

Direct Anterior Approach Total Hip Arthroplasty for Femoral Neck Fractures in the Lateral Position

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Objective: To compare the clinical efficacy of artificial total hip arthroplasty (THA) for femoral neck fracture between direct anterior approach (DAA) in lateral position and posterior lateral approach (PLA).

Methods: Comparison of 200 cases of patients who underwent THA collected between September 2019 and August 2021 was done. Incision length, intraoperative bleeding, operative time, difference in postoperative haemoglobin from preoperative levels, length of hospital stay, postoperative time to get off the floor, visual analogue score (VAS) for pain, preoperative and postoperative Harris scores for the hip, and measurements of the acetabular abduction angle and anterior acetabular tilt angle at 6 months postoperatively were collected, and all the cases were followed up for at least 2 years.

Results: Compared with the PLA group, the DAA group had a shorter incision length, less intraoperative blood loss, less postoperative haemoglobin reduction compared with the preoperative period, a shorter hospital stay and an earlier first time to get off the floor after surgery, however, the comparison of operative times was not statistically significant; Patients in the DAA group had a lower VAS in the early postoperative period compared to PLA; Patients in the DAA group had higher hip Harris scores at 6 weeks and 6 months postoperatively; There was no significant difference in acetabular abduction angle and acetabular anterior tilt angle between the two groups at 6 months postoperatively.

Conclusion: Compared to PLA, DAA in THA is minimally invasive, has less pain, less bleeding, earlier time out of bed, shorter hospital stay, better early hip function, faster rehabilitation, and better joint stability.

Keywords: direct lateral approach, DAA, femoral neck fractures, total hip arthroplasty, THA, Hip function, postoperative rehabilitation

Introduction

With the aging of the population, the number of patients with hip fractures is gradually increasing, and femoral neck fracture is one of the common fractures of the hip.^{1,2} Patients will experience a significant reduction in quality of life after fracture, with high rates of disability and mortality.^{3,4} Total hip arthroplasty (THA) is a common surgical procedure for the treatment of femoral neck fracture in the elderly, and its surgical approaches mainly include posterolateral approach (PLA) and direct anterior approach (DAA).^{5,6} PLA is a traditional method that allows adequate exposure of the surgical field, but PLA also has the disadvantages of high intraoperative bleeding and elevated risk of dislocation.^{7,8}

DAA is a surgical approach that follows the anatomical structure of the human internervous/muscular planes, which is less traumatic and can effectively avoid damage to important blood vessels and nerves.^{9,10} At present, there is a lack of follow-up comparisons between DAA and PLA. In this study, the aim of this study is to compare the clinical effect of DAA and PLA on femoral neck fracture.

Data and Methods

Inclusion and Exclusion Criteria

Inclusion criteria: (1) Patients with initial unilateral THA; (2) BMI <30 kg / m²; (3) Able to walk independently before fracture.

Exclusion criteria: (1) Hip dysplasia or congenital hip disease; (2) those with preoperative infectious diseases; (3) those who could not tolerate the risks of surgery and anaesthesia and those who could not complete the postoperative rehabilitation successfully; and (4) those with other contraindications to surgery.

General Information

From September 2019 to August 2021, 200 patients with THA were selected, including 103 cases of DAA and 97 cases of PLA. Male 84 cases, female 116 cases. The general data of the two groups of patients, sex, age, BMI (body mass index) and other statistical comparison, found that the differences between the groups had no statistical significance ($P > 0.05$, Table 1). All patients undergo surgery within a week of the fracture.

Surgical Methods

DAA THA

After the success of general anaesthesia, the patient is placed in the uninjured lateral position, fixed the position, and made a surgical incision with a length of about 8–10 cm from about 3cm lateral and below the anterior superior iliac spine, along the direction of the line connecting the starting point and the small head of the fibula.

Blunt separation of the medial aspect of the vastus tensor fasciae latae muscle from the fascia was performed. The ascending branch of the lateral circumflex femoral artery is found and ligated, and the anterior joint capsule of the hip joint is removed.

We performed osteotomy of the fractured stump of the femoral neck, expose the acetabulum, polish the acetabulum with a ball file, and place the acetabular prosthesis according to abduction of 40°~45° and anterior tilt of 15°~20°. The hip joint is internally retracted and externally rotated, so that the lateral joint capsule of the femoral neck is fully loosened. Use the medullary file to expand the marrow cavity of the femoral bone marrow, choose the appropriate type of joint prosthesis, insert the femoral stem and head prosthesis, and evaluate whether the hip joint is stable. No drain was placed intraoperatively.

