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A prospective cohort study investigating functional recovery in patients with avascular necrosis hip following total hip arthroplasty using a direct anterior versus direct posterior surgical approach in Indian population

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ABSTRACT

Background: This study examines the comparative outcomes of the Direct Anterior Approach (DAA) and Direct Posterior Approach (DPP) in patients undergoing Total Hip Arthroplasty (THA) for Avascular Necrosis of the hip.
Methods: A total of thirty patients were divided equally between the two surgical methods, with half number of patients undergoing DAA and half undergoing DPP. Key performance metrics, including Modified Harris Hip Score (MHHS), blood loss, operative time and length of hospital stay, were analysed to determine which approach offered superior postoperative recovery and patient satisfaction. A convenient sampling technique was used in our study. Epi Info 2023 software was used for statistical analysis of data. The study was conducted in Government medical college and associated group of hospitals. The study was conducted from 01/06/2022 to 30/06/2023.
Results: It shows that both approaches led to significant improvements in Modified Harris Hip Score (MHHS) postoperatively, with no statistically significant difference in the final hip function at various follow-up intervals. However, DAA required a smaller incision, making it cosmetically favourable but resulted in greater blood loss and longer operative time due to its technical complexity. DPP, on the other hand, was associated with faster operative time and slightly lower blood loss but had a higher risk of postoperative dislocation. Despite these differences, there was no significant difference in hospital stay duration or overall complication rates between the two groups.
Conclusions: While both DAA and DPP are effective for THA, the choice of approach may depend on surgeon expertise and patient-specific factors, with DAA offering better cosmetic outcomes and DPP offering a technically easier procedure with fewer blood loss complications. Further long-term studies are suggested to analyse any potential differences in complication rates beyond the early postoperative period.

Keywords: Avascular necrosis, Direct anterior approach, Direct posterior approach, Modified harris hip score

INTRODUCTION

In medical nomenclature, joint reconstruction procedures are termed as “arthroplasty”. Arthr (o)-refers to the procedure as it is “related to a joint” while– plasty from Greek origin means “to form”. Arthroplasty procedures can be performed on any joint in the body and entails an operative reconstruction of the joint. Examples of arthroplasty include resection arthroplasty (excision of articulating surfaces), interposition arthroplasty (insertion of a substance such as fascia, dermis, cartilage between articulating surfaces of a joint) and total joint arthroplasty. There are several approaches to the hip joint that can be utilized for total hip replacement and these include with some variations the posterior approach (Moore or Southern), the direct anterior approach (Smith Peterson).

the lateral approach (Hardinge), the anterolateral approach (Watson Jones). The anterior approach to the hip takes advantage of the interval between the sartorius muscle and the tensor fascia lata muscle to access the hip joint. The upper aspect of this approach provides visualization of and access to the entire ileum and hip joint. Nearly all surgery of the hip can be performed through this approach or through different portions of the approach. The anterior approach remains a standard approach to the hip in pediatric orthopedic surgery for developmental hip dysplasia, whereas in adult orthopedic surgery it is used mostly to expose the anterolateral aspect of the femoral head, the femoral neck and the anterior aspect of the acetabulum to treat femoral head fractures, for biopsy or for excision of ectopic bone.[1]

Although not as common, several have noted routine use of this technique for Revision Total arthroplasty as well as Hemiarthroplasty for Fracture. Some anatomic features of the native hip and pelvis are recognized to make a direct anterior approach more difficult. Acetabular protrusion brings the femoral canal closer to the pelvis and can limit the access to the femur. Neck shaft angle with decreased offset positions the femoral canal deeper in the thigh and factors associated with obese muscular males can limit the exposure.[2] A potential disadvantage of the anterior approach is diminished access to the posterior column. If a patient has retained posterior acetabular hardware or posterior wall deficiency with augmentation contemplated, the anterior exposure might prove unsuitable.[3]

Proponents of this approach cite improved recovery times, lower pain levels, improved patient satisfaction, improved accuracy on both implant placement/alignment and leg length restoration, routine use of this technique for revision total arthroplasty as well as hemiarthroplasty for fractures. The direct anterior approach (DAA) can be used for patients of nearly all body habitus and hip conditions.

To study functional recovery in patients with Avascular Necrosis Hip Following Total Hip Arthroplasty Using a Direct Anterior Versus Direct Posterior Surgical Approach. To Assess the Functional outcome of the patient using MHHS (Modified Harris Hip Score). To calculate the operating time associated with each approach. To know the incision length taken in each approach and which approach is cosmetically superior. To calculate the blood loss with each approach. To know the patient satisfaction and recommendation of surgery postoperatively.

