the extensive resection of the posterior capsule for more exposure of the proximal femur in the beginning. Although the DAA has an advantage with regard to dislocation over other approaches, excessive soft-tissue resection may also lead to dislocation. More attention should be paid to avoid excessive soft-tissue resection.

There are several limitations to our study. The primary weakness is the retrospective study design. So, risk factors and comorbidities of patients could not be stratified with adverse outcomes. Another limitation of this study is the relatively small sample size. A larger sample size is needed to generalize our findings. Third, the follow-up period was relatively short. To support our findings, additional long-term research will be required.

Despite these limitations, this study will be meaningful for surgeons who perform THA for the elderly with femoral neck fractures and consider transition from the PA to DAA. This study showed that the DAA for THA was similar to the PA in terms of operative time, amount of bleeding, and incidence of complications even when performed by those on the learning curve. The DAA was advantageous for early rehabilitation as a muscle-sparing procedure in the elderly with femoral neck fractures.

## CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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