

A meta-analysis comparing the direct anterior with other approaches in primary total hip arthroplasty



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ABSTRACT

Background: Proponents of the direct anterior approach (DAA) for THAs suggest earlier recovery with no increased complications whereas opponents suggest higher complication rates.

Methods: We conducted a meta-analysis of randomized controlled trials (RCTs) to compare the outcomes of the DAA versus other surgical approaches in primary THAs.

Results: We identified 18 RCTs suitable for detailed extraction of the data. The RCTs included a total of 1661 patients with a mean age of 62 years (range 55–69). Using the DAA led to a significant improvement in the Harris Hip score by a mean of 5.6 points (95% confidence interval (CI) 4.3 to 6.8, $p < 0.01$, heterogeneity I^2 18%) and the WOMAC score by a mean of –3.1 points (95% CI –4.1 to –2.1, $p < 0.001$, I^2 0%) at 6 weeks postoperatively, reduction in the analgesic requirements on the day of surgery (Morphine Equivalents –3.6 95% CI –6.5 to –0.7, $p = 0.02$, I^2 50%) and pain scores on day one postoperatively (VAS –1.3 95% CI –1.5 to –1.1, $p < 0.01$, I^2 91%). DAA was associated with a smaller incision (–3.2 cm 95% CI –3.3 to –3.1, $p < 0.01$, I^2 99%) and there was no significant difference in complication rates ($P = 0.20$) among the study groups.

Conclusion: Based on the available studies, the DAA offers superior functional outcomes over other approaches in the immediate postoperative period after primary THA with no increased risk of complications. However, there was no evidence to support the superiority of any approach beyond 6 weeks postoperatively.

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Introduction

Recent few decades have seen a move towards less invasive surgical approaches in all surgical disciplines such as the introduction of endovascular surgery, laparoscopic surgery, and percutaneous approaches to fracture fixation. Improvement in the surgical approaches for total hip arthroplasty (THA) surgery aiming to limit soft tissues dissection and improving overall outcomes has been of particular interest to arthroplasty surgeons.^{1–4} For example, a randomized study which demonstrated that greater trochanteric osteotomy was

not necessary to perform a successful THA led to abandoning this approach at our institution and majority of other centers.⁵

The direct anterior approach (DAA) utilizes the intermuscular plane between tensor fascia lata laterally and sartorius and rectus muscles medially.⁶ Proponents of this approach believe that it results in better early functional outcomes and reduces the risk of complications such as dislocations.^{6–16} Opponents on the other hand, believe that the DAA does not offer any advantage over the traditional surgical approaches and to the contrary, may carry a higher risk of complications especially during the learning curve.^{17,18}

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The objective of this study was to perform a meta-analysis of all published randomized controlled trials (RCTs) to determine whether functional outcomes and complications of THA performed through the DAA is any different to THA performed through other surgical approaches.

Materials and methods

The methods for this review were based on Cochrane methodology for conducting systematic reviews and meta-analyses.¹⁹

a) Study selection criteria

Types of studies

Randomized controlled trials and quasi-randomized (for example, allocation by hospital number or date of birth) trials have been considered for this review.

Types of participants

The participants were adults who underwent THA regardless of the type or size of prosthesis used.

Types of interventions

The intervention considered was the use of DAA versus other approaches in primary THAs. Trials including synchronous or sequential bilateral primary and revision surgery were excluded.

Types of outcome measures

The primary outcome measure was

Functional outcome scores including the Harris Hip Score (HHS)²⁰ and Western Ontario and McMaster osteoarthritis index (WOMAC).²¹

The secondary outcome measures were

1. Postoperative analgesic requirements and pain scores
2. Hospitalization time
3. Length of incision
4. Surgical time
5. Complications such as: infection, wound healing problems, neurovascular damage, fractures, thrombosis, dislocations, component malpositioning, heterotopic ossification and death.