METHODS

This was a prospective study on Indian population during postoperative recovery period and after hospital stay. This was a single-Centre prospective, expertise-based, quasi-randomized trial.

A convenient sampling technique was used in our study. Epi Info 2023 software was used for statistical analysis of data. The study was conducted in Government medical college and associated group of hospitals. the study was conducted from 01/06/2022 to 30/06/2023.

The ethical committee approval was taken from the member secretory institutional ethical committee (IEC) Government Medical College Kota. The study involves patients undergoing a primary total hip arthroplasty to reduce the pain and disability associated with hip avascular necrosis through either the direct anterior (DA) or direct posterior (DP) surgical approach. Baseline assessments will be performed at the patients' pre-admission clinic visit, approximately one month prior to surgery. After surgery, follow-up study assessments occur according to the standard of care for this surgery: on the day of discharge from the hospital and at 1 month, 4 month and 1-year post-surgery.

Eligibility criteria

Patients must be between the 18 and 75 years of age. Patients diagnosed with avascular necrosis hip and undergoing a primary unilateral total hip arthroplasty.

Exclusion criteria

BMI greater than 40. Total knee arthroplasty on the ipsilateral limb. Comorbidities of a lower extremity that would affect gait or an inability to ambulate at least 10 metres without the use of a gait aid preoperatively. Patients awaiting another joint replacement surgery of any lower extremity joint within 3 months of the primary surgery or were unable to give informed consent.

Randomization

Referrals to the orthopedic outpatient clinic will be sorted onto the monthly schedule randomly and patients will be then seen by whichever surgeon holds clinic on that day. Thus, patients will be 'quasi-randomized' to each surgeon and therefore to treatment arm. According to expertise and preference, one orthopaedic surgeon performs all DA procedures and the other performs all DP procedures.

Implant

Cemented and uncemented both implants are used depending upon patients age and medical condition.

Surgical outcomes

The operation time in minutes will be defined as the period of time from the beginning of skin incision to surgical closure.

The incision length in centimeters will be measured on graduated scale.

The intraoperative blood loss in milliliters will be the total amount of blood from the suction device and number of gauze pieces used.

Functional outcome

The Harris hip score (HHS) will be developed for assessment of the results of hip surgery. The hip joint function will be evaluated at periodic time intervals after operation. The score collects points from the assessment of four aspects: pain, function, degree of deformity and range of motion of the hip. The higher the added score, the better the results, providing a range of added scores from 0 to 100 points. Complications with each approach.

Selection of cases:

30 cases of direct anterior and direct posterior surgical approaches are taken into consideration for this study. (15 direct anterior, 15 direct posterior).

Pre operative evaluation

A detailed clinical examination and radiological assessment was done to assess the nature of deformity, bone stock, functional impairment and component sizes. Pre-operative templating is routinely done in all cases. Pre-operative clinical evaluation was done using modified Harris Hip Scoring.

RESULTS

Some observations were made in our study. The mean age of the patient was 42.46±14.80 years ranging from 18-70 in DAA and the mean age of the patient was 36.73±8.73 for DPP ranging from 18-70. For DAA 46.66% patients belong to 29-39 age group. For DPP 33.33% Patients belong to 29-39 age groups. Male dominated our study group with a total percentage of 66.66%. Females holds the remaining 33.33%.The mean preoperative MHHS was 47.33±8.37 for DAA. And the mean postop MHHS was 49.2±7.36 for DPP. The mean postoperative MHHS was 337.2±10.92 for DAA and the mean postoperative MHHS was 337.6±9.89 For DPP. The postoperative MHHS p value is 0.917 which is not significant.

The mean blood loss for DAA was 378.33±26.43. The mean blood loss for DPP was 332.66±10.83. The p value for blood loss in DAA vs DPP is 0.0001 which is statistically significant. The mean value for incision length (cm) for DAA is 10.33±1.91. The mean value for incision length (cm) for DPP is 13.33±1.39. The p value for incision length DAA versus DPP is 0.0001 which is statistically significant. The mean value for Operating time(min) in DAA is 98±6.21. The mean value for Operating time(min) in DPP is 58±5.6. The p value for Operating time time(min) is 0.0001 which is statistically significant. The mean value for Duration of stay in hospital postoperatively for DAA is 5.66±1.39. The mean value for duration of stay in hospital postoperatively for DPP is 6.6±2.66. The p value for duration of stay in hospital postoperatively for DAA versus DPP is 0.3536 which is statistically insignificant. We have noted complications such as Superficial skin infection with DAA in single patient and posterior dislocation in DPP patient. Post operatively, all the patients (100%) reported satisfaction with the surgery, increased function and reported either no pain or small amount of pain but no compromise in daily life activities. all of them (100%) would recommend the surgery procedure to other with similar problems.

