European Review for Medical and Pharmacological Sciences 2023; 27: 5604-5613

Comparison of clinical efficacy between direct anterior approach and posterolateral approach in primary total hip arthroplasty

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Abstract. – OBJECTIVE: The aim of this study was to retrospectively analyze the clinical efficacy of the direct anterior approach (DAA) vs. posterolateral approach (PLA) in primary total hip arthroplasty (THA).

PATIENTS AND METHODS: A total of 382 patients who underwent primary THA in our hospital from March 2016 to March 2021 were identified as research subjects, with 183 patients in the DAA group and 199 in the PLA group. Outcome measures included operation time, intraoperative blood loss, postoperative creatine kinase (CK), Harris score, visual analogue scale (VAS), postoperative hospital stay, and postoperative complications.

RESULTS: DAA resulted in significantly longer operative time but lower intraoperative bleeding volume vs. PLA. Three months postoperatively, patients receiving DAA showed significantly lower visual analogue scale (VAS) scores and higher Harris scores than those given PLA. No hip dislocation was observed in the DAA group.

CONCLUSIONS: DAA results in less intraoperative hemorrhage and muscle damage, better postoperative recovery, and a lower incidence of hip dislocation.

Key Words:
Total hip arthroplasty, Direct anterior approach, Posterolateral approach, Clinical efficacy.

Introduction

Total hip arthroplasty (THA) is a common treatment method for various end-stage hip diseases, such as hip osteoarthritis, femoral head necrosis, hip dysplasia, etc. THA has achieved outstanding clinical efficacy[1]. The traditional posterolateral approach (PLA) requires the severing of the obturator and piriformis muscles and causes soft tissue injuries and certain damage to the posterior stability, resulting in severe postoperative pain and a high risk of dislocation[2,3]. By contrast, the direct anterior approach (DAA), with the intramuscular approach, provides multiple benefits such as reduced intraoperative muscle damage, rapid recovery, and a low incidence of dislocation[4,5]. However, it has been argued[6,7] that DAA has a long learning curve and is associated with risks such as long operation time and heavy bleeding.

The aging of the population has led to an increase in the number of clinical cases requiring hip replacement surgery. With the widespread concept of enhanced recovery surgery, minimally invasive joint replacement surgery has won the attention of scholars[8,9]. DAA can effectively preserve the hip muscles by manipulating the muscle gap to the front of the joint. In recent years, there has been a resurgence in the field of joint surgery in China, and it has gained widespread attention and application[10]. Statistics indicate that DAA is the preferred surgical method for 18% of joint surgeons and is still increasing year by year. However, there is a longer learning curve, and there may be more complications in the early stage: the lateral femoral cutaneous nerve may be injured, resulting in proximal femoral fracture or poor incision healing[11]. Reportedly, the incidence rate of DAA injury to the lateral femoral cutaneous nerve was 31.9%. Pain is a common symptom of nerve damage, and 45.6% of patients with lateral femoral cutaneous nerve injury symptoms reported pain, which also led to more patients with mixed neuropathic pain after DAA[12]. With the improvement of people's living standards, surgical patients are eager for accelerated postop-

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erative recovery in order to improve their quality of life. How to safely and efficiently reduce postoperative pain and swelling, and accelerate postoperative recovery is the urgent desire of the majority of physicians and patients.

The physiological mechanism of postoperative pain involves neurogenic and nociceptive sources. The current postoperative analgesia is performed based on multimodal analgesia and individual differences, to achieve a good analgesic effect and reduce the use of analgesic drugs[13]. Traditional Chinese medicine believes that femoral neck fractures are caused by trauma. The femoral neck fractures have local multiple blood stasis, obstruction of qi and blood, and pain[14]. The disease can be classified as "bone erosion" and "bone atrophy". For the elderly population, the body is weak, the qi and blood are weak, and the liver and kidneys are deficient. The liver deficient cannot nourish the tendons, and the bones are withered, and they are subjected to slight indirect or direct external forces, such as hip damage, buttocks landing, slipping on flat ground, leading to fractures. Femoral neck fractures in the elderly are mostly due to insufficient liver and kidney, weak qi and blood, and weak muscles and bones. Traditional Chinese medicine believes that qi and blood are important substances for replenishing bones, so hip replacement surgery combined with appropriate liver and kidney drug treatment is essential[15]. In this study, Xuduan Jiegu Decoction plus hip arthroplasty are employed.

To this end, this study aims to retrospectively analyze the clinical efficacy of DAA *vs.* PLA.

Patients and Methods

Case Data

This was a retrospective, single-center, observational study approved by our hospital's Medical Ethics Committee, and informed consent was obtained from all the patients. From March 2016 to March 2022, a total of 382 patients underwent primary THA in our hospital. Though this study was a single-center study, and the included hip diseases were different, it will not influence the results and conclusions since the surgery was performed by the same surgeon.

Inclusion criteria: (1) patients who had hip joint diseases (femoral head necrosis, hip arthritis, or hip dysplasia) and underwent joint replacement; (2) patients with primary hip arthroplasty; (3) BMI <30 kg/m^2; (4) preoperative assessment indicated a good surgery tolerance, no medical symptoms were detected in clinical tests, and no surgical contraindications were found; (5) patients younger than 85 years old; (6) The patients were informed of the treatment plan and can cooperate with the study.