Exclusion criteria were: Studies not randomized, any study comparing DAA with another approach in dissimilar circumstances (e.g. different anaesthesia for each group of patients), animal studies and studies where the above mentioned outcomes were not evaluated.

b) Search methods for identification of studies

The following exploded MeSH terms were used for the initial literature search: “Direct anterior approach” and “Total Hip Arthroplasty”. Text searches of key fields were included. A MEDLINE search was then refined to clinical trials and randomized controlled trials in human adults. The search was extended to other databases: EMBASE, the Cochrane

Controlled Trials Register, HealthSTAR, CINAHL and further adapted for Google and Google Scholar searching for trials of DAA and total hip arthroplasty published in any language from 1966 to January 2018. The bibliographies of retrieved trials and other relevant publications, including reviews and meta-analyses, were cross-referenced for additional articles. The following websites were searched to identify unpublished and ongoing studies: Current Controlled Trials (www.controlled-trials.com), Centre Watch (www.centerwatch.com), Trials Central (www.trialscentral.org), The National Institute for Health Research (<https://www.nihr.ac.uk/>), Journal of Bone and Joint Surgery - British Volume (now the Bone and Joint Journal) and American Volume (www.ejbs.org) and the American Academy of Orthopaedic Surgeons (www.aaos.org) were searched manually.

c) Data collection and analysis

Selection of the studies

Two authors independently applied the search strategy to select references from the aforementioned databases. The article titles and abstracts were reviewed independently. When there was doubt, the full article was retrieved for further scrutiny. The two authors independently assessed each full study report to see if it met the review's inclusion criteria. Authors were contacted for more information and clarification of data as necessary. Disagreement was discussed with the senior author and when no consensus was reached, the particular study was excluded.

Data extraction and management

A data extraction form was designed and agreed by the authors. A pilot test of five articles was performed to ensure the form's consistency. Initially, two authors extracted the data independently which was later on reviewed jointly to produce agreed accurate data. Disagreements were resolved by consensus or consultation with the senior author. Authors of individual trials were contacted directly to provide further information when necessary.

Assessment of risk of bias in included studies

Two authors independently assessed risk of bias for each study using the criteria outlined in the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011).^{1,9} This included assessing the risk of bias for the following domains: (a) random sequence generation (selection bias), (b) allocation concealment (selection bias), (c) blinding of participants and personnel (performance bias), (d) blinding of outcome assessment (detection bias) (e) incomplete outcome data (attrition bias) (f) selective outcome reporting (reporting bias) and (g) other sources of bias. We completed a ‘Risk of bias’ table for each eligible study and classified each study as having ‘low,’ ‘high,’ or ‘unclear’ risk of bias with respect to each domain. We resolved disagreements between review authors by consensus.

Statistical analysis

Review Manager Database (RevMan version 5.3, The Cochrane collaboration 2014) was used for analysis of the selected studies. Continuous data for each arm in a particular study was expressed as mean and standard deviation and the

treatment effect as mean differences. We used the weighted mean difference to summarize across-trial findings since outcomes were measured consistently across trials (without recourse to using standardized mean differences). Dichotomous data for each arm in a particular study was expressed as proportions or risks, and the treatment effect as risk differences. Missing data was sought from the authors. Where this was not possible or data was missing through loss to follow-up, intention-to-treat principles were used. Summary estimates of the overall effect of treatment are provided in the form of a forest plot. The Mantel-Haenszel (M–H) method was used to combine studies using a fixed effects model. The presence of statistical heterogeneity was assessed through Q and I^2 statistics, a value of $I^2 > 50\%$ being considered substantial heterogeneity. We planned to assess reporting bias using funnel plots if more than 10 studies reported on the outcomes. We also compared the method descriptions of the included studies with the actual reported outcomes in the results section to assess selective outcome reporting bias.

Subgroup analysis

We planned to analyze potential sources of heterogeneity using the following subgroup analyses:

- type of approach used for comparison with the DAA (lateral, posterior)
- type of instrumentation (orthopaedic table vs. no table) used for the DAA

Source of funding

No external or internal funds were received in the conduct of this review. The authors declare that they have no conflict of interest.

Results

Description of studies

The literature search strategy was applied, then refined and reapplied. Three hundred and twenty studies were identified as potential relevant studies and subsequent scrutiny of the abstracts and full publications led to the exclusion of 302 studies for various reasons according to inclusion and exclusion criteria (Fig. 1).