PLA THA

The patient was placed on the healthy side, and an arc-shaped incision of about 10–15 cm was made centred on the apex of the greater trochanter. The skin and subcutaneous tissue are cut layer by layer, along the incision direction to open the fascia tensile muscle, blunt separation of the gluteal muscles and deep fascia, hip flexion internal spin, along the rotor interline to cut the external rotor muscle and the posterior joint capsule. The affected limb is internally rotated and flexed, the osteotomy plane is determined, the femoral head is amputated and taken out, and the acetabulum is polished and the acetabular prosthesis is inserted according to the abduction of 40°~45° and the anterior tilt of 15°~20°. The appropriate femoral prosthesis and femoral head are selected and implanted, the stability and mobility in all directions are tested to be good and there is no tendency of dislocation, and haemostasis is performed in the operation area. The external rotator group is sutured to the stop of the greater trochanter using absorbable sutures. No drain is placed and the incision is closed layer by layer.

Table 1 Demographics and Preoperative Data

Group	Age (years, $\bar{x} \pm s$)	Gender (Male /Female)	BMI (kg/m ² , $\bar{x} \pm s$)
DAA	67.3 \pm 2.9	44/59	23.2 \pm 1.9
PLA	66.6 \pm 3.2	40/57	22.7 \pm 2.0
Statistical value	Z=-1.635	$\chi^2 = 0.005$	Z= -0.768
P value	0.102	0.945	0.77

Postoperative Treatment

All patients were treated with cefazolin sodium for three consecutive days postoperatively to prevent infection. Multimodal analgesia, anticoagulation and other symptomatic treatments were used in the postoperative period. After the patient was awake, isometric contraction of quadriceps muscle and ankle pump exercise were performed. On the first postoperative day, the same group of physicians instructed the patients to help the walker to go down to the ground for a small amount of activities, and instructed gait training, standing hip flexion and leg lifting training, etc., and gradually increased the training time and intensity according to the patient's recovery.

Gradually increase the number of treatments and the time to get out of bed, after discharge from the hospital outpatient follow-up to guide the later rehabilitation exercise.

Efficacy Assessment and Follow-Up Indicators

Evaluation by a specialist senior joint surgery physician specialising in the field. Incision length, intraoperative bleeding, operation time, difference in haemoglobin from preoperative level at 1 day postoperatively and 5 days postoperatively, length of hospital stay, time to get off the floor after operation, visual analogue score (VAS) of pain at preoperative, 24h, 48h, 72 and 120h postoperatively, Harris scores of the hip joints at preoperative and 6 weeks, 6 months, 1 year, and 2 years after operation were collected. In addition, X-rays were repeated at the third month, sixth month and one year after the operation. Acetabular angle and anterior tilt were measured by the surgeon in the surgical group at 6 months after surgery.

Intraoperative and postoperative complications (surgical incision infection, joint dislocation, etc.) were recorded to analyse and compare the efficacy and safety of the two different surgical approaches in patients with femoral neck fractures.

Statistical Methods

SPSS 25.0 statistical software was used to analyze the data, the metrology data was expressed in mean \pm standard deviation ($\bar{x} \pm s$), inter-group comparison using independent sample *t* test, *t* value is the statistical value of *t* test. $P < 0.05$ is statistically significant, and the smaller the *P* value indicates that the result is more significant.

Results

Perioperative Period

No serious complications such as vascular and nerve injury occurred during the operation in both groups. No blood transfusions or blood thinners were used in either group. The perioperative data of the two groups are shown in Table 2. The incision length, intraoperative bleeding, haemoglobin drop level in the 1st postoperative day, haemoglobin drop level in the 5th postoperative day, hospital stay and the first time to get down to the ground after surgery of the DAA group were smaller than those of the PLA group, and the differences were all statistically significant ($P < 0.05$). However, there was no statistically significant difference in operation time between the two groups ($P > 0.05$) (Table 2).

