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MODIFIED DIRECT ANTERIOR APPROACH FOR TOTAL HIP ARTHROPLASTY IN AN INDONESIAN POPULATION WITH PRIMARY STANDARD INSTRUMENTS OF TOTAL HIP ARTHROPLASTY: OUR EXPERIENCES AND SHORT-TERM FOLLOW-UP

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ABSTRACT

The direct anterior approach (DAA) for total hip arthroplasty (THA) is a very sophisticated and complicated surgery typically performed using a specialized operating room table and instruments. In our clinic, this procedure was performed with a modified incision to avoid dependence on a special operating room table, and we could use ordinary THA instruments. There is an obvious absence of literature regarding this subject. The methods of this research a total of 31 patients (31 hips) were recruited for primary THAs from January 1, 2020, to December 31, 2021, who underwent THAs using the DAA in the supine position with modified incision. The technical feasibility and early results were evaluated. Results: The orientation of the acetabular component average cup inclination was 41.57 o ±6.7 o, (23 o -57 o) and the mean cup anteversion was 17.36 o ± 5 o, (11 o -38 o). The incidence of neutral coronal femoral stem alignment was 30 hips (97%), varus was 1 (3%), neutral sagittal alignment was 30 hips (97%), and flexion was 1 (3%). The preoperative Harris Hip Score (HHS) was 57.89 points (range: 17-68 points), whereas the postoperative HHS was 89.97 points (range: 82-100 points). There were no postoperative problems such as proximal femur fracture, hematoma, superficial wound complications, deep vein thrombosis, lateral femoral cutaneous nerve damage, heterotopic ossification, loosening of the acetabular component, loosening of the stem, dislocation, infection, nor postoperative periprosthetic fracture. Conclusion: The DAA supine for THA with modified incision may be a valuable alternative in the absence of a special operating room table or special instruments for DAA. This technique also seems to provide satisfactory clinical and radiographic outcomes with acceptable complications in our early follow-up.

Keywords: Direct Anterior Approach, Total Hip Arthroplasty, Primary Standard Instrument

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INTRODUCTION

Total Hip Arthroplasty (THA) is a highly successful orthopedic operation. THA is a surgery commonly performed to treat patients with hip pathologies such an osteoarthritis (1). The most frequently used procedures for THA are the direct lateral and posterior approaches (2,3). The posterior method is the most often utilized worldwide (4,5,6,7). Minimally invasive surgical methods for primary THA with the direct anterior approach continue to be an extremely successful operation (5,8). The Direct Anterior Approach (DAA) has received increased attention from orthopedic surgeons and patients throughout the world (1,2,7,9) and tissue-sparing arthroplasty has led to a surge in the use of DAA for total hip arthroplasty (10). The advantages of DAA include less bleeding, faster recovery after surgery, less pain, lower dislocation rate, and accurate prosthesis placement (1,5,11-14).

Previous research has shown that the DAA is often conducted with the patient supine on a specifically designed operating room table (2,9,15). DAA- supine with modified incision has several advantages, such as: a) the operating table did not have to be adjusted, b) eccentricity distance of surgical instruments is easier, c) the proximal femur is easier to expose, d) smaller incision, and e) the components of the acetabulum are easily visible.

In our country, THA is usually performed with the posterior approach. We predicted that supine DAA of primary THA could also be performed on a standard operating table with primary instruments of THA, with a modified incision of DAA, because in our country not all centers have DAA instruments. Specifically, we aimed to perform a study of the feasibility of clinical outcomes and radiographic data with the supine DAA for THA with a modified incision of DAA with primary instruments of THA.

MATERIAL AND METHODS

This study was approved by the Medical and Health Research Ethics Committee of Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada. All patients who were enlisted who were eligible to give written informed permission, are above the age of 30 and have hip osteoarthritis with severe pain and/or walking difficulties. Criteria for exclusion were: (i) proximal femoral deformity, (ii) posterior acetabular deficiency (iii) stiff hips, (iv) Crowe type III/IV hip developmental dysplasia, (v) past hip surgeries, and (vi) severe osteoporosis. Anesthesia and Position in all patients were given spinal anesthesia and put on a standard operating table and positioned supine.

Surgical Procedures with the patient were placed in the supine position. The incision was guided by the Anterior Superior Iliac Spine (ASIS), the groin crease, tuberculum innominate and head of fibula. The incision was about 10-12cm, starting 3 finger bread distal and 3 finger bread lateral of the ASIS (modified incision) (Figure 1.). The subcutaneous tissue was incised sharply until the fascia after the Tensor Fascia Late (TFL) muscle was identified. The TFL and sartorius were separated through the

Hueter's gap and revealed the extra femoral artery.

