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Earlier functional recovery and discharge from hospital for THA patients operated on via direct superior compared to standard posterior approach: a retrospective frequency-matched case-control study

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Abstract

Background: The direct superior hip approach (DSA) has been less researched than other approaches in the literature. We retrospectively compared the early postoperative and functional outcomes of patients with hip osteoarthritis undergoing total hip arthroplasty (THA) via DSA with a matched control group using a standard posterior approach (SPA).

Methods: The DSA group comprised 100 THAs performed via DSA by a senior surgeon between January 2018 and May 2019. Patients with primary osteoarthritis and ASA score $\leqslant 3$ who were eligible for surgery were included. The DSA group was compared to a matched cohort of 100 patients operated on with a SPA in the same period by another chief surgeon. Patients were matched for age, sex, and ASA score. All patients received the same postoperative chemoprophylaxis, pain management and physiotherapy. 2 independent attending arthroplasty surgeons assessed the incision length, operative time, blood loss, hospital stay, and complications. VAS, HHS, and HOOS scores were also evaluated for a year postoperatively.

Results: Mean incision length and hospital stay were significantly lower in the DSA group. DSA patients had non-significantly lower intraoperative blood loss, transfusion needs, and postoperative pain than SPA patients. Mean operation time and complication rate did not differ between groups. The DSA group demonstrated significantly greater functional scores than the SPA group at the first postoperative month. No differences in scores were recorded following the third month.

Conclusions: The DSA approach may provide earlier functional recovery and hospital discharge for THA patients compared with SPA. DSA was equivalent to SPA concerning pain and blood loss, showing minimal complication rates.

Keywords

DSA, direct superior approach, hip approaches, minimally invasive surgery, posterior approach, THA, total hip arthroplasty

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Introduction

Orthopaedic surgeons have displayed a growing interest in minimally invasive surgery (MIS) total hip arthroplasty (THA) procedures over the last 2 decades.[1,2] Despite the plethora of available MIS procedures, a widely accepted definition has not yet been determined. MIS techniques are broadly divided into the muscle-sparing and mini-incision approaches, involving either an incision <10 cm or minimal soft tissue and muscle release.[2,3]

The reported advantages of MIS over the standard procedure in THA are decreased perioperative blood loss, decreased postoperative pain, and shorter length of hospital stay.[2,3] MIS has also been related to enhanced postoperative rehabilitation and shorter walking aid assistance.[2–4] A recent meta-analysis also suggested that the mini-incision posterior approach showed early improvement in functional scores, reduced operating time, and length of hospital stay compared with the standard procedure.[3]

On the other hand, impeded acetabular and proximal femoral intraoperative visualisation during the MIS THA escalates the risk of intraoperative complications such as implant malposition and periprosthetic fractures. In addition, the challenging access to the acetabulum and femur requires special retractors, radiography, and offset reamers, leading to inconsistent outcomes among surgeons.[1,3,5,6]

The direct superior approach (DSA) is a muscle-sparing MIS hip posterior approach that spares the iliotibial band and diminishes the damage to short external rotators (SER).[1] It offers an excellent view of the acetabulum and femur, even for dysplastic hips or obese patients.[1] This approach can be performed with standard instrumentation either for cemented or uncemented primary THAs.[1,7] The DSA is reported to be a straightforward, fast, and painless approach, with minimal blood loss and low complication rates, offering quick recovery and good cosmetic results.[1,9] A minimal learning curve has also been reported for DSA.[10,11]

To the best of our knowledge, however, a limited number of studies have evaluated the performance of DSA.[1,8–15] Also, no comparative study between the DSA and the standard posterior approach (SPA) has been published. Our study aimed to retrospectively analyse the early postoperative and functional outcomes of patients suffering from end-stage hip osteoarthritis undergoing THA via DSA compared with a matched control group using the SPA, both being performed by a senior surgeon.

Methods

This retrospective comparative study was performed in our Academic Department, which is a tertiary referral centre for arthroplasty and approved by our Hospital Health Research Ethics Board. All patients provided written informed consent before inclusion in the study. All data were registered in the regional academic arthroplasty registry (ART).