Seventeen RCTs^{7–9,11,12,17,22–32} and one quasi-RCT¹³ were included in the meta-analysis. Management protocols were similar and patients' demographics were comparable for each study as detailed in Table 1. The majority of studies were small with participant numbers ranging from 33 to 163. Trials performed were all primary for THA. The mean age of patients was 62 (range 56–67) for the DAA and 63 (range 55–69) for other approaches. A posterior approach was utilized in 10 studies^{7,12,13,17,22,23,28–31} and a lateral approach in 8 studies^{8,9,11,24–27,32}. Uncemented prostheses were used in 15 studies^{7–9,11,12,17,22–25,27,29–32} whereas in two studies^{26,28} a hybrid THA (cemented acetabular and uncemented femoral components) was utilized. A specialized table for the DAA was

utilized in four studies.^{7,12,22,23} Two studies compared functional outcomes using gait analysis one of which also used computer navigation in performing the DAA and compared it to the posterior approach¹⁷ and the other compared the DAA with the lateral approach.⁹ Aspirin³² and Coumadin¹¹ were used for DVT prophylaxis in two studies. Mechanical and pharmacological prophylaxis were used in two studies,^{8,31} LMWH in 4 studies^{22,25,27,30} whereas the other studies did not record their DVT prophylaxis protocol. Three studies^{11,30,32} stated a transfusion trigger of Hemoglobin <8 g/dl. There were 5 studies^{8,11,26,27,32} which used regional anaesthesia, two studies^{23,29} used general anaesthesia and three studies^{22,25,28} used either regional or general anaesthesia whereas the rest of the studies did not specify the type of anaesthetic used. No studies reported on mortality in their series of patients.

Risk of bias in included Studies

The random sequence generation was not specified or sufficient information to permit judgement was not available in 6 studies.^{8,12,23–25,31} The sequence was generated by admission number (odd or even) in the quasi-RCT.¹³ The method used for allocation concealment was unclear in 10 studies^{7–9,23–27,29,31} whereas in one study an open random allocation schedule was used which was classified as high risk for selection bias.¹³ Although blinding of participants was impossible, 6 studies^{11,22,26,27,30,32} blinded personnel who were involved in the postoperative assessment of outcomes but the rest of the studies carried the potential for performance bias.^{7–9,12,13,17,23–25,28,29,31} Eight studies^{9,11,17,26–28,30,32} blinded assessors and hence it was felt that those studies were of low risk for detection bias. Three studies^{23,25,28} raised concerns regarding attrition as patients either dropped out or there has been insufficient data reporting follow up. There were no concerns in reporting any other sources of bias (Figs. 2 and 3).

Regarding publication bias, a funnel plot analysis for the complications outcome including 14 studies^{7,8,11–13,22–25,27–31} showed minimal asymmetry around the pooled risk difference (RD), suggesting a low risk of publication bias (Fig. 4). On the other hand, the procedure we used to retrieve all RCTs was comprehensive and systematic, and two review authors conducted independent selection from results obtained by the searches and checked prospective clinical trial registers and unpublished data for assessment of publication bias. Additionally, a well-conducted non-significant trial would have had a reasonable chance of being published. Thus, the risk of publication bias is low.

Effects of interventions

The majority of outcomes studied in this meta-analysis are discrete numerical data. For example, the HHS and WOMAC are scores measured in whole numbers to a total score of 100 and 96 respectively. However, for most of the studies included in this meta-analysis, authors presented the means of those scores to a precision of 2 decimals. Whilst we understand that the mean scores should have been presented as whole numbers, we preferred to analyse the outcomes using the numbers quoted in the original studies in order to avoid any reporting bias.