Table 2 Comparison of Perioperative Data Between the DAA and PLA ($\bar{x} \pm s$)

Group	Length of Incision(cm)	Intraoperative Haemorrhage (mL)	Surgical Time(min)	Haemoglobin Drop on Postoperative Day 1 (g/L)	Haemoglobin Drop on Postoperative Day 5 (g/L)	Length of Stay in Hospital(d)	First time off the Ground After Surgery(h)
DAA	10.3 \pm 1.4	151.9 \pm 28.5	80.1 \pm 8.8	8.8 \pm 1.9	21.9 \pm 3.2	7.0 \pm 1.1	19.9 \pm 2.9
PLA	13.2 \pm 1.6	249.7 \pm 27.8	80.8 \pm 9.0	11.6 \pm 3.1	32.3 \pm 4.0	9.9 \pm 1.9	28.2 \pm 4.6
t value	-18.047	-24.534	-0.559	-7.713	-20.190	-12.431	-15.036
P value	<0.001	<0.001	0.577	<0.001	<0.001	<0.001	<0.001

Comparison of VAS Scores Between the Two Groups

The results of VAS scores of patients in the two groups are shown in Table 3. The VAS scores of patients in both groups decreased significantly over time ($P < 0.05$). The difference in VAS scores between the two groups before surgery was not statistically significant ($P > 0.05$); the VAS scores of the DAA group were smaller than those of the PLA group after surgery, and the difference between the two groups was statistically significant at 24 h, 48 h, and 72 h after surgery ($P < 0.05$), and the difference between the two groups was no longer statistically significant at 120 h after surgery ($P > 0.05$) (Table 3).

Comparison of Hip Joint Function Scores Between the Two Groups

Hip joint clinical function score The difference between the preoperative Harris score of the two groups of patients was not statistically significant ($P > 0.05$). The Harris score of the hip joint showed greater improvement at 6 weeks and 6 months postoperatively ($P < 0.05$), which was statistically significant. However, there was no statistically significant difference at 1 and 2 years postoperatively ($P > 0.05$) (Table 4).

Postoperative Imaging Evaluation

The postoperative imaging results of the two groups are shown in Table 5. The differences between the two groups in acetabular anterior tilt angle and acetabular abduction angle were not statistically significant ($P > 0.05$). By the time of the final follow-up, none of the 200 patients who had been followed up had seen any loosening, displacement or fracture of the prosthesis, and there were no signs of such as heterotopic ossification (Table 5).

Table 3 Comparison of VAS Score Follow-Up Results ($\bar{x} \pm s$)

Group	Preoperative ($\bar{x} \pm s$)	24 Hours After Surgery($\bar{x} \pm s$)	48 Hours After Surgery($\bar{x} \pm s$)	72 Hours After Surgery($\bar{x} \pm s$)	120 Hours After Surgery($\bar{x} \pm s$)
DAA	6.4±0.9	5.0±0.8	3.7±0.8	2.4±0.6	1.4±0.7
PLA	6.6±0.8	5.6±0.9	4.4±0.7	3.1±0.5	1.4±0.6
t value	-1.316	-5.409	-6.110	-7.717	-0.464
P value	0.190	<0.001	<0.001	<0.001	0.643

Table 4 Harris Scores of the DAA Group and PLA Group ($\bar{x} \pm s$)

Group	Preoperative	6 Weeks after Surgery	6 Months after Surgery	1 Year after Surgery	2 Year after Surgery
DAA	39.5±3.6	81.5±4.0	89.9±2.2	91.9±2.1	93.0±1.3
PLA	38.7±3.2	77.9±3.8	86.9±2.1	91.4±1.4	92.6±1.1
Statistic value	1.585	6.528	9.727	2.145	1.751
P value	0.115	<0.001	<0.001	0.033	0.082

Table 5 Comparison of Postoperative Imaging Measurements
($\bar{x} \pm s$)

Group	Anterior Acetabular Tilt Angle (°)	Acetabular Abduction Angle (°)
DAA	17.2±1.4	41.3±1.4
PLA	17.3±1.6	41.8±1.5
Statistic value	-0.669	-2.370
P value	0.504	0.19

Discussion

The annual incidence of femoral neck fracture is expected to increase to 7–21 million by 2050.¹¹ Elderly patients with femoral neck fractures are treated with THA surgery to improve their hip deformity and help with early ground movement to avoid long-term bed-induced complications.^{12,13} With the increasing number of THA patients, the choice of surgical approach has been a hot topic of debate, and the advantages and disadvantages of various surgical approaches for THA, and the differences in the efficacy of different surgical approaches have been a topic of discussion among orthopedic surgeons for many years.^{14–17} Prior to this, some researchers also believed that DAA group relative to PLA group, DAA group hospitalization time, surgery time shortened, blood transfusion rate decreased. And due to the removal of the rear stabilizer caused by the higher risk of joint dislocation, increased refurbishment rate.^{18,19}