The DSA group comprised 100 elective primary unilateral THAs performed via DSA by a senior surgeon between January 2018 and May 2019. Inclusion criteria were adult patients with primary osteoarthritis and an American Society of Anesthesiologists (ASA) score ⩽3. Severe hip pain and disability of walking were the primary indications for THA. All patients were preoperatively informed about the type of hip approach that would be executed. Patients with inflammatory arthritis, malignancies, revision THAs, trauma, severe hip dysplasia, prior hip procedures with retained hardware, and ASA score >3 were excluded from the study.

The DSA group was compared to a matched cohort of 100 patients operated on with the SPA in the same period by another chief surgeon. Patients were matched based on age, sex, and ASA score using frequency matching.[10] All surgical procedures were performed with standard instrumentation. Patients received the same postoperative chemoprophylaxis pain management and physiotherapy protocols. 2 attending orthopaedic surgeons not involved in the surgical procedures performed clinical follow-up, radiographic assessment, and analysis.

Operative techniques

All patients were positioned in the lateral decubitus position.[7] The skin incision for SPA began 5 cm distal to the greater trochanter; it was centred on the femoral diaphysis up to the greater trochanter, where it curved toward the posterior superior iliac spine for 6–8 cm. The fascia lata and iliotibial band were then incised, and the muscle fibres of the gluteus maximus were bluntly split down to the short external rotators. The gluteus medius was retracted to gain access to the acetabulum. The sciatic nerve was preserved. The SER, quadratus femoris, and capsule were tenotomised at their insertion into the greater trochanter.[7] At the end of the operation, the SER and the capsule were repaired with absorbable sutures. DSA has been previously described in detail.[1] The incision was performed between the middle and posterior thirds of the greater trochanter, 45° backward, and upwards from the posterosuperior corner of the greater trochanter.[1,9,14] The subcutaneous tissue was incised in line with the skin incision. The fascia of the gluteus maximus was then incised sharply to allow blunt division of the gluteus maximus muscle fibres, preserving the iliotibial band. Once the fat around the hip capsule was swabbed down, the GMed was identified, and a Langenbeck retractor was placed under the GMed to better expose the PF and gluteus minimus (GMin) muscles. The SER were then tenotomised close to their femoral insertion, stripped off the posterior capsule, tagged with an Ethibond suture, and retracted posteriorly to keep the sciatic nerve safe. The capsule was also incised and tagged with a running Ethibond suture, and the formed flap was pulled back. The hip was then dislocated, and the femoral head was removed. A curved retractor was placed over the anterior acetabular rim to retract the proximal femur anteriorly, and a Hohmann retractor was positioned beneath the transverse acetabular ligament to facilitate the acetabular view. A small self-retainer was placed superoposteriorly to hold the SER capsular flap away during reaming. Preparation of acetabulum and femur and implantation was performed with standard non-offset instruments.[1,7] During femoral preparation, the hip was placed in flexion, adduction, internal rotation, and knee flexion of 90° with the tibia vertical. A blunt Hohmann was positioned under the anterior femoral neck to lift the femur and the second on the calcar to retract muscles away. Once the definite implants were positioned, the capsular flap was repaired first, followed by the musculotendinous flap with tagging sutures passing through a transosseous channel made in the greater trochanter and lower part of GMed.[1,7]

Perioperative management

All patients received general anaesthesia. Intravenous teicoplanin 400 mg twice a day was begun preoperatively and continued for 24 hours postoperatively. Patients were given 1 gr of tranexamic acid intravenously preoperatively and low-molecular-weight heparin postoperatively, continuing daily for a month. Postoperative pain was initially managed with intravenous paracetamol 3 times, lornoxicam twice a day, and tramadol for 48 hours. The patient's discharge from hospital was decided by the surgeon based on their general condition, lab tests, and rehabilitation progress.

Clinical and radiographic assessment

Preoperatively, a typical comprehensive medical history had been documented. 2 independent attending arthroplasty surgeons recorded the length of incision, operative time, type of implant, anaesthetic technique, estimated blood loss, intraoperative complications, blood transfusion rate, and hospital stay. Each patient had a clinical and radiographic follow-up on the first, third, and twelfth month after the index operation. Complications, re-administration, and revision rates were registered. The independent physicians evaluated pain with a visual analogue scale (VAS) score on the first postoperative day and the last day of hospitalisation. They also tested hip function using the Harris Hip Score (HHS) and the Hip disability and Osteoarthritis Outcome Score (HOOS) preoperatively and postoperatively at 1, 3, and 12 months.