Table 1: Age.

Age (in years)	DAA		DPP	
	No. of patients	%	No. of patients	%
18-28	3	20	3	20
29-39	7	46.66667	5	33.33333
40-50	4	26.66667	2	13.33333
51-60	1	6.666667	3	20
61-70	0	0	1	6.666667
>70	0	0	1	6.666667
Total	15	100	15	100
Mean±SD	42.46±14.80		36.73 ±8.73	
P value	0.2071 (NS)			

Table 2: Gender.

Gender	DAA		DPP	
	No. of patients	%	No. of patients	%
Male	11	73.33333	10	66.66667
Female	4	26.66667	5	33.33333
Total	15	100	15	100

The mean value of age group selected for DAA is 42.46±14.80 and for DPP is 36.73±8.73. so, most of the subjects are middle aged group category in both the approaches.

Table 3: MHHS After 1 year follow up.

MHHS	DAA		DPP	
	Pre Op mean	Post Op mean	Pre Op mean	Post Op mean
Mean	47.33	337.2	49.2	337.6
Sd	8.37	10.92	7.36	9.89

In DAA among 15 subjects 11 are male and 4 females. In DPP 10 are male and 15 females. This also explains the higher incidence of AVN among male population.

Table 4: MHHS in DAA versus DPP

MHHS	DAA versus DPP
pre op P value	0.5219
Post op P value	0.917

The mean MHHS after 1 year of follow up in DAA is 337.2±10.92 and mean MHHS after 1 year of follow up in DPP is 337.6±9.89.the p value is 0.917 and statistically insignificant.

Table 5: Blood loss in DAA versus DPP.

Blood Loos (ml)	DAA	DPP
Mean	378.33	332.66
SD	26.43	10.83
p value	0.0001	

The mean blood loss in DAA is 378.33±26.43 and mean blood loss in DPP is 332.66±10.83. on calculating p-value it is 0.0001 which is statistically significant.So higher amount of blood loss is seen in DAA as compared to DPP.

Table 6: Incision length.

Incision length (cm)	DAA	DPP
Mean	10.33	13.33
SD	1.91	1.39
P value	0.0001	

The mean incision length in DAA is 10.83±1.91 and the mean incision length in DPP is 13.33±1.39. on calculating p-value it is 0.0001 which is statistically significant.

Table 7: Operative Time.

OT Time (min)	DAA	DPP
Mean	98	58
SD	6.21	5.6
P value	0.0001	

Table 8: Duration of stay Postoperative.

DOSP	DAA	DPP
Mean	5.66	6.4
SD	1.39	2.66
P value	0.3536	

The mean operating time for DAA is 98±6.21minutes and mean operating time for DPP is 58±5.6 minutes. on calculating p value, it is 0.0001 which is statistically significant.

The mean duration of stay in hospital postoperatively in DAA is 5.66±1.39. And mean duration of stay in hospital postoperatively in DPP is 6.4±2.66. On calculating p value, it is 0.3536 which is statistically insignificant.

DISCUSSION

Total hip arthroplasty (THA) is considered as one of the most important procedures in the field of Orthopaedic surgery, however, evidence on the most common approaches to this procedure still stirs controversies. Several studies found the anterior approach to achieve superior clinical outcomes when compared with the posterior approach.[4-8] In a systematic review of randomized and non-randomized studies comparing both approaches, Higgins et al, found that the anterior approach showed superior clinical outcomes at short-term follow-up in four studies.[7] Conversely, Taunton et al, reported superior outcomes at early postoperative assessment following THA through the posterior approach when compared with the anterior approach, but no further differences in functional outcomes remained at 12 months after surgery.[9]

In comparison with the posterior approach, the anterior approach was associated with superior pooled HHS (mean of 4.06 points for short-term and 1.52 points for mid and long-term follow-up), but such difference did not reach the minimal 16-point clinical importance for the HHS.[10] Thus, the clinical superiority attributed to the anterior approach over the posterior approach to THA remains unclear. Similarly in our study there is no much difference in MHHS assessed for functional improvement during any time of follow up period. Thus, there is no clear difference in functional improvement between DAA and DPP and our study goes parallel with others score. Corroborating our findings, one systematic review reported a similar rate of major complications for both approaches, including intraoperative fractures.[11] Higgins BT et al. A recent study found dislocations to be more prevalent among patients submitted to the posterior approach, with no differences in intraoperative fracture rates.[12] Another systematic review on early postoperative complications following THA also reported no differences in complication rates between anterior and posterior approach.[7] Regarding minor complications, one single cohort found high rates of LFCN neuropraxia in patients submitted to the anterior approach,[13] which lead us to perform a sensitivity analysis for minor complications that showed no differences between the approaches.