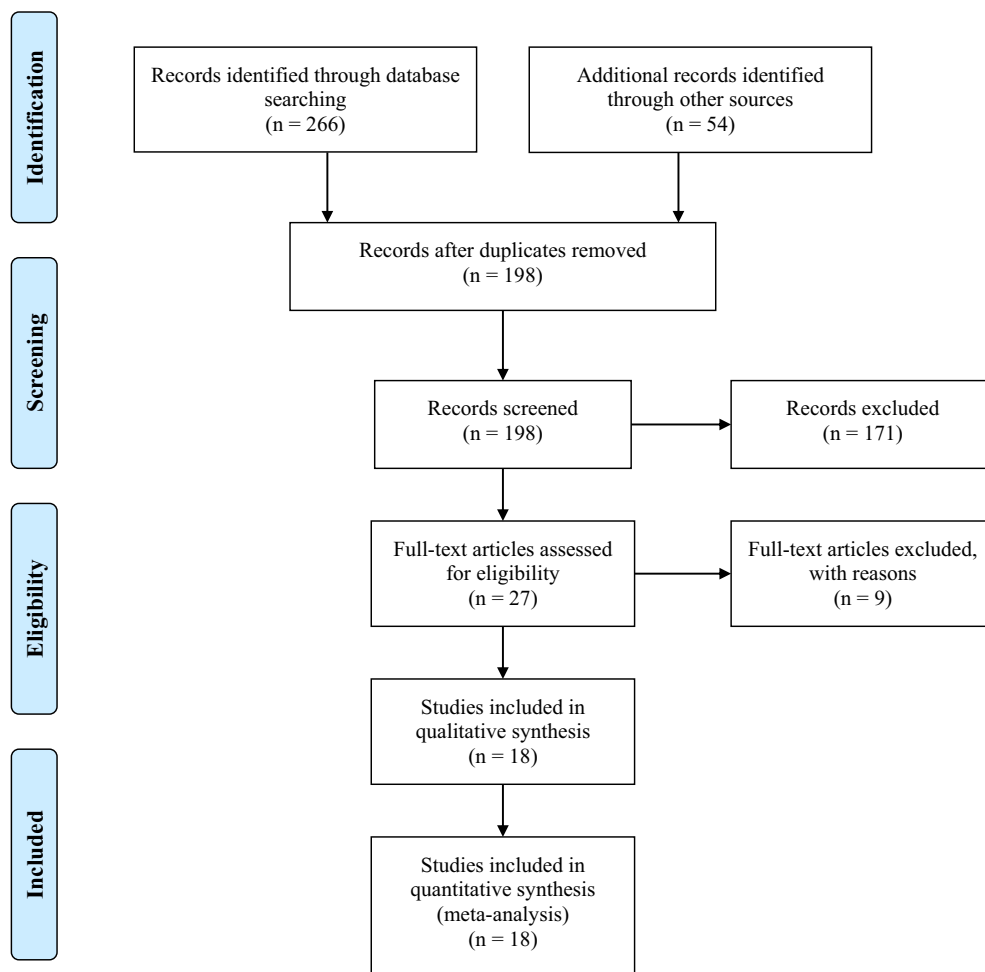


Fig. 1 – PRISMA chart of the study selection process.

Functional outcomes

HHS at 6 weeks

Eight studies^{7,8,11,12,23,25,28,29} with a total of 598 patients were eligible for this outcome; 285 patients underwent the DAA and 313 underwent other approaches. Using the DAA led to significantly higher improvement in the HHS at 6 weeks with no significant statistical heterogeneity among the study groups (MD 5.6, 95% confidence interval (CI) 4.3 to 6.8, $P < 0.001$, Heterogeneity $I^2 = 18\%$). (Fig. 5)

WOMAC at 6 weeks

In four trials^{8,11,12,22} involving 263 patients, data on WOMAC at 6 weeks were available. Using the DAA led to a significantly higher improvement in WOMAC with no significant statistical heterogeneity among the study groups (MD -3.1 95% CI -4.1 to -2.1 , $P < 0.001$, $I^2 = 0\%$) (Fig. 6).

Postoperative analgesic requirements and pain scores

In three trials^{7,11,26} involving 350 patients, using the DAA led to a significant reduction in Morphine Equivalents (MEs) with no significant statistical heterogeneity among the study groups on day of surgery (MEs -3.6 95% CI -6.5 to -0.7 , $p = 0.02$, $I^2 = 50\%$). Despite a similar trend on day one and two

postoperatively (ME -1.3 and -1.1 respectively), the results were not statistically significant ($P = 0.14$ and $P = 0.18$ respectively). The visual analogue score (VAS) was the only means of measuring pain and according to the data available from 5 studies,^{7,25–27,30} the DAA was associated with reduction of VAS on day one postoperatively (VAS -1.3 95% CI -1.5 to -1.1 , $p < 0.01$, $I^2 = 91\%$). There was not enough data to analyze pain scores on the day of surgery or beyond the first day after the operation.

