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Comparison of DAA and PLA Approaches for Total Hip Replacement in the Treatment of Femoral Neck Fractures

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Abstract

Objectives: Femoral neck fractures are becoming more common within nowadays. This research is to explore the clinical effect of primary total hip replacement (THA) via direct anterior approach (DAA) and posterolateral approach (PLA) in the treatment of femoral neck fracture. **Methods:** Retrospective analysis of 100 cases of elderly patients with femoral neck fracture who underwent total hip arthroplasty admitted to Tianyou Hospital affiliated to Wuhan University of Science and Technology from January 2019 to January 2022. 50 patients treated with DAA approach were included in the observation group, and 50 patients treated with PLA approach were included in the control group. The operation indexes, postoperative acetabular abduction angle and anteversion angle, hip joint function, Harris score and complications were compared between the two groups. **Result:** The length of incision in the observation group was shorter than that in the control group, and the amount of intraoperative bleeding and postoperative hospital stay were shorter than those in the control group ($P < 0.05$); There was a statistically significant difference between the two groups in the ratio of acetabular abduction angle and its safe zone, and the length difference of both lower limbs ($P < 0.05$), while there was no statistically significant difference between the two groups in the ratio of acetabular anteversion angle and its safe zone, eccentricity, and its recovery rate ($P > 0.05$); Harris score of hip joint: 6 months after operation, the anterior approach group was significantly higher than the posterolateral approach group ($P < 0.05$), and there was no statistical difference between the two groups 12 months after operation ($P > 0.05$); The total incidence of complications in the observation group was lower than that in the control group, with a statistically significant difference ($P < 0.05$). **Conclusion:** DAA and PLA approaches for total hip replacement can restore the hip joint structure

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of patients with femoral neck fractures and achieve good results, but DAA approach has greater advantages in early postoperative recovery, improvement of hip joint function, small surgical injury, high application value, so it is recommended.

Keywords

Total Hip Replacement, Femoral Neck Fractures, Direct Anterior Approach, Posterolateral Approach, Clinical Effect

1. Background

Femoral neck fracture is a common fracture disease in the elderly. With the change of transportation and the aging of the population, the incidence rate of femoral neck fracture increases year by year [1]. The main treatment for femoral neck fracture in the elderly is hip replacement, and the recovery of hip joint function after operation is of great significance [2]. For such patients, hip replacement and other surgical treatments are often used in clinical practice to improve symptoms, promote the recovery of independent activities, and improve the quality of life of patients [3]. The posterolateral approach (PLA) is often used clinically, which is easy to operate, but will damage the external rotator muscles and the posterior joint capsule, which is easy to cause complications such as dislocation of the prosthesis after surgery, and is not conducive to the recovery of joint function [4]. The DAA approach is to perform hip joint replacement from the muscle space between the rectus femoris and the sartorius, tensor fascia lata. Compared with PLA, it has the advantages of minimally invasive, less damage, and faster early functional recovery [5]. In recent years, hidden blood loss has gradually attracted the attention of clinicians and has been regarded as a reference index for functional recovery after joint replacement. Hidden blood loss is found after joint replacement and treated in time to fully restore blood circulation function, which is conducive to postoperative recovery of patients. Therefore, this study will compare the two surgical approaches and analyze their efficacy and complications.

2. Materials and Methods

2.1. General Information

Retrospective analysis was made on 100 patients with femoral neck fracture who needed THA from January 2019 to January 2022 in the author's hospital. They were randomly divided into control group and observation group with 50 cases each. The control group consisted of 22 males and 28 females, aged from 61 to 78 years, with an average age of (70.01 ± 2.22) years; Affected side: left side 24 cases, right side 26 cases. The observation group consisted of 20 males and 30 females, aged from 63 to 77 years, with an average age of (69.02 ± 3.52) years; Affected side: left side 22 cases, right side 28 cases. There was no significant dif-

ference in general data between the two groups ($P > 0.05$). The study was approved by the hospital ethics committee, the operator has informed the patient of the research purpose before and after the operation, and the patient has known and signed the relevant informed consent form.