Exclusion criteria: (1) patients with simultaneous bilateral total hip arthroplasty; (2) patients with a medical history of previous hip surgery; (3) BMI greater than 30 kg/m^2; (4) patients with severe heart, brain, liver, kidney organic lesions, and severe functional disorders; (5) patients with coagulation dysfunction; (6) patients with systemic infection; (7) patients who have received anticoagulation therapy or drugs that affect coagulation function such as warfarin or aspirin before surgery; (8) patients who have been bedridden for a long time before surgery; (9) patients who have a history of lower extremity thrombotic diseases; (10) patients who have multiple fractures; (11) open hip fractures with vascular and nerve damage; (12) allergies to drugs or allergic constitution.

The original sample size calculation estimated that 60 patients in each group would be needed to detect a 3-point difference between groups in a 2-sided significance test with a power of 0.8 and an alpha error level of 0.05.

The study protocols were approved by the Ethics Committee of The First Hospital Affiliated to Zhejiang Chinese Medical University. The study was done in accordance with the protocol, its amendments, and standards of Good Clinical Practice. All participants provided written informed consent before enrolment.

Surgical Methods and Perioperative Management

All operations were performed by surgeons with abundant surgical experience. Standardized perioperative management methods were performed, including anesthesia, multimodal pain management, and postoperative rehabilitation programs. All patients received bio prostheses. Tranexamic acid for hemostasis and low molecular weight heparin were routinely used to prevent perioperative thrombosis.

In the DAA group, the patients were maintained in a lateral position, and a 2 cm-long incision was made downward and outward from the anterior superior iliac spine to the capitulum fibulae. The skin and subcutaneous tissue were opened layer by layer, and the sartorius muscle gap of the tensor fascia lata was exposed, followed by the exposure of the articular capsule. The femoral distance was

at 1-1.5 cm, the femoral neck was severed, the femoral head was removed, the acetabulum was fully exposed, the acetabular fossa was cleaned, the acetabulum was ground to the appropriate size, and the acetabular cup and lining were implanted. The affected limb was rearward extended, externally rotated, and adducted, the joint capsule and muscle tissue of the proximal femur were released, then the prosthesis stem and head of appropriate size were implanted, and the joint was reset. When installing the prosthesis, the contralateral hip provided references for matched length. During the operation, the height of the rotation center of the femoral head was measured, and the lower poles of the patella on both sides and the heel were touched to determine whether the two lower limbs were of the same length. The hip joint could be moved at an unlimited angle, without the dislocation of the prosthesis.

In the PLA group, the patients were maintained in a lateral position, and the incision was made with the center at the apex of the greater trochanter, the skin and subcutaneous tissue were incised successively, the gluteus maximus was bluntly separated, and the gluteus medius and quadratus femoris were retracted. Part of the short external rotator muscles was severed, and the posterior joint capsule was exposed. The femoral distance was kept at 1-1.5 cm, the femoral neck was cut off, and the prosthesis was implanted (the implantation method was the same as that in the DAA group).

On the basis of the treatment in the two groups, Xuduan Jiegu Tang was added: *Drynaria* 15 g, *Dipsacus asperoids* 15 g, *Salvia* 10 g, *Psoralea* 15 g, *Pyritum* 10 g, etc. It was decocted to 300 ml and taken in the morning and evening, one dose per day, the course of treatment spanned 1 month (Figure 1).