Hospitalization time

Ten studies^{7,8,11,13,22,23,25,28,30,32} with a total of 863 patients were eligible to measure the effect of DAA on hospitalization time. Using the DAA led to a significant reduction in hospitalization time but with significant statistical heterogeneity among study groups (MD -0.8 days 95% CI -0.9 to -0.7 , $P < 0.001$, $I^2 = 99\%$).

Length of incision

Nine studies^{7,11,13,22,25–27,29,30} with a total of 957 patients were eligible to compare the effect of DAA versus other approaches on length of incision. DAA led to a smaller incision (MD -3.2 cm 95% CI -3.3 to -3.1 , $P < 0.001$). However, there was

Table 1 – Characteristics of the included studies.

Study	Intervention	Number of Cases	Age	Female/Male	BMI
Barrett 2013	Anterior	43	61.4	14/29	30.7
	Posterior	44	63.2	25/19	29.1
Cheng 2017	Anterior	35	59	20/15	27.7
	Posterior	37	62.5	20/18	28.3
Christensen 2015	Anterior	28	64.3	15/13	31.1
	Posterior	23	65.2	12/11	30.4
D'arrigo 2009	Anterior	20	64	8/12	22.7
	Mini-incision lateral	20	66.3	6/14	27.6
De Anta-Díaz 2016	Anterior	49	64.8	24/26	26.6
	Lateral	50	63.5	23/26	26.9
Dienstknecht 2014	Anterior	55	61.9	33/22	27.6
	Lateral	88	61.3	47/41	30.1
Luo 2016	Anterior	52	N/A	N/A	N/A
	Posterior	52	N/A	N/A	N/A
Mayr 2009	Anterior	16	65	11/6	27
	Lateral	17	69	9/8	29
Mjaaland 2015	Anterior	83	67.2	59/25	27.7
	Lateral	80	65.6	50/30	27.6
Nistor 2017	Anterior	35	67	26/9	27.45
	Lateral	35	64	16/19	28.63
Parvizi 2016	Anterior	44	56.5	26/18	26.52
	Lateral	40	55.07	26/14	30.28
Reininga 2013	Anterior	35	60.3	24/11	27.3
	Posterior	40	60.5	32/8	26.2
Restrepo 2010	Anterior	50	62.02	33/17	25.18
	Lateral	50	59.91	28/22	25.17
Rykov 2017	Anterior	23	62.8	15/8	29
	Posterior	23	60.2	12/11	29.3
Taunton 2014	Anterior	27	62.05	15/12	27.7
	Mini-incision posterior	27	66.4	14/13	29.2
Xu 2017	Anterior	43	57.4	16/27	24.3
	Posterior	39	59.2	14/25	24.7
Zhang 2006	Anterior	60	61	35/25	N/A
	Posterior	60	62.5	32/28	N/A
Zhao 2017	Anterior	60	64.88	36/24	24.35
	Posterior	60	62.18	34/26	25.58

N/A: not available.

significant statistical heterogeneity among the study groups, $I^2 = 99\%$).

Surgical time

Eleven studies^{7–9,11,25–30,32} with a total of 968 patients were eligible to measure the effect of DAA on surgical time. DAA prolonged the surgical time by an average of 7 min (95% CI 5.7 to 7.7, $P < 0.001$, $I^2 = 98\%$) when comparing it to other surgical approaches.

Other outcomes

There were no significant statistical differences in other outcomes reported including Hb, Hct, CRP and CK levels among the study groups.

Complications

Fourteen trials^{7,8,11–13,22–25,27–31} reported on complications in 1188 patients of whom 580 underwent a DAA and 608 underwent other approaches. Significant complications in the DAA

group included two component malpositioning requiring revision surgery in one case, 9 intra-operative fractures treated either with protected weightbearing alone or cerclage wiring and protected weightbearing, four infections two of which required further operations, one aseptic loosening requiring revision surgery, one dislocation requiring closed reduction, four cases of DVTs, one case of heterotopic ossification, two cases of iliopsoas tendonitis, one case of a ruptured tensor fascia lata and a patient who experienced a snapping iliotibial band which resolved with therapy and anti-inflammatory medications. In the other group of patients, complications related to the posterior approach included one case of recurrent dislocation requiring revision surgery, a dislocation treated with closed reduction, three intraoperative fractures treated with cerclages, two deep infections requiring irrigation and debridement then healed without complications, two cases of DVTs and one case of a cerebrovascular accident. Complications related to the lateral approach included one case of component malpositioning, two cases of sciatic nerve injuries (one temporary and one permanent), four cases of an intraoperative fractures requiring cerclage wiring and a suture granuloma requiring excision 10 weeks