Statistical analysis

Standard statistical methods were applied for descriptive statistics. We assessed the normality of data distribution using the Kolmogorov-Smirnov and Shapiro-Wilk tests. Statistical tests were 2-tailed. All p-values < 0.05 were considered statistically significant. A 2-sided independent sample t-test or Mann-Whitney U-test was used to compare continuous variables normally and not normally distributed. Chi-square test (X^2 test) was used to compare categorical variables. Inter-rater agreement between raters was measured with the Cohen kappa coefficient (κ). Statistical analyses were performed using SPSS software (IBM, version 25.0).

Results

200 patients met the inclusion criteria and were retrospectively enrolled in the study. All arthroplasties were performed between January 2018 and May 2019. 3 patients were lost to follow-up for social reasons. 2 patients were lost from the SPA, and the other 1 from the DSA group.

Table 1 shows the preoperative baseline characteristics and demographics of patients. The 2 groups were matched for age, sex, and ASA grade; they were also comparable as far as body mass index (BMI) and preoperative diagnosis were concerned. Table 2 depicts intraoperative and postoperative data for patients as well as implant characteristics. In the DSA group, 27 patients received hybrid THA (Trident cup/Exeter stem, Stryker, Mahwah, USA) and 73 uncemented THA (Pinnacle cup/Summit stem, Depuy Synthes). In the SPA group, 18 patients underwent hybrid THA (Trilogy cup/VerSys stem, Zimmer Biomet Inc, Warsaw, IN, USA) and 82 uncemented THA (Trilogy cup/VerSys stem, Zimmer-Biomet Inc). The percentage of hybrid and cementless THAs was comparable between groups ($p = 0.128$) (Table 2).

The mean incision length was statistically significantly lower, favouring the DSA group (9.1 cm vs. 13.4 cm, $p < 0.001$). The mean operation time was comparable between groups (60.8 minutes vs. 61.3 minutes, $p = 0.512$). The estimated intraoperative blood loss ($p = 0.121$), the need for blood transfusion ($p = 0.157$) and postoperative pain (first postoperative day 4.5 vs. 4.8, $p = 0.095$, last day of hospitalisation 2.4 vs. 2.6, $p = 0.085$) were lower for the DSA group; however, these differences did not reach statistical significance. The mean hospital stay was significantly lower for the DSA compared to the SPA group (2.3 days vs. 3 days, $p < 0.001$).

No sciatic nerve palsies, intraoperative fractures, or thromboembolic events were recorded in either group. There was a case of hip dislocation in a 64-year-old woman in the SPA group 3 weeks postoperatively. It was treated with closed reduction and hip spica protection for 6 weeks. No cases of acute deep infection were documented. However, there were 2 cases of superficial wound infection managed with debridement and oral antibiotics in patients with high BMI, 1 in each group. The rate of mild wound bruising or controlled haematoma was higher for DSA than the SPA group; however, this difference was not significant (8 vs. 3, $p = 0.121$). It was attributed to the increased pressure on wound edges from retractors.

Table 1. The demographics and preoperative comparative baseline characteristics of the patient groups.

Parameters	DSA	SPA	*p*-Value
Number	100	100	
Preoperative diagnosis[b]			
Primary osteoarthritis	100	100	
Age (years)[a]	65.39 ± (8.38)	65.51 ± (7.85)	0.534[c]
Sex[b]			
Male	42	37	0.470[d]
Female	58	63	
ASA Grade[b]			
I	24	28	0.752[d]
II	70	65	
III	6	7	
BMI (kg/m^2)[a]	28.38 ± (3.09)	27.94 ± (2.98)	0.754[e]
BMI <30[b]	75	69	0.345[d]
BMI >30[b]	25	31	
Operated side[b]			
Right	58	65	0.309[d]
Left	42	35	
Comorbidities[b]			
Diabetes mellitus	36	26	0.126[d]

DSA, direct superior approach; SPA, standard posterior approach; BMI, body mass index; ASA, American Society of Anesthesiologists score.
[a]The values are given as the mean with the standard deviation (±) in parentheses.
[b]The values are given as raw numbers.
[c]Tests were performed using Mann-Whitney U-test.
[d]Tests were performed using the chi-square (X^2) test.
[e]Tests were performed using an independent sample *t*-test.