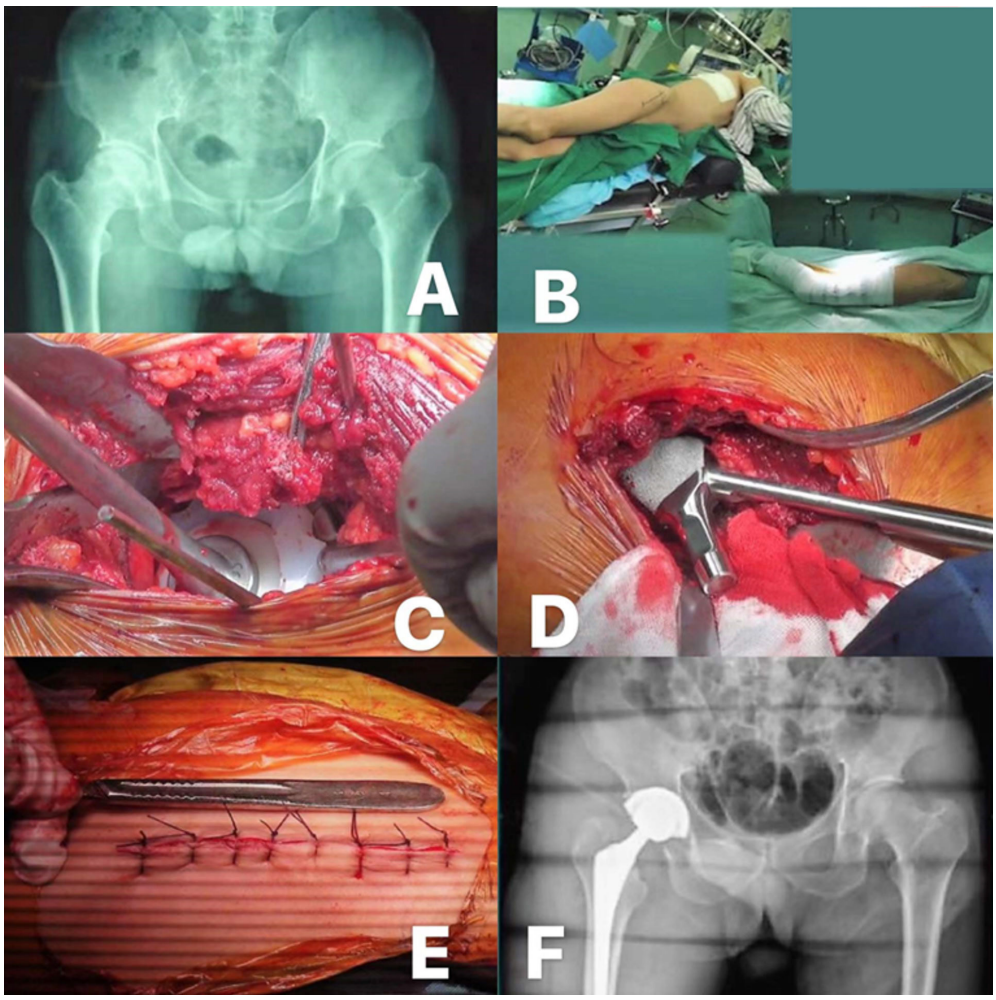

Figure 1. Basic procedure of DAA for THA. **A**, Preoperative anteroposterior X-ray of both hips. **B**, Patient position: lateri-cumbent position. **C**, Implantation of the acetabular prosthesis. **D**, Implantation of side femoral prosthesis. **E**, Length of surgical incision. **F**, Postoperative anteroposterior X-ray of both hips.

Evaluation Indicators

(1) Surgery-related indices: operation time, intraoperative bleeding volume, perioperative hemoglobin decline (the lowest postoperative hemoglobin – preoperative hemoglobin), hospital stay, and level of creatine kinase (serum muscle injury marker).
(2) Clinical function score: visual analogue scale (VAS) score and Harris score were recorded respectively before the operation, 6 weeks after the operation, 3 months after the operation, and 6 months after the operation.
VAS score: 1 straight line was divided into 9 equal points, with the two ends representing 0 points of no pain and 10 points of severe pain. Patients marked the straight line according to their subjective feelings to reflect the pain level. The measurement was required before and after treatment.
Harris score: the content includes four aspects of pain, function, deformity, and joint mobility, and the total score is 100, with 90 points or more for excellent, 80-89 points for good, 70-79 points for moderate, and less than 70 points for poor.
(3) Postoperative complications: postoperative complications included hip dislocation, incision infection, periprosthetic infection, intraoperative periprosthetic fracture, and intraoperative nerve injury.

Statistical Analysis

Statistical analysis was performed with SPSS 19 (IBM Corp., Armonk, NY, USA). Normally distributed measurement data were expressed as mean plus or minus standard deviation (±s). Comparisons of means between two groups were first performed with a Chi-squared F-test; an independent sample *t*-test was used for Chi-squared data and an independent sample *t*-test for non-Chi-squared data; paired sample *t*-test was used for intra-group pre-post comparisons. The *t*-test was taken to compare the measurement data, and the χ^2 test was taken to compare the enumeration data of the two groups of patients. $p<0.05$ was considered to be statistically significant.

Results

General Clinical Data

A total of 382 patients underwent primary THA, among which DAA was given to 183 patients, including 102 males and 81 females, aged 38-85 (61.1±10.1) years, and PLA was given to 199 patients, including 109 males and 90 females, aged 37-87 (60.8±10.7) years. There was no significant difference in age, sex, BMI and primary disease between the two groups (Table I).

Surgery-Related Indices

The operation time of two groups was similar. DAA resulted in significantly less intraoperative blood loss, shorter hospital stays, and lower perioperative hemoglobin levels *vs.* PLA. The creatine kinase levels were significantly increased after treatment in both groups, with lower levels observed in the DAA group (Table II).

Clinical Function Score

The DAA group obtained higher Harris Hip Score (HHS) and lower VAS scores than the PLA group within 3 months after the operation, and this difference was absent 6 months after the operation (Table III).

Table I. Comparison of general clinical data between DAA group and PLA group.

	DAA (n=183 cases)	PLA (n=199 cases)	*p*-value
Age	61.1±10.1	60.8±10.7	0.286
Sex (Male/Female)	98/85	89/110	0.085
BMI	25.7±4.3	25.1±4.5	0.675
Left and right side	101/82	112/87	0.830
Primary disease			
Hip Osteoarthritis	43 (23.5%)	52 (26.1%)	0.552
Necrosis of the femoral head	67 (36.6%)	76 (38.2%)	0.750
Congenital hip dysplasia	28 (15.3%)	29 (14.6%)	0.842
Femoral neck fracture	45 (24.6%)	42 (21.1%)	0.417

Table II. Comparison of relevant perioperative indicators between DAA group and PLA group.

