ORIGINAL STUDY — HIP AND KNEE

acta orthopaedica belgica, 2025, 91, 265-275

doi.org/10.52628/91.3.14375

Longitudinal incision vs bikini incision for anterior total hip arthroplasty: A systematic review and meta-analysis from the FP-UCBM Hip Study Group

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The direct anterior approach (DAA) for total hip arthroplasty (THA) with two distinct skin incisions has gained popularity due to its muscle-sparing benefits. This systematic review and meta-analysis aimed to compare postoperative outcomes and complications associated with these incisions in DAA THA. A systematic literature search was conducted using PubMed and Scopus to identify studies comparing the bikini and longitudinal incisions in DAA THA. Studies were included if they reported postoperative outcomes, complications such as lateral femoral cutaneous nerve (LFCN) injury, wound healing issues, infections, and functional scores. Meta-analysis was performed using Review Manager (RevMan 5.4), with perioperative outcomes and complications analyzed as mean differences (MD) or odds ratios (OR) with 95% confidence intervals (CI). Nine studies comprising 2,292 patients were included. No significant differences were found in clinical outcomes, including Harris Hip Score (HHS) and Oxford Hip Score (OHS) ($p > 0.05$). LFCN injury rates were comparable between groups (OR 0.92, $p = 0.82$), and revision rates showed no significant differences (OR 0.58, $p = 0.20$). While the bikini incision resulted in improved scar aesthetics and slightly shorter hospital stays, it was associated with a potentially higher risk of wound complications. Both bikini and longitudinal incisions demonstrated similar safety and efficacy in DAA THA. The choice of incision should be tailored to patient-specific factors, with further research needed to assess long-term outcomes, including chronic nerve dysfunction and implant longevity.

Keywords: Total Hip Arthroplasty; Direct Anterior Approach; Longitudinal incision; Bikini incision; Lateral femoral cutaneous nerve apraxia.

INTRODUCTION

Total hip arthroplasty (THA) is a common and highly effective procedure for treating hip joint disorders, significantly improving patient mobility and quality of life[1]. With an ageing population and the increasing prevalence of degenerative joint diseases, demand for THA is expected to increase further[2]. Moreover, the average age of patients undergoing THA is decreasing, and with advancements in implant design and the surgical technique, THA has become an excellent option for young adults who need to return to physically demanding activities to improve their quality of life[3-5]. Among the various surgical approaches used in THA, the direct anterior approach (DAA) has gained popularity due to its muscle-sparing nature, resulting in reduced postoperative pain, less soft tissue insult, shorter hospital stays, and faster functional recovery[6,7]. DAA approach was first described by Carl Hueter in 1881 for treating injuries and hip infections, subsequently

improved by Smith-Petersen 1917 and later enhanced by Judet for hip arthroplasty[8,9]. The modern DAA gained popularity by Matta in US and by Leuning developing the minimally invasive bikini incision (BI) approach[10,11].

Within DAA THA, two distinct skin incisions are commonly employed: DAA THA traditionally involves a longitudinal incision overlying the tensor fasciae latae, perpendicular to the Langer's lines[12].

Alternatively, the bikini incision runs parallel to the anatomic skin tension lines, often resulting in decreased scar formation and improved cosmesis[13]. Both incisions are shown in Figure 1.

Dislocation after the posterior approach (PA) is still problematic and increase the rate of revisions[14,15]. Preserving soft tissue, DAA THA may confer an advantage to the patients[16].

However, the DAA has several challenges. Objections to its use include the significant learning curve, inferior wound healing, lateral femoral cutaneous nerve (LFCN) dysesthesia in the anterolateral thigh, potential risk of soft-tissue injury, femoral fractures[17,18].

Given the ongoing debate, this systematic review and meta-analysis aim to evaluate whether there was any difference in postoperative outcomes and complication associated with DAA in THA using anterior longitudinal incision vs bikini incision.

MATERIAL AND METHODS

This systematic review and meta-analysis included observational, prospective, and retrospective studies that evaluated the outcome and the complications of DAA THA using a bikini vs. longitudinal incision. Studies were included if they reported postoperative outcomes, complications including LFCN injury (inclusive of neuropraxia, dysesthesia, and hypoesthesia), superficial or deep infection, wound healing complications, fracture, and dislocation.

Exclusion criteria were non-English language studies, systematic or narrative reviews and meta-analyses, case series, case reports, preclinical and cadaveric studies.

Search methods for identification of studies

A systematic literature search was performed using the following databases: Pubmed-Medline, Scopus. We used the following search strategy: (“direct”[All Fields] OR “directed”[All Fields] OR “directing”[All Fields] OR “direction”[All Fields] OR “directional”[All Fields] OR “directions”[All Fields] OR “directivities”[All Fields] OR “directivity”[All Fields] OR “directs”[All Fields]) AND (“anterior”[All Fields] OR “anteriores”[All Fields] OR “anteriorization”[All Fields] OR “anteriorized”[All Fields] OR “anteriors”[All Fields]) AND (“approach”[All Fields] OR “approach s”[All Fields] OR “approachability”[All Fields] OR “approachable”[All Fields] OR “approache”[All Fields] OR “approached”[All Fields] OR “approaches”[All Fields] OR “approaching”[All Fields] OR “approachs”[All Fields]) AND (“bikini”[All Fields] AND (“approach”[All Fields] OR “approach s”[All Fields] OR “approachability”[All Fields] OR “approachable”[All Fields] OR “approache”[All Fields] OR “approached”[All Fields] OR “approaches”[All Fields] OR “approaching”[All Fields] OR “approachs”[All Fields])) AND ((“hip”[MeSH Terms] OR “hip”[All Fields]) AND (“arthroplasty”[MeSH Terms] OR “arthroplasty”[All Fields] OR “arthroplasties”[All Fields])). The reference list of the articles was screened manually. Two reviewers (G.F.P.