The abductor muscle was protected by a blunt retractor at the superior extracapsular femoral neck, while the TFL muscle was moved laterally by another retractor over the lateral femoral greater trochanter. The ascending branch of the lateral femoral artery was ligated or coagulated. When the fat on the capsule was removed, an additional blunt retractor was placed on the extracapsular inferior femoral neck to bring the rectus femoris inward, and the anterior hip capsule was exposed clearly.

To get a good look at the femur and acetabulum, a capsular incision was done. The femur's neck was sliced using a saw in a two-cut procedure. The fragment's anterior section was broader than its posterior section to facilitate removal of the neck and femoral head. The acetabulum was reamed with an offset cup reamer after the labrum and fat were removed. For initial stability, the cementless acetabular component was press-fitted into the cup and was 2 mm bigger than the final reamer. When the original cup's stability was in doubt, we employed attaching screws to add further support.

The surgeon utilized a bone hook implanted in the femoral canal to stretch the proximal femur toward the anterior position of the acetabulum after acetabular transplantation. The surgical assistant gently positioned the operative leg in an adducted, hyperextended, and externally rotated position. The capsule was the first structure to be exposed. The capsule was removed continuously to get good exposure of the proximal femur. During capsular release, the posterolateral hip capsule must be released. The important aspects involve release of the posterolateral hip capsule using a retractor placed on the femoral calcar and the abductor muscles pulled with another retractor.

After the capsule was released, a blunt retractor was inserted into the femur to elevate the proximal femur. The broach was rotated at least two sizes smaller than the intended stem size to gain anteversion control. When the last broach was held inside the canal, the trial neck piece was put in place. Following hip reduction, leg length was measured intraoperatively based on the contralateral lower limb length from the ASIS to the tip of the malleolus medialis to achieve leg distance equivalency or to minimize leg length differences. Accordingly, the appropriate neck lengths for femoral prosthesis were chosen. It is vital to assess the hip's stability when the repair is completed (Figure 2 and 3).

In the TFL fascia, we applied flowing sutures, with intermittent sutures for the subcutaneous tissue, and the skin. Perioperative Treatment Cefazoline was used as an intravenous prophylactic antibiotic and given 30 minutes before surgery and 48 hours thereafter. We also used an oral anticoagulant containing the active ingredient rivaroxaban, which was taken 6 hours after surgery and was maintained daily for 5 weeks. Limited mobilization can be done after surgery and continued with routine physiotherapy.

Outcome Measure with Harris Hip Score (HHS), cup orientation, stem coronal and sagittal alignment and clinical outcomes. The secondary outcomes were wound healing and postoperative complications. Postoperative radiographic evaluations with standard anteroposterior pelvic radiographs and lateral thigh radiographs were collected for all patients and were based on photo storage and communication systems. The Lewinnek method was used to determine the anteversion angle of the acetabular components. Stem alignment was evaluated according to Abe et al (16).

The Brooker classification system was used to assess heterotopic ossification. Radiolucent lines with a width of more than 1 mm were recorded at the component bone contact, stem coronal and sagittal alignment using the approach outlined by Chen et al (9). Statistical Analysis with the data was analyzed by SPSS v. 23 (IBM Corp., Armonk, NY, USA). Measured data were expressed as mean ± standard deviation (SD). A paired samples Wilcoxon signed-rank test was used for comparison between mean preoperative and postoperative limb-length discrepancies. Statistical results were declared significant if $p < 0.05$.

Figure 1. supine position with landmark, 3 fingers distal and 3 fingers laterally from the ASIS then make an incision 3 cm distally towards the fibular head.

Figure 2. Insertion Femoral implant with ordinary instrument

Figure 3. Ordinary Instrument of Total Hip Arthroplasty

RESULTS

A total of 32 patients were recruited for primary THA, from January 1st, 2020, to December 31st 2021, with 31 of them receiving primary THA utilizing DAA-supine position with modified incisions. One patient was omitted because he was under the age of 30. As a result, comprehensive clinical and radiological data for 31 hips were accessible postoperatively. The demographic characteristics of patients are summarized in Table 1. A total of 31 hips were found to have osteoarthritis.

Table 1. Demographic Data

Parameters	Values
Number of patients	N: 31
Preoperative diagnosis	Osteoarthritis: 31
Age (mean±SD, range)	58.16 ± 13.18, (33-82)
Gender	Male:12; Female:19
Body Mass Index (mean±SD,range)	26.42 ± 3.38, (18-33)

Abbreviations: SD, standard deviation.

Table 2 shows that the average cup inclination was 41.57° ±6.7°, (23° -57°) and the mean cup anteversion was 17.36° ± 5°, (11°-38°). The incidence of neutral coronal femoral stem alignment was 30 hips (97%), varus was 1 (3%), neutral sagittal alignment was 30 hips (97%), and flexion was 1 (3%).