	DAA (n=183 cases)	PLA (n=199 cases)	*p*-value
Operation time (from skin incision to completion of suture) (min)	81±11.8	77±10.1	0.157
Intraoperative blood loss (ml)	110±60.3	191±53.5	0.019
Hospital stay (day)	7.2±1.1	9.1±1.5	0.023
Perioperative hemoglobin decline (g/L)	1.9±0.4	2.5±0.5	0.014
Creatine Kinase (U/L)			
Before operation	57±23.1	60±18.9	0.758
1 day after operation	189±34.5	239±31.1	0.016
3 days after operation	169±32.9	337±32.5	0.001

Table III. Comparison of VAS score and HHS score between the DAA group and the PLA group.

	VAS score			HHS score		
	DAA group	PLA group	*p*-value	DAA group	PLA group	*p*-value
Before operation	4.7±1.9	4.8±2.1	0.161	51.1±8.8	49.8±9.1	0.198
6 weeks after operation	1.5±1.1	2.3±1.2	0.015	88.9±9.5	79.1±10.2	0.012
3 months after operation	1.3±0.8	1.8±0.9	0.034	92.4±9.7	85.1±9.6	0.028
6 months after operation	1.2±0.4	1.3±0.4	0.485	96.5±10.1	95.5±9.8	0.571

Perioperative Complications

During the follow-up period, 2 patients had a hip dislocation, both of whom were from the PLA group. Both of them did not have hip dislocation again after manual reduction under anesthesia. There were no periprosthetic fractures in both groups. In the DAA group, there were 3 cases of lateral femoral cutaneous nerve injury, which recovered 6 months after operation. In the PLA group, there were 2 cases of sciatic nerve traction, which basically recovered within 1 year after operation. During follow-up, there were 2 cases of surgical incision infection in each group, which were successfully managed after anti-infection treatment. One patient in the PLA group developed periprosthetic infection six months after the operation. Due to ineffective anti-infection treatment, prosthesis exclusion and revision surgery were performed. One patient in the DAA group developed intraoperative periprosthetic fracture (greater trochanteric fracture), which was bundled with cables during the operation (Table IV).

Discussion

With the continuous development of medical technology, the relevant surgical approaches have also become diversified. At present, DAA and PLA are the most adopted approaches. PLA allows for full vision and easy operation. However, due to the intraoperative destruction of the external rotator muscle group, which destroys the joint's posterior lateral stabilizing structures, PLA requires restrictions on some special positions to prevent complications such as joint dislocation, thus compromising postoperative recovery[12].

Table IV. Perioperative complications in the DAA group and the PLA group.

	DAA (n=183 cases)	PLA (n=199 cases)	*p*-value
Hip dislocation	0 (0)	2 (1.0%)	0.174
Incision infection	2 (1.1%)	2 (1.0%)	0.933
Periprosthetic infection	0 (0)	1 (0.5%)	0.337
Intraoperative periprosthetic fracture	1 (0.5%)	0 (0)	0.296
Nerve damage	3 (1.6%)	2 (1.0%)	0.586

The DAA was first proposed and operated in 1881, and the DAA currently used in clinical practices is improved by the Smith-Petersen approach[16,17]. DAA preserves the intact periprosthetic muscle groups, has less surgical damage, allows early postoperative mobility, has no postural restrictions, results in a much lower incidence of prosthetic dislocation, and provides good rehabilitation outcomes[18].

Clinical Results

There was no significant difference in operation time between the two groups. The operation time is considered to be correlated with factors such as the surgeon's experience, complete surgical instruments and cooperation with skilled assistants. However, PLA causes a higher risk of posterior dislocation when the affected limb is inadvertently placed in the adducted, flexed, and internally rotated after the operation. The patients in the DAA group are theoretically less prone to the risk of dislocation than those in the PLA group, as DAA does not cause muscle injuries and has good stability. A previous study[19] recommended acetabular cup abduction of 35-50° and anteversion of 10-25° as a safe range. An angle exceeding the safe range may be attributed to the dislocation of the poorly positioned prosthesis. Hartog and Vehmeijer[6] found that the more experience a surgeon has with DAA, the shorter the operative time. It has been reported[20] that the incidence of dislocation after DAA operation is low, ranging from 0.6% to 1.2%.

In this study, there was no significant difference in operation time between the PLA control group and the DAA group, and postoperative imaging showed that the position of the artificial hip prosthesis in the two groups was basically within the ideal range. However, there were 2 cases of dislocation after the operation in the PLA group, while no case of dislocation in the DAA group was detected. It is suggested that the short external rotator is critical for the stability of the prosthesis, especially for elderly patients. In the DAA group, the prosthesis entered directly from the intramuscular gap without cutting off any muscles around the joint, which well protected the soft tissue around the prosthesis. Therefore, postoperative joint stability was significantly strengthened, and patients were less prone to dislocation and other risks.

The DAA has advantages in functional recovery, gait walking, hip pain and hospital stay. It facilitates the early recovery of patients, reduces medical expenses and improves the satisfaction of patients. Bremer et al[21] stated that through postoperative MRI scanning analysis, the DAA results in significantly less damage to soft tissue than PLA. According to the research results of Christensen and Jacobs[22], patients in the DAA group experienced significantly shorter time to perform off-bed activities and shorter hospital stay, could walk and recover muscle strength without the assistance of external tools at an earlier stage, and obtained higher Harris score and lower VAS score than those in the PLA group. By combining with gait analysis, Zhao et al[23] found that due to less muscle damage, the gait analysis results of patients in the DAA group were closer to normal within 3 months after the operation, yet there was no significant difference in the gait and functional recovery of the two groups 6 months after surgery. In the present study, patients in the DAA group had milder pain, longer walking time and distance, and significantly better motion range of the joints than those in the PLA group. This indicated that the recovery in the early postoperative period of patients in the DAA group was better than that of the PLA group. But over time, 3-6 months after the operation, there tended to be no significant difference between the two groups of patients regarding the motion range of the joint, pain, and functional exercise.