2.2. Inclusion Criteria

1) Conforms to the diagnostic criteria in the "Guidelines for the Diagnosis and Treatment of Femoral Neck Fracture in Adults" [6], and there is no surgical contraindication; 2) Unilateral hip replacement was performed for the first femoral neck fracture; 3) Able to tolerate the treatment of this study. **Exclusion criteria:** 1) patients with coagulation dysfunction; 2) Patients with spinal cord and nerve dysfunction; 3) Patients with severe cardiovascular and cerebrovascular diseases; 4) Patients with bacterial infection; 5) Patients with a history of total hip replacement.

2.3. Methods

2.3.1. Preoperative Preparation

All patients have completed preoperative routine examinations: blood routine examination, biochemical examination, erythrocyte sedimentation rate, C-reactive protein, fasting blood glucose, blood coagulation function, lower limb blood vessel color ultrasound, heart color ultrasound, electrocardiogram, etc. The coagulation function and other indicators were evaluated in detail, and the appropriate prosthesis type and placement position were selected through preoperative template measurement.

2.3.2. DAA Group

The patient lies flat on the operating table, the pubic symphysis is directly opposite the folding position of the operating table, routinely disinfected the cloth (exposing the anterior superior iliac spine). Make the hip joint in an overextended position, take 3 cm from the outside of the anterior superior iliac spine and make a longitudinal incision about 7 - 9 cm to the small head of the fibula 3 cm to the distal end, cut the skin and subcutaneous tissue layer by layer to the fascia lata, cut the fascia of tensor fascia lata longitudinally, ligate the ascending branch of the lateral femoral circumflex artery, fully expose the Hueter space and joint capsule, cut the joint capsule in an inverted "T" shape, and expose the femoral head, femoral neck fracture and hip joint cavity. Cut off the femoral neck 1 cm above the lesser trochanter and take out the femoral head. Acetabulum files the acetabulum to a proper size and uniform point bleeding is enough. After installing the test model to measure the size of the acetabulum cup, flush with a large amount of normal saline, place the biological acetabulum cup prosthesis, ensure that the abduction angle of the acetabulum cup is $40^\circ \pm 10^\circ$, and the anteversion angle is $15^\circ \pm 10^\circ$, and place the lining. Folding bed, place the patient's lower limbs in the shape of "4", make the affected limb adduct, rotate outwards and bend the knee, use the medullary cavity file to enlarge the medullary cavity

of the femur in turn, install appropriate femoral prosthesis, observe the length of both lower limbs and the position of the femoral stem prosthesis under the fluoroscopy of the "C" arm X-ray machine, select appropriate biological femoral stem prosthesis and femoral head prosthesis with appropriate neck length, flush the medullary cavity, place the prosthesis, and reposition the joint, After the activity of hip joint is confirmed to be good and stable, clean the joint cavity, suture layer by layer, and sterilize and bandage.

2.3.3. PLA Group

The patient lies on the healthy side of the operating bed. After anesthesia, the pelvis and trunk were at 90˚ to the bed. A posterolateral incision about 10 - 12 cm long was made on the affected side of the hip joint. The skin, subcutaneous tissue and fascia were incised layer by layer. The gluteus maximus muscle fibers were blunt dissection to expose the piriformis muscle on the greater trochanter and the obturator muscle. Cut off the piriformis muscle group attached to the greater trochanter. The joint capsule was cut to expose the hip joint. The hip joint capsule was cut T-shaped to expose the femoral neck fracture. Cut off the femoral neck 1 cm above the lesser trochanter and take out the femoral head. Expose and file the acetabulum, implant the prosthesis and lining (abduction angle is about 40˚ - 45˚, anteversion angle is about 15˚ - 20˚), rotate, flex and adduct the hip joint, expose the proximal end of the femur, gradually expand the medullary cavity file to the appropriate position, install the prosthesis test model, reset and check the hip joint activity to the satisfaction, fluoroscopy shows that the prosthesis is suitable in size, both lower limbs are equal in length, take out the test model, and implant the corresponding femoral stem and femoral head prosthesis. Repair the external rotator muscle group and close the incision layer by layer.

2.3.4. Postoperative Treatment

The two groups of patients were given the same treatment plan after surgery, and the patients began ankle pump exercise after anaesthesia awake. In the observation group, there was no special position restriction after operation, and the patients could move to the ground early; In the control group, the affected lower limbs should be kept in a neutral and abduction position after operation. When rolling over, a pillow should be clamped between the legs. After lying in bed for about 3 days, the affected lower limbs can be moved to the ground.