Tabel 2. Post-Operative Implant Position

Parameters	Values
Orientation of cup, mean ± SD, Range	
Anteversion	17.36° ± 5° ,(11°-38°)
Inclination	41.57° ± 6.7 °,(23° - 57°)
Stem coronal alignment	
Neutral	30 (97%)
Varus	1 (3%)
Valgus	0
Stem sagittal alignment	
Neutral	30 (97%)
Flexion	1 (3%)
Extension	0

Abbreviations: SD, standard deviation.

(Table 3.) shows that clinical and functional outcome measures increased considerably from preoperative to postoperative. The preoperative Harris Hip Score (HHS) was 57.89 points (range: 17-68 points), whereas the postoperative HHS was 89.97 points (range: 82-100 points). There were no postoperative problems such as proximal femur fracture, hematoma, superficial wound complications, deep vein thrombosis (DVT), lateral femoral cutaneous nerve (LFCN) damage, heterotopic ossification, loosening of the acetabular component, loosening of the stem, dislocation, infection and postoperative periprosthetic fracture.

Table 3. Harris hip scores preoperatively to postoperatively

Parameters	Mean±SD, Range	Mean±SD, Range
Harris Hip Score Before DAA-supine with modified incision	57.89 ± 11.29, (17-68)	p <0.000
Harris Hip Score After DAA-supine with modified incision	89.97 ± 4.58, (82-100)	p <0.000

Abbreviations: DAA, Direct Anterior Approach

Parameters	Values
Hematoma	0
Superficial wound complications	0
Dislocation	0
LFCN injury	0
Heterotopic ossification	0
Loosening of the acetabular	0
component	0
Loosening of the stem	0
Postoperative periprosthetic	0
fracture	0
DVT	0
Infection	0
Proximal femoral fracture	0

Abbreviations: DVT, deep vein thrombosis; LFCN, lateral femoral cutaneous nerve.

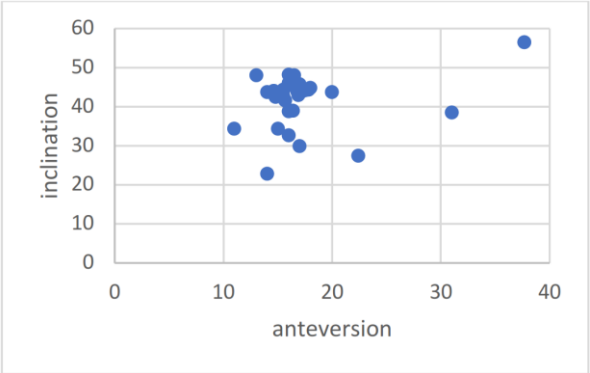

Figure 4. Scatter diagram depicting the acetabular components.

DISCUSSION

Total Hip Arthroplasty (THA) with the Direct Anterior Approach (DAA) is becoming increasingly important to patients and surgeons because it is a minimally invasive operation. The DAA is usually performed using a special operating table and special instrument for DAA (9). The PROfx table was used by Matta et al. to perform a supine DAA (17). Horne at al. reported that a traction table allows for real-time position assessment with fluoroscopy and helps facilitate the procedure through assisted positioning (7). The modern fracture traction table was used by Beret et al. with both feet on the boot in with supine position (8).

In our study, the patient was placed supine with a modified incision (3 finger bread distal and 3 finger bread lateral of the ASIS) on a standard operating table and the primary ordinary THA instruments could be used. The table was used without the traction function and the results showed that with a regular table the outcomes were good. Generally, there are no special requirements for the operating table in our study. The advantages of our technique are it does not require a special table, it is easier to expose the proximal femur and surgical instruments and does not require eccentricity distances.

The clinical outcome there were good outcomes in incision length, Harris Hip Score (HHS), visual analog score (VAS) and hospitalizations. DAA incision length is shorter than conventional THA (12). One of the most prevalent problems during THA with DAA is LFCN injury because of the severe traction on the nerves, where the site and breadth of the incision are variables that induce LFCN damage (9). In our study, no LFCN injury was found so that DAA with modified incision could be an alternative approach to THA. Barret el al. revealed that DAA results in less pain and better mobility after surgery (8). Chung et al revealed patients who received THA with DAA were able to walk earlier than those with posterior approach (18).

A significant difference was found in operating time with the modified incision, by which the operation time was shorter due to easier exposure of the proximal femur. Jia et al. revealed that operative time was higher in the DAA than Posterior Approach (6). Chung et al. reported similar results for DAA and Posterior Approach in terms of surgery time, bleeding volume, and complications (18). The difference in operating time can be caused by the expertise and experience of the operator in performing DAA. Melman et al. showed that with increasing experience, surgery time and the incidence of technical complications were improved (19).