Bergin et al[24] analyzed the levels of inflammation and muscle damage after THA treatment *via* DAA and PLA and found that the creatine kinase level in the PLA group was significantly higher than that in the DAA group. The results of this study are similar to those of the above-mentioned study[24], which all indicate that THA treatment *via* DAA has less muscle damage and provides more adequate soft tissue protection *vs.* PLA. It facilitates the rapid recovery of joint function and the reduction of local inflammatory reactions. The reason may be related to factors including the intraoperative cutting of the ascending branch of the lateral femoral circumflex artery and the blood loss caused by blunt muscle dissection.

Complications

Compared with the PLA, DAA features a longer learning curve, which is correlated with the incidence of complications. Moskal et al[25] suggested that the incidence of perioperative complications in the THA treatment *via* DAA was closely related to the surgeon's experience and familiarity with surgical techniques. Perioperative fractures and lateral femoral cutaneous nerve injury

are the most common complications[26]. There are large differences in reports[27,28] in terms of lateral femoral cutaneous nerve (LFCN) injury caused by various factors during skin incision and separation of superficial muscles, with the incidence ranging from 0 to 31.9%. The incidence of greater trochanter fracture is about 1%, and the incidence of femoral fractures is 1.6%-8%[29]. According to research[30], the incidence of complications can be significantly reduced after learning from 57-100 cases of DAA operations. In the present study, there were 3 cases of lateral femoral cutaneous nerve injury and 1 case of greater trochanteric fracture. The reasons are as follows: 1) The nerve damage was caused by unclearly distinguished body surface marking, incision position, and intramuscular space, incorrect incision plane, excessive intraoperative stretch, and incision injury. 2) Injuries were caused by unclear levels of suture and mistakenly sutured cutaneous nerve due to insufficient experience. 3) Fractures resulted from the violent external rotation of the affected limb to fully expose the proximal femur when the soft tissue was insufficiently released during the operation. 4) Fracture of the greater trochanter resulted from the improper force in peeling off the soft tissue around the greater trochanter with the instrument, especially in patients with osteoporosis. In terms of long-term prosthesis revision, Ponzio et al[31] conducted a follow-up study of more than 4 years and found that the revision rate of patients in the PLA group was 2.7%, while that in the DAA group was 0.7% in the same period, indicating that DAA also provides benefits in prosthesis stability and durability. Periprosthetic infection is one of the major problems with orthopedic prosthetic surgery. The incidence of periprosthetic infection varies depending on the site of intervention, with different published case studies[31,32] reporting a rate of 0.5% to 3.0% for first implantation, with a significantly greater risk of prosthesis revision. In this study, the infection rates of both groups were low. This may be related to the shorter follow-up, but it also indicates that the surgical modality in our hospital has a significant safety profile.

Reflections

Bender et al[33] suggested that patients with BMI <30 kg/m^2, good hip mobility, no evident soft tissue contracture, no abnormal hip anatomy, and no medical history of previous joint surgery are better for surgeons unfamiliar with DAA. Moreover, the anatomical structure should be accurately identified during the operation, and the lateral femur requires adequate release of the muscles around the greater trochanter and the joint capsule to avoid serious complications such as fractures.

The conventional DAA approach is mostly performed with the patient in the horizontal position but requires a special surgical bed with folding capabilities, which may not be available in some hospitals. Chen et al[34] adopted a lateral DAA approach and obviated the need to re-adjusting the surgical bed intraoperatively by simply moving the affected limb and exposing the proximal femur[3]. In the present study, all the surgeries were performed in the lateral position with a normal surgical bed. The angle of prosthesis placement was similar to that of the posterior lateral when dealing with the acetabular side intraoperatively. The lateral femoral operation was performed without adjusting the position of the surgical bed, with the active limb in the posterior extension internal and external rotation position, and with more flexibility and ease of adjustment according to soft tissue release, to achieve optimal exposure of the proximal femur and complete the prosthesis preparation for implantation.

Many types of hip diseases have different pathogenesis, and most conventional conservative treatments fail to obtain a complete cure. Under the condition of conforming to the indications for artificial total hip arthroplasty, favorable treatment results could be achieved by integrating comprehensive preoperative preparation, prosthesis selection, strict intraoperative operation, and postoperative care. The THA should be performed according to the patient's condition and the special features of the anatomical structure of the hip joint: ① preoperative examination of all aspects of the patient's physical status should be performed, and advance bone traction, treatment of comorbidities, and nutritional supplementation are necessitated. ② Suitable prostheses were selected based on the results of X-ray radiographs or CT scans. ③ The key link in the surgical process is to identify the true acetabulum and remove the surface cartilage in the acetabulum until the bone is revealed (during the operation of removing the acetabular cartilage, the patient can be kept in an abduction position of 40-45° and an anterior tilt position of 15-25°). Force should be applied to the posterior wall of the acetabulum to minimize the wear of the anterior wall and to ensure stable and good bony support around the prostheses. For patients with different fractions of hip damage, flexible adjustments should also be carried out to