In general, the DAA approach that we apply nowadays is a surgical approach to the Smith-Peterson approach, and has been used by more and more joint surgeons to perform THA in recent years.^{20–23} The DAA approach exposes the femoral head through the muscle gap, reduces muscle damage during surgery, ensures the integrity of the soft tissues around the joint, reduces the incidence of myasthenia gravis, and increases the stability of the hip joint.^{24,25} However, when applying PLA, it is easy to cause damage to the posterior gluteus maximus, external rotator group, and joint capsule, which affects the posterior stability of the joint, increases the incidence of postoperative joint dislocation in patients, and the pain in patients is more pronounced in the postoperative period. The results of this study also showed that patients in the DAA group first got down to the ground earlier than the PLA group after surgery, and according to the VAS score, the patients' pain sensation was more advantageous than that of the PLA group, which are the reasons why the patients could perform functional exercises earlier. Early functional exercise in elderly patients with femoral neck fracture after DAA can improve hip function as well as quality of life, avoid the effects of muscle atrophy, lower limb deep vein thrombosis and cardiopulmonary impairment brought about by bed rest, and reduce the probability of postoperative complications in patients, thus reducing the length of hospital stay.

In this study, we showed that the DAA group was more advantageous than the PLA group in terms of intraoperative bleeding, haemoglobin drop on the 1st postoperative day and haemoglobin drop level on the 5th postoperative day. The THA was accompanied by invisible blood loss, and the level of haemoglobin decline was lower in the DAA group. In addition to the smaller DAA incision and intraoperative blood loss, we believe that this is because the DAA group had the same relatively small amount of invisible blood loss due to the reduction of partial muscle dissection and tissue separation, which led to the difference in the level of postoperative haemoglobin decline between the two groups of patients.

In terms of hip function, Christensen²⁶ reported that DAA was superior to PLA in terms of length of hospital stay, improvement in pain, and discontinuation of mobility aids, but did not find a subjective or objective difference between the two at 6 weeks postoperatively. The present study similarly concluded that patients in the DAA group recovered hip function earlier after surgery and had better immediate postoperative outcomes. Unlike the present study, after a longer period of follow-up and a larger sample size, it was found that hip function was still slightly better in DAA compared to PLA at 6 weeks postoperatively and at 6 months postoperatively, in relation to the patient's walking and because of the difference in postures used to prevent dislocation of the joints, which led to differences in daily activities.

Compared with the PLA surgical approach, there is a certain learning curve for the DAA, and the technical points and difficulties are to adequately expose the proximal femur and adequately loosen the femoral stop of the anterolateral hip joint capsule.^{27,28} In addition, there are certain limitations on the exposure of the operative field, which may lead to a decrease in the accuracy of the position of the prosthesis placed by the operator, requiring the operator to possess precise anatomical judgement to minimise the risk of dislocation of the articular prosthesis in the postoperative period.^{29,30} Postoperative imaging measurements performed in this study showed that there was no significant difference between the two groups in terms of acetabular anterior tilt angle, acetabular abduction angle, and bilateral lower extremity length, indicating that the surgical approach was reliable in both groups. Moreover, after 2 years of follow-up, no other complications were found in the DAA group compared with conventional PLA. It should be noted that the control of the patient's position, the pulling of the pulling hooks and bone hooks, and other operations during the DAA approach require close cooperation between the surgeon and the assistant in order to be completed.

In addition, the DAA approach has some limitations on the exposure of the operative field, which will most likely lead to a decrease in the precision of the position of the prosthesis placed by the operator, requiring the operator to have extensive clinical experience, be familiar with the anatomy, as well as to be able to judge the intraoperative prosthesis activity to minimise the risk of dislocation of the articular prosthesis in the postoperative period. In addition, there are some limitations to this study. For example, the number of cases in this study was relatively small, and the type of prosthesis used was not analysed in subgroups. Moreover, a longer follow-up period is needed to assess the joint stability and functionality of the patients.

In conclusion, the DAA group after THA surgery was more minimally invasive, less painful, had less bleeding, got out of bed earlier, had a shorter hospital stay, had a faster recovery of hip function in the early stage, and could obtain rapid recovery and good joint stability than the PLA group.

Data Sharing Statement

The data is available from the corresponding author upon the reasonable request.

Ethical Approval and Consent to Participate

This study is a retrospective clinical control, which was approved by the Ethics Committee of Northern Jiangsu People's Hospital Affiliated to Yangzhou University. During the study, we strictly followed the relevant requirements and ethical standards of the Helsinki Declaration, and all patients included in the study signed a written informed consent.

Consent for Publication

Informed consent was obtained from all the participants and/or their legal guardian to publish their information.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors have no conflicts of interest to declare in this work.

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