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Barrett 2013	+	?	-	-	+	+	+
Cheng 2017	+	+	+	-	+	+	+
Christensen 2015	?	?	-	-	-	+	+
D'Arrigo 2009	?	?	-	-	+	+	+
De Anta-Diaz 2016	?	?	?	?	+	+	+
Dienstknecht 2014	?	?	-	-	-	+	+
Luo 2016	?	?	?	?	+	+	+
Mayr 2009	+	?	-	+	+	+	+
Mjaaland 2015	+	?	+	+	+	+	+
Nistor 2017	+	?	+	+	+	+	+
Parvizi 2016	+	+	+	+	+	+	+
Reininga 2013	+	+	-	+	+	+	+
Restrepo 2010	+	+	+	+	+	+	+
Rykov 2017	+	+	-	+	-	+	+
Taunton 2014	?	+	-	-	+	+	+
Xu 2017	+	?	?	?	+	+	+
Zhang 2006	-	-	-	?	+	+	+
Zhao 2017	+	+	+	+	+	+	+

Fig. 2 – Risk of bias summary: review authors' judgements about each risk of bias item for each included study.

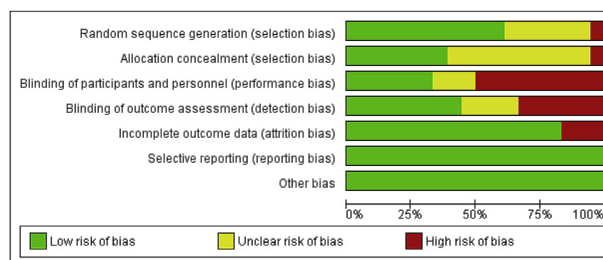


Fig. 3 – Risk of bias graph: review authors' judgements about each risk of bias item presented as percentages across all included studies.

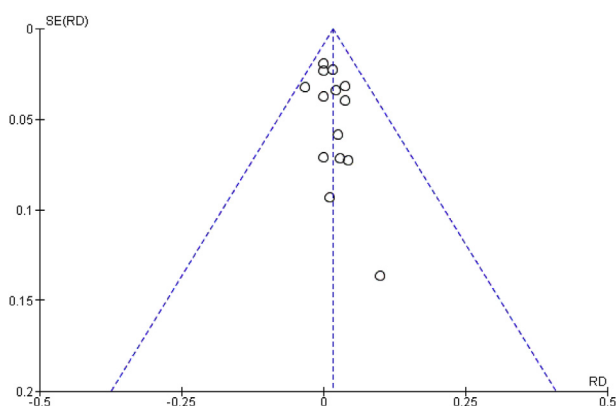


Fig. 4 – Trials of Direct anterior approach vs. other approaches: funnel plot of complications. Trials are scattered with minimal asymmetry around the pooled risk difference (RD), suggesting minimal publication bias.

postoperatively. Neuropraxia of the lateral femoral cutaneous nerve was reported in 33 DAA cases^{22,27,31} but this resolved within 6 months postoperatively. On the other hand, there was a significantly higher grade of fatty atrophy of the gluteal muscles noted on MRI imaging in the lateral approach in comparison to the DAA (22 vs. 2 cases).²⁴ However, this did not affect the Harris Hip scores of the patients involved ($P = 0.68$).²⁴

Despite a slightly higher complication rate in the DAA group (35 vs. 27); there was no statistically significant difference among the study groups in relation to overall complications ($P = 0.19$).