effectively reconstruct the hip joint's normal center of rotation and restore the lower extremity's normal length. ④ Patients with Garden type III and IV should consider bone fusion of the acetabular prosthesis when performing prosthetic replacement, and the abnormal matching between the head and socket can be improved by various methods, including smaller socket cups, structural bone grafting of autologous bone in the bone defect area, high-level reconstruction of the hip center, and inversionplasty of controlled fractures of the medial acetabular wall. ⑤ After the procedure, drainage and administration of anti-thrombotic drugs and antibiotics are performed to prevent the occurrence of deep vein thrombosis and infection in the lower extremities.

In recent years, Traditional Chinese medicine (TCM) has shown unique advantages in adjuvant therapy after fracture surgery, and TCM adjuvant therapy after hip replacement has gradually become a focus of clinical research. TCM believes that fractures and surgical trauma are diseases in which the limbs are damaged externally, and the qi and blood are damaged internally. The postoperative recovery process of patients undergoing hip replacement is a process of removing blood stasis and regenerating new ones. It is believed[35] that promoting blood circulation and removing blood stasis can regulate qi and blood in the whole body and promote the repair of surrounding tissue damage. Fractures, surgical injuries, etc., can cause injury to the meridians, resulting in an evident imbalance of qi and blood, in insufficient qi and blood, and obstruction of the bones and collaterals[36]. Additionally, elderly patients have different degrees of osteoporosis (bone atrophy, low back pain, bone paralysis, etc.), and the growth and development of bones are closely related to the essence and qi of the kidney[37]. Therefore, adjuvant therapy such as invigorating qi and promoting blood circulation, invigorating kidney and strengthening bones can improve the postoperative rehabilitation effect of elderly patients with hip arthroplasty. Xuduan Jiegu Decoction is composed of *Drynaria*, *Dipsacus Asperoids*, *Salvia*, *Psoralea*, *Pyritum*. Among them, *Drynaria* can promote the absorption of calcium by bone, and improve the level of blood calcium and blood phosphorus, which is beneficial to bone calcification[38]. It forms with bone salt and promotes the activity of acid phosphatase and the decomposition of proteoglycan in tissues. *Dipsacus Asperoids* promote blood circulation and remove blood stasis and have evident effects on blood stasis, swelling and pain, and fractures. *Psoraleae* can promote the osteogenesis of osteoblasts in the body, so that the osteoblasts on the inner and outer periosteum actively produce an increase in the number of inner and outer callus so that the fracture can heal as soon as possible. *Pyritum* promotes blood circulation and removes blood stasis, establishes bone, and relieves pain, which is conducive to the healing of fractures. *Astragalus* is a traditional Chinese medicine for tonifying qi and deficiency, which has the effects of tonifying qi and raising yang, firming the surface and stopping sweating, detoxifying and expelling pus, and diuresis and swelling[39-41]. In this study, Xuduan Jiegu Decoction was used for symptomatic treatment to achieve the effects of invigorating the kidney and strengthening the bones, promoting blood circulation and removing blood stasis, invigorating the kidney and helping the yang, and renewing the tendons and healing injuries.

Limitations

1) The short follow-up failed to determine the long-term efficacy of DAA. 2) This study was a single-center study with small sample size. 3) There is a lack of research on obese people and patients with significant soft tissue contracture due to end-stage femoral head necrosis. Despite the above deficiencies, this method can be applied to the routine treatment of patients with hip disorders in various medical institutions. It is expected that future clinical studies with larger samples can provide more clinical evidence for this treatment method.

Conclusions

DAA group has no evident restriction for body position, extremely low risk of prosthesis dislocation, and results in rapid functional recovery, reduced pain, improved quality of life, and shortened hospital stay *vs.* PLA. Further trials are required prior to clinical promotion.

Ethics Approval

The study was approved by the Ethics Committee of Zhejiang Chinese Medical University, Zhejiang Province, China, with number: 2015-5258/234.

Informed Consent

The informed consent was signed by the patients and their families.

Availability of Data and Materials
All data are available upon request to the corresponding author.

Conflict of Interest
The authors declare no conflict of interest.

Funding
This study was supported by Zhejiang Province Traditional Chinese Medicine Science and Technology Plan Project (2023ZL038).

Authors' Contributions
All authors contributed equally to the study.