Table 2. Intraoperative and early postoperative comparative data of the patient groups.

Intra- and early postoperative data	DSA	SPA	*p*-Value
Incision Length (cm)[a]	9.16 ± (1.25)	13.43 ± (1.66)	<0.001[c]
Operative Time (min)[a]	60.85 ± (13.74)	61.35 ± (12.16)	0.512[c]
Estimated Intraoperative Blood loss (ml)[a]	175.3 ± (53.88)	194.4 ± (72.79)	0.121[c]
Blood Transfusion[b]			
Yes	16	24	0.157[d]
No	84	76	
Hospital Stay (days)[a]	2.32 ± (0.56)	3.0 ± (0.75)	<0.001[c]
Discharge[b]			
Home	83	77	0.289[d]
Rehabilitation	17	23	
Fixation[b]			
Hybrid	27	18	0.128[d]
Uncemented	73	82	
Head Diameter (mm)[b]			
32	43	52	0.203[d]
36	57	48	
Trauma bruising			
Yes	92	97	0.121[d]
No	8	3	
VAS score			
1st-day exit	4.51 ± (1.7)	4.88 ± (1.64)	0.095[c]
	2.47 ± (1.02)	2.68 ± (0.99)	0.085[c]

DSA, direct superior approach; SPA, standard posterior approach; VAS, visual analogue scale.
[a]The values are given as the mean with the standard deviation (±) in parentheses.
[b]The values are given as raw numbers.
[c]Tests were performed using the Mann-Whitney test.
[d]Tests were performed using the chi-square (X^2) test.

Table 3. Preoperative and postoperative HHS and HOOS comparative data of the patient groups.

	DSA	SPA	*p*-value
HHS[a]			
pre-op	44.49 ± 3.56	44.35 ± 3.77	0.287[b]
1-month post-op	81.6 ± 3.33	77.82 ± 4.01	0.001[b]
3-months post-op	88.9 ± 3.29	87.95 ± 3.66	0.160[b]
1-year post-op	92.54 ± 2.57	92.70 ± 2.31	0.598[b]
HOOS Symptoms[a]			
pre-op	44.35 ± 4.8	45.28 ± 5.1	0.181[b]
1-month post-op	75.7 ± 4.14	72.6 ± 4.52	0.001[b]
3-months post-op	87.65 ± 4.06	87.2 ± 3.97	0.448[b]
1-year post-op	92.61 ± 3.64	91.99 ± 4.2	0.265[b]
HOOS Pain[a]			
pre-op	41.6 ± 5.24	42.1 ± 3.6	0.257[b]
1-month post-op	76.9 ± 3.62	75.2 ± 4.03	0.005[b]
3-months post-op	88.62 ± 3.61	87.82 ± 3.9	0.255[b]
1-year post-op	92.44 ± 4.62	92.09 ± 3.99	0.494[b]
HOOS ADL[a]			
pre-op	38.67 ± 5.5	38.56 ± 3.77	0.811[b]
1-month post-op	78.11 ± 4.90	74.89 ± 3.90	0.001[b]
3-months post-op	87.93 ± 3.97	87.13 ± 3.17	0.211[b]
1-year post-op	92.90 ± 3.39	92.07 ± 3.84	0.125[b]
HOOS S&R[a]			
pre-op	36.87 ± 10.97	37.65 ± 11.91	0.677[b]
1-month post-op	44.25 ± 12.42	39.07 ± 11.93	0.037[b]
3-months post-op	55.50 ± 14.65	55.50 ± 19.68	0.687[b]
1-year postpop	71.55 ± 17.59	69.64 ± 21.70	0.795[b]
HOOS QOL[a]			
pre-op	38.57 ± 6.82	38.32 ± 6.86	0.880[b]
1-month post-op	57.20 ± 8.58	53.48 ± 8.87	0.03[b]
3-months post-op	70.94 ± 8.85	70.00 ± 10.87	0.683[b]
1-year post-op	84.60 ± 8.05	84.95 ± 9.23	0.519[b]

HHS, Harris Hip Score; HOOS, Hip disability and Arthritis Outcomes Score; ADL, Activities of Daily Living; S&R, Sport & Recreation; QOL, Quality of Life.
[a]The values are given as the mean with the standard deviation (±) in parentheses.
[b]Tests were performed using Mann-Whitney U-test.