2.4. Observation Index and Efficacy Evaluation

1) Incision length, intraoperative bleeding, time out of bed, hospital stay; 2) Imaging indicators of prosthesis installation: measure the acetabular abduction angle (the angle between the longitudinal axis of the body and the central axis of the acetabulum), acetabular anteversion angle (the angle formed by the acetabular opening plane and the sagittal plane), eccentric distance (the vertical distance from the rotation center of the femoral head prosthesis to the long axis of the

femoral shaft), and the length difference of both lower limbs (the length difference between the bilateral anterior superior iliac spine and the medial malleolus) on the postoperative X-ray film. 3) Harris score of hip joint 6 and 12 months after operation [7]. 4) Occurrence of postoperative complications and adverse reactions.

2.5. Statistical Methods

SPSS 22.0 software was used for statistical analysis. T-test was used for data analysis and comparison; Chi square test was used to compare the counting data.

3. Results

All patients were followed up for 12 months.

3.1. Comparison of Surgical Conditions and Imaging Indexes of Prosthesis Installation between the Two Groups

Compared with PLA group, DAA group had less hospital stay, less intraoperative bleeding, less postoperative drainage, and longer operation time, with statistically significant differences ($P < 0.05$), see Table 1 for details. There was no significant difference in the anteversion between the two groups ($P > 0.05$); The difference in abduction angle and length of both lower limbs between the two groups was statistically significant ($P < 0.05$), see Table 2 for details. In DAA group, 10 patients (8.55%) had a difference in the length of their lower extremities of >10 mm, and in PLA group, 17 patients (17.17%) had a difference in the length of their lower extremities of >10 mm.

Table 1. Comparison of operation conditions between the two groups (1) [n = 50, ($\overline{x} \pm s$)].

Item	n	Hospital stay	Operation time	Intraoperative bleeding	Volume of drainage
DAA group	50	8.24 ± 3.04	122.79 ± 35.95	217.56 ± 164.51	225.09 ± 97.71
PLA group	50	9.00 ± 2.15	58.13 ± 11.42	271.47 ± 101.03	304.85 ± 74.39
t		−2.147	18.384	−2.947	−6.802
P		0.033	<0.001	0.004	<0.001

Table 2. Comparison of operation conditions between the two groups (2) [n = 50, ($\overline{x} \pm s$)].

Item	n	Acetabular anteversion angle	Acetabular abduction angle	The length difference of both lower limbs
DAA group	50	13.32 ± 3.97	40.70 ± 4.90	5.13 ± 3.65
PLA group	50	13.81 ± 5.48	42.84 ± 5.60	6.32 ± 4.35
t		−0.733	−3.001	−2.194
P		0.465	0.003	0.029

3.2. Comparison of Hip Joint Function between Two Groups

See Table 3. The excellent and good rate of Harris score of hip joint: 6 months after operation, the anterior approach group was significantly higher than the posterolateral approach group ($P < 0.05$). There was no significant difference between the two groups 12 months after operation ($P > 0.05$).

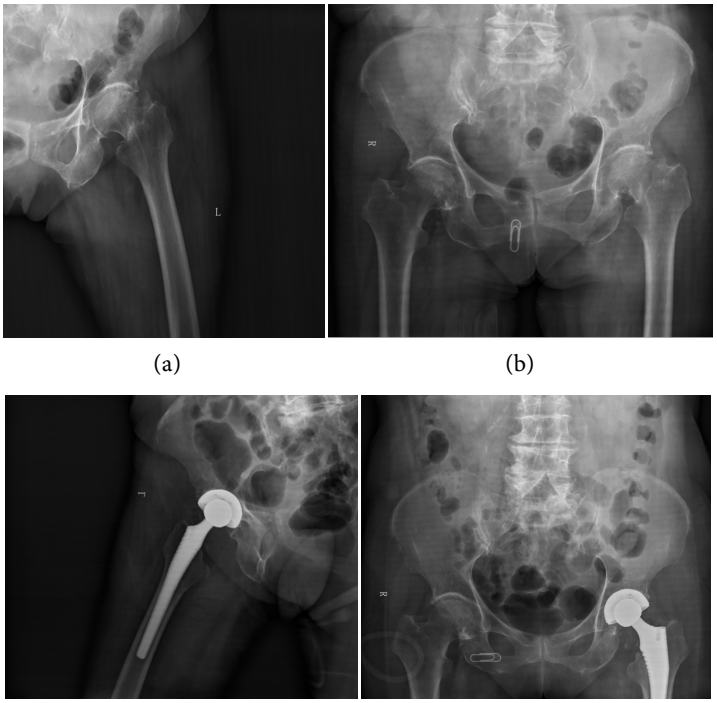
3.3. Comparison of Postoperative Complications between the Two Groups