References

1) Courpied JP, Caton JH. Total Hip Arthroplasty, state of the art for the 21st century. Int Orthop 2011; 35: 149-150.
2) Damm P, Zonneveld J, Brackertz S, Streitparth F, Winkler T. Gluteal muscle damage leads to higher in vivo hip joint loads 3 months after total hip arthroplasty. PLoS One 2018; 13: e0190626.
3) Barrett WP, Turner SE, Leopold JP. Prospective randomized study of direct anterior vs postero-lateral approach for total hip arthroplasty. J Arthroplasty 2013; 28: 1634-1638.
4) Berend KR, Lombardi AV Jr, Seng BE, Adams JB. Enhanced early outcomes with the anterior supine intermuscular approach in primary total hip arthroplasty. J Bone Joint Surg Am 2009; 91 Suppl 6: 107-120.
5) Rodriguez JA, Deshmukh AJ, Rathod PA, Greiz ML, Deshmane PP, Hepinstall MS, Ranawat AS. Does the direct anterior approach in THA offer faster rehabilitation and comparable safety to the posterior approach? Clin Orthop Relat Res 2014; 472: 455-463.
6) Hartog YM, Vehmeijer SB. High complication rate in the early experience of minimally invasive total hip arthroplasty by the direct anterior approach. Acta Orthop 2013; 84: 116-117.
7) Scardino M, Di Matteo B, De Angelis A, Anzillotti G, Martorelli F, Simili V, Monteleone G, Bovio M, Tasso F, Laino ME, Tommasini T, Savevski V, Grappiolo G, Kon E, D'Amato T. Clinical efficacy of implementing a Patient Blood Management (PBM) Protocol in joint replacement surgery: a retrospective cohort study in a national referral center. Eur Rev Med Pharmacol Sci 2022; 26: 9221-9229.
8) Pop AM, Russu OM, Zuh SG, Feier AM, Pop TS. The Impact of Living Arrangements on the Prevalence of Falls after Total Joint Arthroplasty: A Comparison between Institutionalized and General Geriatric Population. Int J Environ Res Public Health 2023; 20: 3409.
9) Tasso F, Simili V, Di Matteo B, Monteleone G, Martorelli F, De Angelis A, D'Amato T, Bovio M, Altomare D, Campofreda G, Marcacci M, Scardino M. A rapid recovery protocol for hip and knee replacement surgery: a report of the outcomes in a referral center. Eur Rev Med Pharmacol Sci 2022; 26: 3648-3655.
10) Lin B, Lan Y, Lu Z, Xie S, Lin F, Weng Y, Feng E, Chen J. The compared study about femoral stem malalignment with or without the special curved rasp during DAA total hip arthroplasty. BMC Musculoskelet Disord 2023; 24: 319.
11) Van Dooren B, Peters RM, Ettema HB, Schreurs BW, Van Steenbergen LN, Bolder SBT, Zijlstra WP. Revision risk by using the direct superior approach (DSA) for total hip arthroplasty compared with postero-lateral approach: early nationwide results from the Dutch Arthroplasty Register (LROI). Acta Orthop 2023; 94: 158-164.
12) Jin Z, Wang L, Qin J, Hu H, Wei Q. Direct anterior approach versus posterolateral approach for total hip arthroplasty in the treatment of femoral neck fractures in elderly patients: a meta-analysis and systematic review. Ann Med 2023; 55: 1378-1392.
13) Demeulenaere M, Janssens GPL, van Beek N, Cannaerts N, Tengrootenhuysen MMF. Optimizing Rapid Recovery After Anterior Hip Arthroplasty Surgery: A Comparative Study of Fascia Iliaca Compartment Block and Local Infiltration Analgesia. J Arthroplasty 2022; 37: 1338-1347.
14) Lan Y, Feng E, Lin B, Lu Z, Lin F, Weng Y. Direct anterior posteriorlateral approachs for clinical outcomes after total hip arthroplasty in the treatment of severe DDH. BMC Musculoskelet Disord 2022; 23: 958.
15) Nie DX, Sun WG, Wang XQ, Wang MJ, Sun JB, Chen C. [Comparison of curative effect between Tianji robot assisted screw placement and traditional cannulated screw internal fixation for femoral neck fracture]. Zhongguo Gu Shang 2023; 36: 221-225.
16) Varner C, Dixon L, Simons MC. The Past, Present, and Future: A Discussion of Cadaver Use in Medical and Veterinary Education. Front Vet Sci 2021; 8: 720740.
17) Connolly KP, Kamath AF. Direct anterior total hip arthroplasty: Literature review of variations in surgical technique. World J Orthop 2016; 7: 38-43.
18) Rossini M, Adami S, Bertoldo F, Diacinti D, Gatti D, Giannini S, Giusti A, Malavolta N, Minisola S, Osella G, Pedrazzoni M, Sinigaglia L, Viapiana O, Isaia GC. Guidelines for the diagnosis, prevention and management of osteoporosis. Reumatismo 2016; 68: 1-39.
19) Ye X, Zeng J, Liu Y, Wang J. Clinical evaluation of total hip arthroplasty for osteoarthropathy secondary to septic hip arthritis. Medicine (Baltimore) 2023; 102: e33227.
20) Abdel MP, von Roth P, Jennings MT, Hanssen AD, Pagnano MW. What Safe Zone? The Vast Majority of Dislocated THAs Are Within the Lewinnek Safe Zone for Acetabular Component Position. Clin Orthop Relat Res 2016; 474: 386-391.

21) Bremer AK, Kalberer F, Pfirrmann CW, Dora C. Soft-tissue changes in hip abductor muscles and tendons after total hip replacement: comparison between the direct anterior and the transgluteal approaches. J Bone Joint Surg Br 2011; 93: 886-889.

22) Christensen CP, Jacobs CA. Comparison of Patient Function during the First Six Weeks after Direct Anterior or Posterior Total Hip Arthroplasty (THA): A Randomized Study. J Arthroplasty 2015; 30: 94-97.