The mean preoperative HSS and HOOS scores were comparable between groups (Table 3). The mean postoperative functional scores were significantly improved at all follow-up times compared to the preoperative for both groups ($p < 0.001$) (Table 3). However, the mean postoperative functional scores were significantly improved for the DSA compared to the SPA group at the end of the first follow-up month ($p < 0.001$). Functional improvement was also greater but at a non-significant level for the DSA group compared with the SPA group at the end of the third month. No differences in functional scores were noted between groups 1 year postoperatively (Table 3). There was a strong agreement between surgeons, $\kappa > 0.8$, $p < 0.001$ for all parameters screened.

Discussion

In this retrospective matched controlled study, we compared the intraoperative and early postoperative outcomes of 2 matched groups of patients undergoing primary THA using either DSA or SPA. A high-volume surgeon performed the procedures for each group. Demographics did not confound our study's outcomes. Our 2 groups were matched for age, sex, and ASA scores. Also, both group patients had comparable mean BMI. We found that the DSA is associated with significantly higher patient functional scores in the first postoperative month and significantly lower hospital stay than the SPA. DSA patients demonstrated non-significantly lower blood loss, less need for blood transfusion, and less postoperative pain. Both groups had similar complications rates and surgical times.

Early discharge

This study showed that patients undergoing DSA were discharged earlier from the hospital than those who had the SPA. The DSA is an MIS, tissue-sparing approach that enhanced earlier patient mobilisation and favourable functional results, enabling faster discharge from the hospital compared to patients undergoing SPA. The decreased length of hospital stay of DSA patients compare to SPA needs to be further confirmed in higher-level studies. Similar studies have suggested that the DSA is associated with a significantly lower hospital stay than other approaches.[12,15] In a retrospective comparative study, the length of hospital stay was shorter for the DSA and direct anterior approach than the posterolateral approach.[15] Duijnisveld et al.[10] showed that patients undergoing THA with DSA had a shorter but not statistically significant mean length of hospital stay compared with the mini-posterior approach.

Functional results

Our study primarily showed the early functional improvement and less postoperative pain of patients undergoing DSA compared to SPA. These noticeable differences during the first postoperative month could be multi-factorial but mainly attributed to MIS and tissue preserving techniques. DSA is a tissue friendly approach that preserves the iliotibial band and quadratus femoris with a smaller incision than SPA.[1] These reasons are mainly implicated for the earlier recovery of DSA patients compared to SPA. The perception of less pain and earlier recovery is primarily attributed to iliotibial band preservation and modified capsular repair in DSA-THA.[16] In a retrospective comparative study, more than 3000 patients who underwent bilateral THA through DSA with and without iliotibial band preservation were asked to identify their perception of pain. The majority of patients preferred IT-band preservation surgery.[16] Recently advances in physiotherapy and intraoperative pain management protocols may have been improved and become more intense over time, contributing to limited postoperative pain and early functional recovery.[17] In our study, physiotherapy and pain management were similar for both groups and can be excluded as a reason for the differences between the groups. Numerous studies have demonstrated that the mini-incision posterior approach facilitated earlier recovery, enhanced functional scores, and reduced hospital stay than the standard posterior approach procedure.[6] In a prospective matched comparative study, DSA has been correlated with the same gains in patient-reported outcome measures as a mini-posterior approach.[10] However, Nam et al.[13] failed to find any difference in residual pain incidence after THA using the DSA or mini-posterior approach.