1) In the posterolateral approach group, there were 3 cases of incision infection, 2 cases of nerve injury, 1 case of acetabular fracture, and 3 cases of bedsore. The complication rate was 18.00%. 2) In the anterior approach group, 1 case had incision infection, 1 case had acetabular fracture, and 1 case had bedsore. The complication rate was 6.00%. The incidence of postoperative complications in the DAA approach group was significantly lower than that in the PLA approach group ($P < 0.05$). There were no serious complications such as deep vein thrombosis, prosthesis loosening, hip dislocation and periprosthetic fracture in both groups.

Typical cases are shown in Figure 1, Figure 2. Figure 1 shows a 75-year-old female patient with left femoral neck fracture who was operated through the DAA approach. Figure 1(a), Figure 1(b) are the preoperative pelvis AP and Lateral radiograph of hip joint, we can see the fracture of left femoral neck, and Figure 1(c), Figure 1(d) show the postoperative pelvis AP and Lateral radiograph of hip joint, the prosthesis is in good position. Figure 2 shows a 58-year-old female patient with right femoral neck fracture who was operated through the PLA approach. Figure 2(a), Figure 2(b) are the preoperative pelvis AP and Lateral radiograph of hip joint, we can see fracture of left femoral neck; Figure 2(c), Figure 2(d) show postoperative pelvis AP and Lateral radiograph of hip joint, the prosthesis is in good position.

Table 3. Comparison of excellent and good rate of Harris score of hip joint between two groups [n (%)].

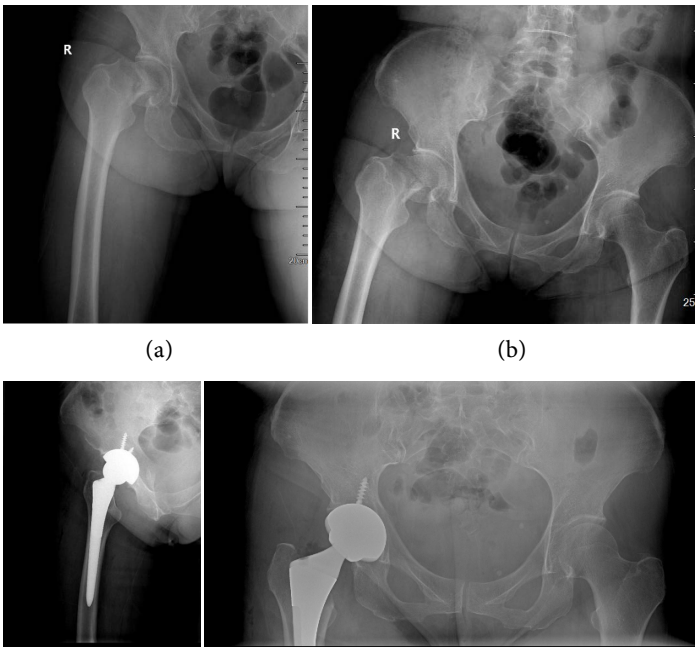
Item	n	excellent	good	fair	poor	Excellent rate
PLA group	50					
6 months after operation		13 (26.00)	25 (50.00)	9 (18.00)	1 (2.00)	38 (76.00)
12 months after operation		21 (42.00)	26 (52.00)	2 (4.00)	1 (2.00)	47 (94.00)
DAA group	50					
6 months after operation		17 (34.00)	29 (58.00)	2 (4.00)	0	46 (92.00)
12 months after operation		26 (52.00)	22 (44.00)	1 (2.00)	0	48 (96.00)



(a) (b)

(c) (d)

Figure 1. Female, 75 years old, left femoral neck fracture, THA through the DAA. (a) (b) Preoperative pelvis AP and Lateral radiograph of hip joint shows fracture of left femoral neck; (c) (d) Postoperative pelvis AP and Lateral radiograph of hip joint shows that the prosthesis is in good position.