Subgroup analysis

A posterior approach was utilized in 10 studies^{7,12,13,17,22,23,28–31} and a lateral approach in 8 studies.^{8,9,11,24–27,32} Whilst a direct comparison between the posterior and lateral approaches was impossible, the magnitude of effect against the DAA was analyzed in Table 2a. This has shown more pronounced results when comparing DAA to the posterior approach in relation to HHS at 6 weeks and length of incision. However, the DAA showed better VAS scoring at day one postoperatively when compared to the lateral as opposed to the posterior approach (Table 2a).

A specialized table for the DAA was utilized in 4 studies only.^{7,12,22,23} Whilst a direct comparison between a table vs. no

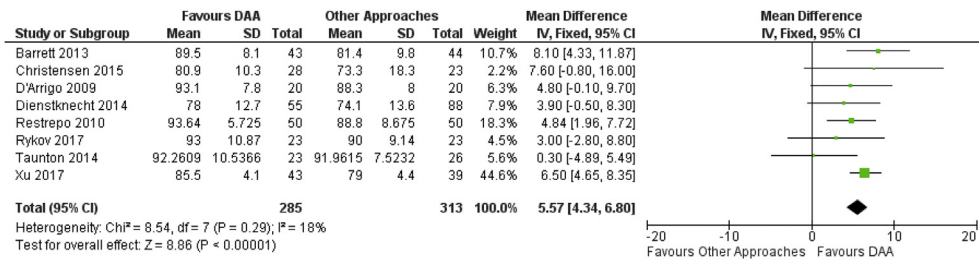


Fig. 5 – HHS outcome forest plot analyses at 6 weeks. The black diamond signifies that the mean difference is in favor of the DAA. The size of each square depends on the weight of each study as detailed in the forest plot. A green colored square is given to continuous outcomes and a blue square to dichotomous outcomes.

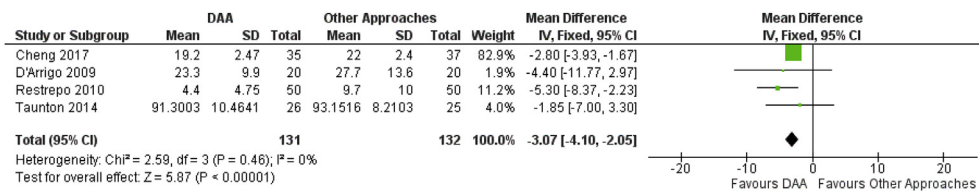


Fig. 6 – WOMAC outcome forest plot analysis at 6 weeks.

Table 2a – Subgroup analysis of outcomes according to surgical approach.

Outcome	DAA vs. Lateral Approach	DAA vs. Posterior Approach
HHS at 6 weeks	MD 4.60 (2.44, 6.77) P < 0.001	MD 6.04 (4.54, 7.54) P < 0.001
VAS Day 1 Postop	MD -1.82 (-2.07, -1.57) P < 0.001	MD -0.65 (-0.91, -0.38) P < 0.001
Length of incision	MD -2.59 (-2.84, -2.34) P < 0.001	MD -3.26 (-3.37, -3.15) P < 0.001

table approach was impossible, the magnitude of effect comparing DAA utilizing a table vs. no table was included in Table 2b. Using a no table approach was associated with better VAS scoring at day one postoperatively, shorter hospitalization and length of incision and a markedly reduced length of operation. However, there was no difference noted with the HHS at 6 weeks postoperatively using a table vs. no table approach (Table 2b).

Table 2b – Subgroup analysis of outcomes according to DAA no Table vs. DAA with Table.

Outcome	DAA no Table	DAA Table
HHS at 6 weeks	MD 5.55 (4.19, 6.92) P < 0.001	MD 5.66 (2.79, 8.52) P < 0.001
VAS Day 1 Postop	MD -1.41 (-1.60, -1.21) P < 0.001	MD -0.50 (-0.96, -0.04) P = 0.03
Hospitalization time	MD -0.84 (-0.93, -0.75) P < 0.001	MD -0.60 (-0.79, -0.41) P < 0.001
Length of incision	MD -3.41 (-3.52, -3.30) P < 0.001	MD -1.45 (-1.73, -1.17) P < 0.001
Surgical time	MD 6.03 (5.00, 7.05) P < 0.001	MD 23.80 (18.59, 29.01) P < 0.001