Safety and efficacy

The DSA has been shown to be as safe as the SPA for primary THA. However, all MIS approaches have been correlated with a higher risk of complications than standard approaches.[18,19] MIS-THA has been linked with a higher risk of intraoperative acetabular and femoral fractures and postoperative complications such as nerve injuries, wound dehiscence, and infection,[18–20] silent muscle damage, or degeneration with fatty infiltration.[21] The higher risk of complications when using the MIS approach is attributed to impeded acetabular and femoral access, an extended learning curve, and the regular need for unique instrumentation.[22] The main technical aspects of DSA that make this approach distinct from other MIS approaches include the excellent acetabular and femoral view, even for complex primary THAs like dysplastic hips or obese patients, and the reduced damage to SER, minimising the risk of complications.[1] Additional feature include the performance with standard instrumentation either for cemented or uncemented primary THA.[1,8] DSA can be easily extended when necessary to remove hardware from the posterior acetabular column in post-traumatic primary THA, providing an excellent view of the acetabulum and femur.[1,23]

Complications

The complication rate in both study groups was low. There was also no difference in the complication rates between the groups of patients in our study. No sciatic nerve palsies were recorded. The identification and protection of the sciatic nerve during both approaches were sufficient and remained an advantage of both approaches.[1] The wound complication rate of the DSA was very low and similar to the SPA, even in obese and diabetic patients.[1,10] The limited incidence of wound complications can be attributed to anatomical differences compared to other approaches.[6,17] The gluteal region involved in MIS posterior approaches is relatively distant from the perianal area and the abdominal fat inguinal fold, which may macerate the skin in obese patients.[6,17] No dislocation was recorded in the DSA group and only 1 in the PSA. The low dislocation rate could be attributed to the larger heads of 32 mm or 36 mm and the repair of the posterior capsule and SER.[24] The accuracy of implantation from 2 senior surgeons is also implicated and is considered the most important variable for the low dislocation rate.

Overall bleeding

DSA is a soft-tissue-friendly approach with limited blood loss.[1,3,12] There was less blood loss or need for transfusion in DSA compared with SPA; however, the difference was not statistically significant. Posterior approaches have the advantage of being distant from critical vessels. They can also help effectively control bleeding. The medial femoral circumflex artery (MFCA) branches, the main blood supply to the hip crossing the approach field, can easily be identified and cauterised.[25] In addition, preserving the quadratus femoris muscle belly reduces bleeding as MFCA crosses obliquely within its fibres, heading up towards the piriformis fossa.[25] A recent randomised study in primary THA suggested that the DSA resulted in significantly less blood transfusions than a posterolateral approach and similar to DAA.[15]

Overall easiness and learning curve

MIS-THA techniques have demonstrated conflicting results in the literature in terms of operating time and learning curve. Several studies have shown a long learning curve and a higher risk of intraoperative and postoperative complications.[18,26] The learning curve of DSA has been shown to be very short,[10,11] and DSA easy to perform.[1] DSA is easily adopted in our experience, especially by posterior approach users, and the learning curve is low and fast.[10,11] Ezzibdeh et al.[11] suggested that the learning curve of the DSA is <20 patients. In another matched-control study of DSA with the mini-posterior approach, DSA was found to have no learning curve for prosthesis position.[10] Furthermore, no unique instrumentation or offset reamers are needed in DSA compared with other MIS hip approaches.[1] The mean operating time in the DSA group in the current research was comparable to previous DSA studies.[10,11,15]

Limitations of the study

Our study has some limitations. First, this is a retrospective comparative study without randomisation and sample size estimation, and it may be impacted by selection bias. Second, we did not assess long-term results; however, it has been suggested in the literature that 12 months is adequate to assess functional results following a THA. Third, 2 different surgeons performed the operations, and various implants were used in both groups. Both surgical procedures were performed by a senior surgeon, minimising bias which would occur if numerous surgeons with varying experience were involved. Also, our 2 groups were matched for age, sex, and ASA scores, and similar postoperative treatment and physiotherapy were given. The results were properly recorded in an official academic Arthroplasty Registry (ART) and all surgeries were performed in the same hospital and operating room in a tertiary referral center for arthroplasty. Finally, the attending surgeons who conducted the research were blinded to the survey and did not operate on any cases.

Conclusions

The DSA may provide an earlier functional recovery and discharge from the hospital for patients undergoing THA compared to the SPA. The DSA is as efficient as the SPA concerning pain and blood loss, demonstrating similar safety with a minimal complication rate. Further higher-level studies are needed to confirm these findings.

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