Based on the data, it can be claimed that THA has been performed through DAA-supine position with a modified incision with THA primary instruments which has good clinical results. Some of the advantages of the DAA supine position with a modified incision include time of surgery which is shorter, risk of blood loss during surgery is reduced, and less pain. In addition, makes it easier for doctors to find the pelvic position and implantation of the acetabular cup becomes more accurate.

Dislocation is the most common complication of THA. Hip dislocations often require revision of the THA leading to increased costs. The supine posture during DAA-THA can increase the accuracy of the acetabular components (9). The acetabular component's mean anteversion differed considerably between the supine DAA and the posterior approach (9). The acetabular component anteversion in the supine DAA group was clearly lower than in the posterior approach group (8,20). The average gradient of cup components was similar between the DAA group and posterior approach (9). Chung et al. reported mean anteversion and inclination on the posterior approach higher than DAA (18). Meanwhile, according to the results of Moerenhout et al., acetabular cup anteversion in DAA was greater than in the posterior approach (21). Lazaru et al. reported acetabular cup anteversion angle and inclination through DAA were lower than conventional methods (12). Maeda et al. further showed cup angle accuracy in the DAA supine group using a mechanical guide showed no advantage over the DAA lateral position group (22). (Figure 4.) depicts the acetabular components. The main risk factor of dislocation is the misalignment of the acetabular components (23). Dislocations, which still often occur even though the concept of a safe zone has been accepted, were associated with acetabular cup orientation within the Lewinnek safe zone, patient attributes, and surgical variables. One disadvantage of the DAA is the limited access to the posterior column. For this reason, some authors recommend that the surgical approach to THA be based on the surgeon's preferences, experience, and patient-specific considerations (16). Insertion components of the acetabular in the DAA were like the posterior approach, therefore intraoperative radiographs are not required (9). In our study no dislocations were found with a DAA-supine position with modified incisions.

Harris Hip Score (HHS) is frequently used to evaluate patients following THA (24). HHS score ranges from 0 to 100, with the higher scores indicating better outcomes (25). In this study, the mean HHS score increased from 57.89 ± 11.29, with a range of 17-68 before L-DAA to 89.97 ± 4.58 (82-100) after L-DAA, both of which were statistically significant ($p < 0.000$). In the preoperative condition, the mean total of HHS score indicated that the patient had a poor outcome and significantly improved to a good outcome postoperatively. There were no issues following the surgery.

The data from this study showed that THA provided a major functional improvement in patients. In particular, the HHS score

increased by an average of 32 points after THA was done. The mean HHS score for postoperative patients was 89.97 points. Other researchers have also utilized the HHS to evaluate the functional progress of THA patients. Therefore, HHS results with DAA-supine position with a modified incision using the primary instruments of THA give good outcomes.

Stem Alignment in this study, the femoral stem alignment was classified into three groups. Measurements were made of the length axis of the prosthesis and femur determines stem alignment. Stem alignment was defined as neutral, valgus or varus. In the stem coronal alignment, there was neutral at 30 hips (97%), varus at 1 (3%) and no valgus. Then, the stem sagittal alignment gives the same result, with the neutral at 30 hips (97%), flexion at 1 (3%) and none in extension.

Stem alignment is important for restoration of femoral offset and permanent osseointegration of implants (26). As shown in the results, there was no amount of varus in the coronal alignments of the stem. This result shows that the procedure in this study obtained good results because planting straight tapered stems in the varus alignment can lead to poor clinical outcomes. Varus position can cause femoral cortical hypertrophy and thigh pain. However, stem alignment of valgus is not better than varus due to the higher risk for loss of femoral offset compared to the preoperative status (26).

The significance of stem alignment in cementless THA is debatable and may depend on the femoral stem material (27). The variance in stem alignment has a significant influence on the reconstruction of the femoral offset. A deviation of 1° from the neutral axis can result in an offset shift of up to 3 mm (26). In our study, the coronal and sagittal alignments of the stem were exceptionally good. There was no significant difference in a previous study between radiological evaluation and hip function of supine DAA and DAA-lateral decubitus (3). Our research has some limitations. The sample size also was small, and follow-up period was short. This research was conducted without a control group from other approaches, so it is difficult to compare with other approaches.

CONCLUSIONS

DAA-supine position with modified incisions can be used as an alternative approach for THA. DAA-supine position with modified incision can be performed on a standard operating table with primary instruments of THA with satisfactory complication rates, clinical and functional outcome scores, and radiographic data.

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