23) Zhao HY, Kang PD, Xia YY, Shi XJ, Nie Y, Pei FX. Comparison of Early Functional Recovery After Total Hip Arthroplasty Using a Direct Anterior or Posterolateral Approach: A Randomized Controlled Trial. J Arthroplasty 2017; 32: 3421-3428.

24) Bergin PF, Doppelt JD, Kephart CJ, Benke MT, Graeter JH, Holmes AS, Haleem-Smith H, Tuan RS, Unger AS. Comparison of minimally invasive direct anterior versus posterior total hip arthroplasty based on inflammation and muscle damage markers. J Bone Joint Surg Am 2011; 93: 1392-1398.

25) Moskal JT, Capps SG, Scanelli JA. Anterior muscle sparing approach for total hip arthroplasty. World J Orthop 2013; 4: 12-18.

26) Kong X, Grau L, Ong A, Yang C, Chai W. Adopting the direct anterior approach: experience and learning curve in a Chinese patient population. J Orthop Surg Res 2019; 14: 218.

27) den Hartog YM, Mathijssen NM, Peters SJ, Vehmeijer SB. The anterior supine intermuscular approach for total hip arthroplasty: reducing the complication rate by improving the procedure. Hip Int 2015; 25: 28-33.

28) Homma Y, Baba T, Sano K, Ochi H, Matsumoto M, Kobayashi H, Yuasa T, Maruyama Y, Kaneko K. Lateral femoral cutaneous nerve injury with the direct anterior approach for total hip arthroplasty. Int Orthop 2016; 40: 1587-1593.

29) Surace P, Sultan AA, George J, Samuel LT, Khlopas A, Molloy RM, Stearns KL, Mont MA. The Association Between Operative Time and Short-Term Complications in Total Hip Arthroplasty: An Analysis of 89,802 Surgeries. J Arthroplasty 2019; 34: 426-432.

30) Post ZD, Orozco F, Diaz-Ledezma C, Hozack WJ, Ong A. Direct anterior approach for total hip arthroplasty: indications, technique, and results. J Am Acad Orthop Surg 2014; 22: 595-603.

31) Ponzio DY, Poultsides LA, Salvatore A, Lee YY, Memtsoudis SG, Alexiades MM. In-Hospital Morbidity and Postoperative Revisions After Direct Anterior vs Posterior Total Hip Arthroplasty. J Arthroplasty 2018; 33: 1421-1425.e1421.

32) Basile G, Gallina M, Passeri A, Gaudio RM, Castelnuovo N, Ferrante P, Calori GM. Prosthetic joint infections and legal disputes: a threat to the future of prosthetic orthopedics. J Orthop Traumatol 2021; 22: 44.

33) Bender B, Nogler M, Hozack WJ. Direct anterior approach for total hip arthroplasty. Orthop Clin North Am 2009; 40: 321-328.

34) Chen M, Luo Z, Ji X, Cheng P, Tang G, Shang X. Direct Anterior Approach for Total Hip Arthroplasty in the Lateral Decubitus Position: Our Experiences and Early Results. J Arthroplasty 2017; 32: 131-138.

35) ii. Yeh YA, Chiang JH, Wu MY, Tsai CH, Hsu HC, Hsu HC, Lin TL. Association of Traditional Chinese Medicine Therapy with Risk of Total Hip Replacement in Patients with Nontraumatic Osteonecrosis of the Femoral Head: A Population-Based Cohort Study. Evid Based Complement Alternat Med 2019; 2019: 5870179.

36) Liao HH, Yeh CC, Lin CC, Chen BC, Yeh MH, Chang KM, Sun MF, Yen HR. Prescription patterns of Chinese herbal products for patients with fractures in Taiwan: A nationwide population-based study. J Ethnopharmacol 2015; 173: 11-19.

37) Huang MC, Pai FT, Lin CC, Chang CM, Chang HH, Lee YC, Sun MF, Yen HR. Characteristics of traditional Chinese medicine use in patients with rheumatoid arthritis in Taiwan: A nationwide population-based study. J Ethnopharmacol 2015; 176: 9-16.

38) Li H, Gu N, Zhang H, Wang G, Tan Q, Yang F, Ning Y, Zhang H, Lu Z, Xu X, Shi J, Gao C, Li L, Zhang K, Tian H, Wang X, Li K, Li H, Xu Y, Xie S, Yu X. Efficacy and safety of quetiapine extended release monotherapy in bipolar depression: a multi-center, randomized, double-blind, placebo-controlled trial. Psychopharmacology (Berl) 2016; 233: 1289-1297.

39) Zhou S, Shi X, Chen Y, Li L, Chen C. Adriamycin-loaded Gelatin Microspheres in the Treatment of Bone Tumors. J Mod Med Oncol, 2023; 3: 3.

40) Bashir BA. Clinical Implications of Hyperleukocytosis/Leukostasis Syndrome. J Mod Med Oncol, 2023; 3: 2.

41) Gagala J, Tarczynska M, Gaweda K, Matuszewski L. The use of osteochondral allograft with bone marrow-derived mesenchymal cells and hinge joint distraction in the treatment of post-collapse stage of osteonecrosis of the femoral head. Med Hypotheses 2014; 83: 398-400.