However, this specific analysis resulted in an underpowered comparison (p=0.05). In our study we encountered total of 2 complications. Superficial skin infection (SSI) and posterior dislocation. SSI is seen in DAA and Posterior Dislocation is seen in DPP. Posterior dislocation is attributed to the muscle slit DPP and the patients are habitual to flex and internal rotate the hip during sleep. Otherwise, there is no increased rate of complications seen in either of the approach and none

holds superiority in reducing complications. In our study the operative time was about 40 minutes shorter for the procedure performed through the posterior approach when compared with the anterior approach. Considering that a primary THA takes on average 98 minutes, with a standard deviation (SD) of 6.21 minutes, a difference of 40 minutes in operative time may represent a DPP procedure faster as compared to DAA.[8] SHAH RP et al. As the posterior approach has historically been performed prior to the anterior approach, both surgery centers and surgeons may be more familiarized with its performance, indicating an expertise bias that favors this most traditional approach. DAA showed earlier recovery of function in the early post-operative period, which is consistent with previously published meta-analyses.[19-23] The quicker recovery has been attributed to the muscle-sparing nature of DAA by utilizing an inter-nervous plane between tensor fasciae latae and sartorius muscle superficially and between gluteus medius and rectus femoris deeper. Hence, muscle splitting is avoided and soft tissue injury is minimized.[20,24]

This is supported by biochemical and radiological evidence, with reports of lower levels of early post-operative creatine kinase or myoglobin, which are indicators of muscle damage, in DAA compared to other approaches.[25-28] Post-operative MRI studies also noted less muscle and tendon damage in DAA than LA.[27] This may be explained by the fact that the surgical technique adopted in the anterior approach causes minimal muscle damage, thus allowing for a faster gait training and hospital discharge.[14] Bergin PF et al. Three studies reported that patients operated through the anterior approach were able to walk without the aid of crutches within a shorter period after surgery.[9,15,16]

In our study population Patients who underwent the anterior approach stayed in healthcare facilities 5.66 days with a standard deviation of 1.39 whereas patient with DPP stayed for 6.44 days with a standard deviation of 2.66 days, therefore patient undergoing DAA stayed less days than those who underwent the posterior approach. However, the lack of sufficient knowledge on physical therapy protocols adopted during postoperative care hampers any strong inferences on this topic. Moreover, patients submitted to the anterior approach presented lower opioid intake, corroborating previous findings in the literature.[17] Although the overall mean follow-up period was superior to 12 months, when considering RCTs individually, most studies have not completed a mid to long-term follow-up (more than six months). With that, we could not determine the complication rate at 12 months postoperatively. Most preclude attempts to generalize the results.[18]

In our study we noted a blood loss of 378.33 ml with SD of 26.43 in DAA and blood loss of 332.66 ml with SD of 10.83 in DPP. It is noted that there is more amount of blood loss seen in DAA as compared to DPP and the p value stands significant (P less than 0.005). Our observations go in parallel to four RCTs by Ross D et al, which also noted higher blood loss for DAA versus DPP.[29] This could be attributed to the longer operative time for DAA over DPP since blood loss has been noted to increase with surgical duration. Limitations to our study was a small sample size which are not equally distributed in terms of age and sex and a follow up for a short period of time, so the long-term effects of the both approaches could not be studied.

CONCLUSION

After completion of our study, we have been able to reach this Final conclusion. There is no significant difference in MHHS postoperatively in either of the approach. There is increased blood loss seen in DAA, this is attributed to longer duration of surgery using DAA as compared to DPP. The length of incision required in DAA is smaller as compared to DPP and hence cosmetically superior. Operating time for DAA approach is longer as compared to DPP as it is technically challenging as compared to DPP and surgeons hold more experience through posterior approach. There is no significant difference in duration of stay in hospital between DAA and DPP. There is no significant difference in rate of complications in DAA versus DPP but there is a case specific complication of dislocation which is observed in DPP.

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