Discussion

Based on the available published studies, the use of DAA approach to perform primary THA, led to a significantly higher improvement in the measured functional outcome at 6 weeks and analgesic requirements and pain scores on the day of surgery and day one postoperatively. However, there has not been sufficient data to compare outcomes beyond the 6 weeks mark. The studies that reported on the functional outcomes and analgesic requirements did not suffer from significant heterogeneity. It is suggested that muscle sparing surgical approaches and the earlier functional recovery may reduce the length of hospital stay.^{15,33} The data reported by the studies included in this meta-analysis detected that the hospital stay for patients undergoing THA using the DAA approach was significantly shorter by approximately one day, although there was a significant heterogeneity among the study groups which may reflect different perioperative management protocols at various centers.

The analysis of available data also found that patients receiving THA through the DAA had a smaller incision. Although the studies did not report on the functional outcome such as return to work, ability to drive, and other important daily activities, one may postulate that earlier functional recovery may also lead to a better patient satisfaction and also have an economic implication.³⁴

The surgical time using the DAA appeared to be longer than other surgical approaches. We believe this may be a reflection of the technical difficulty of the DAA.¹⁶ Complication rates of THA performed through the DAA may be higher during the learning curve of the surgeons. However, the studies included in this meta-analysis were designed to assess efficacy as the primary outcome and were underpowered to assess the complications associated with the approaches analyzed. Despite the data not allowing a direct comparison in the subgroup analysis, there was a trend towards improvement in

outcomes using a no table technique whilst performing the DAA. This has not been previously investigated in the literature and is worth exploring in further well designed RCTs comparing both approaches.

This study did have some shortfalls that are common to most meta-analyses. There was a large difference in the sample size of the studies included. There was also a large variation in the patients' demographics such as age, gender and severity of the underlying pathology. The inclusion and exclusion criteria were not defined in detail for some studies. We also believe that there were differences in the management protocols between treating centers including strict enhanced recovery and discharge plans implemented by some centers, type of anaesthesia, DVT prophylaxis and postoperative rehabilitation programs. There were also challenges in some of the studies in blinding patients and assessors to the type of surgery performed due to the different incisions. Furthermore, only two studies in this meta-analysis^{9,17} provided gait based functional analysis after THA with contradictory findings. One study detected a superior gait for the DAA group⁹ while the other study did not detect any difference.¹⁷ The outcomes measured by the studies were, however, different.

A single meta-analysis published by Higgins et al.³⁴ recently compared the DAA with the posterior approach. Despite a similar effect of the DAA on hospitalization time, this study did not show any differences in the functional outcomes, the blood loss or the surgical time between the two surgical approaches. However, it is noteworthy that the latter meta-analysis based its findings on 10 retrospective studies, 5 prospective studies and only two RCTs which affect the end point estimates and overall results. Meermans et al.³⁵ conducted a systematic review recently comparing the DAA with other approaches in THA surgery. Whilst some of their findings were consistent with the results of this meta-analysis, it is noteworthy that the Cochrane methodology has not been strictly followed in their study in relation to assessment of risks of bias and publication bias. More importantly, the authors included 42 studies the majority of which were retrospective with only eight RCTs. They also included studies with navigation and other variables all of which weakens end point estimates. Therefore, we strictly included level one studies to provide a direct comparison between the DAA and other approaches and followed the Cochrane methodology in analysing the results. Additionally, Meermans's study was a systematic review and hence no attempt of meta-analysing the outcomes has been performed.

The current study has several strengths. First, we believe, the use of the Cochrane method for meta-analysis has allowed us to include studies with higher level of evidence. Second, to avoid bias in the review process we conducted a thorough literature search of randomized controlled trials, including unpublished abstracts in any language from 1966 using various databases and contacted the authors for further data as necessary. Finally, the meta-analysis was able to demonstrate a significantly higher improvement in the HHS and the WOMAC scores at 6 weeks postoperatively in the DAA group with no significant statistical heterogeneity.

In conclusion, this meta-analysis conducted according to the Cochrane method and including studies of higher level

only, does demonstrate that surgical approach may impact the early functional outcome as well as other parameters following THA. Further reporting of outcomes beyond the 6 weeks mark and conducting well designed long term RCTs taking into account the outcome measures reported in this meta-analysis will enable long term comparison of those approaches.

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