(a) (b)

(c) (d)

Figure 2. Female, 58 years old, Right femoral neck fracture, THA through the PLA. (a) (b) Preoperative pelvis AP and Lateral radiograph of hip joint shows fracture of left femoral neck; (c) (d) Postoperative pelvis AP and Lateral radiograph of hip joint shows that the prosthesis is in good position.

4. Discussion

THA is one of the commonly used surgical methods for the treatment of femoral neck fracture, and its clinical efficacy has been widely recognized [8] [9] [10]. However, THA is also one of the reported surgeries with large blood loss (average 1735 ml) [11]. Therefore, reducing THA perioperative blood loss has become a problem that clinical orthopedics doctors pay close attention to and urgently need to solve.

THA has a variety of surgical approaches, among which the posterolateral approach is more commonly used and has the advantages of simple and intuitive operation [12] [13]. However, in recent years, relevant studies [14] [15] believe that THA via posterolateral approach tends to increase the risk of traumatic complications and is not conducive to postoperative rehabilitation of patients. The DAA approach has gradually become the latest choice for joint surgeons at home and abroad because of its advantages such as less damage to surrounding tissues, quick recovery after operation, etc. [16] [17]. In this study, the amount of intraoperative bleeding, postoperative drainage and hospital stay in the DAA group were less than those in the PLA group, and the differences were statistically significant ($P < 0.05$). The authors believe that the above results are mainly related to the anatomical advantages of the DAA approach. The DAA approach is superior to the PLA approach in reducing the damage to the patient's tissues, alleviating the patient's pain, and speeding up the patient's recovery.

THA is a very mature operation, whether through DAA or PLA approach, it can often achieve good surgical results. In this study, the Harris score of DAA group was higher than that of PLA group in the early postoperative period, with a statistically significant difference ($P < 0.05$), but the difference between the two groups was narrowing over time. The results of Wang *et al.*'s meta-analysis of THA [18] showed that there was no significant difference in Harris scores between DAA and PLA approaches. The reason for analysis is that minimally invasive DAA total hip arthroplasty is less likely to damage the nerves of patients, which can effectively protect the stability of muscle tissue and the rear of the hip joint, and it can make the range of motion of the hip joint unrestricted, which can enable patients to do bending, adduction and other actions earlier, and recover faster after surgery [19]. The posterolateral total hip arthroplasty needs to cut off the muscle group, resulting in soft tissue damage and slow recovery of hip joint function [20]. The author believes that the existence of this difference in this study is still related to the fact that the patients after DAA approach have less pain and better comfort, so they can take early rehabilitation exercise, and the hip joint activity is not restricted.

In this study, 10 patients (8.55%) in the DAA group had a length difference of more than 10 mm, while 17 patients (17.17%) in the PLA group had a statistically significant difference ($P < 0.05$). Gong Dawei *et al.* [21] believed that the DAA approach could better control the difference in the length of both legs. The author believes that the existence of this difference is related to the different po-

sitions of the two surgical approaches. The DAA group is in supine position, and the PLA group is in lateral position. The supine position can directly touch the bilateral anterior superior iliac spine, and the length of both lower limbs can be compared more intuitively. At the same time, the supine position enables the operator to have a more intuitive view of the placement of the acetabular prosthesis, and the pelvic position is more stable, which can better ensure that the acetabular prosthesis is located in the safety zone [22].

Limitations of this study: 1) This study is a retrospective study, with relatively low evidence level and short follow-up time, which cannot reflect the long-term efficacy of PLA and DAA approaches. 2) This study only focuses on the cases of unilateral total hip replacement, and does not analyze and study the cases of bilateral total hip replacement. The research content is not comprehensive enough.

In conclusion, compared with the PLA approach, the DAA approach is more consistent with the concept of rapid rehabilitation, with advantages such as less trauma, fewer complications, fast recovery, and good short-term effect. However, the implementation of the DAA approach is also limited by its disadvantages such as the need for special eccentric tools and long learning curve. Therefore, under the condition that the hardware conditions are met and the DAA approach is skillfully mastered, the DAA approach is a reliable and effective surgical method, which can more effectively promote the recovery of patients' hip joint function.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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