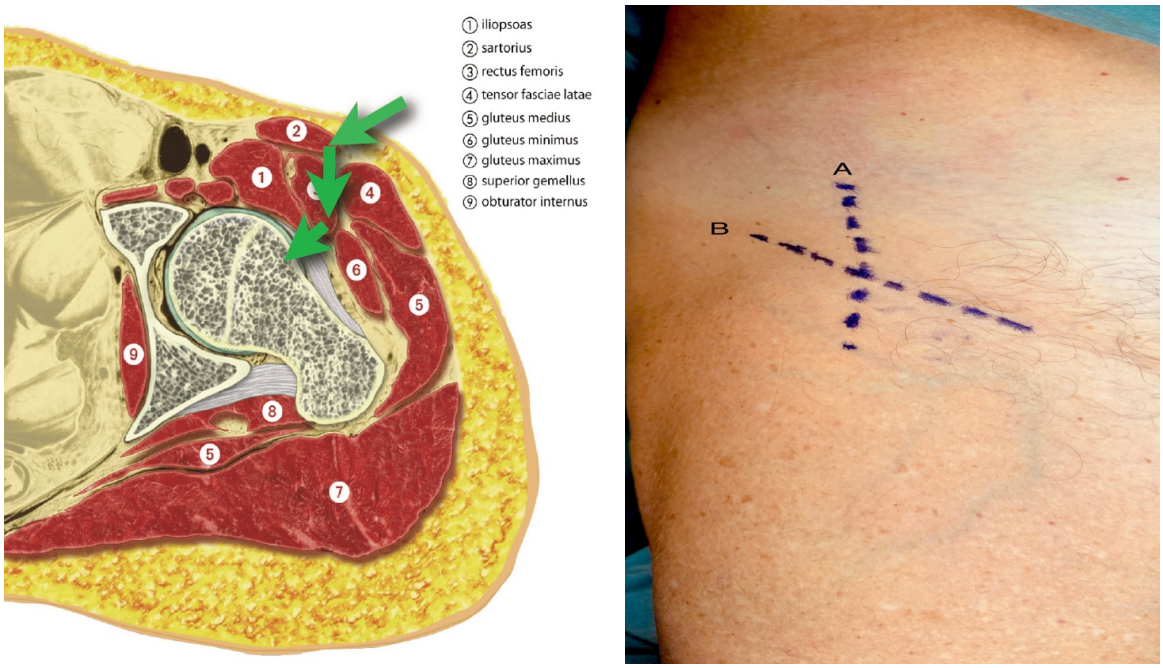

Fig. 1 — Longitudinal (a) and bikini (b) incisions. Intraoperative photo of a right hip.

and F.R.P) evaluated the articles to identify which ones should be included in the review. Search data was November 2024.

Data collection, analysis, and outcomes

Data extraction was independently produced by two reviewers (G.F.P. and F.R.P.). Following study characteristics were extracted: authors, year of publication, type of study, surgical approach, number of patients, mean follow- up, mean age, BMI, diagnosis, surgical information as operating time, incision length, length of hospital stays, blood loss, cup inclination and cup anteversion complications as LFCN injury, superficial or deep infection, wound healing, fracture, and dislocation. Finally, outcomes included clinical scores such as Harris Hip Score (HHS), visual analogue scale (VAS), Western Ontario and McMaster Universities (WOMAC), University of California at Los Angeles (UCLA).

Methodological quality assessment

Two reviewers (G.F.P. and F.R.P) used the Methodological Index for Non-randomized Studies (MINORS)(19) score to assess the quality of the included non-randomized studies. Table I, Review Manager (RevMan) software 5.4 was utilized to perform the meta-analysis. Perioperative outcomes and postoperative PROMS were compared between Bikini and DAA as continuous data with mean difference (MD) and 95% confidence intervals (95% CI). Moreover, LCFN apraxia and revisions were shown as odds ratio (OR), with 95% CI. For low heterogeneity ($I2 < 55\%$) the fixed-effect model was adopted, while for higher heterogeneity the random-effect model was used. Results were significant at $p < 0.05$.

RESULTS

Results of the search

The search was executed on 20 October 2024 using PubMed and Scopus. The literature search identified 70 articles. After screening based on title/abstracts, 35 articles were selected for full text review. Twenty-six studies were excluded for irrelevance, not bikini or longitudinal incision, lack of comparison arm, not English language, systematic review. Finally, nine articles were included in this systematic review and meta-analysis, which were two prospective studies and seven retrospective studies (Fig. 2).

Demographic data

The overall number of participants in all the studies was 2292 patients that underwent DAA THA using a bikini (n = 962) vs longitudinal incision (n = 1330). The mean age of the participants was 67.2 years ranged from 55.9 to 70 years. In the bikini incision group the mean age was 68 years ranged from 56.8 to 70 years and the majority of reported patients were female (568/962; 59 %). In the longitudinal incision group, the mean patient age was 66.5 years ranged from 55.9 to 67.4 years, and the majority of reported patients were female (748/1330; 56 %). Mean BMI data were available in 8 studies and ranged from 23.2 to 31 in the bikini group with mean value of 25 and ranged from 24.2 to 31.1 in the longitudinal group with mean value of 28. The most common diagnosis was osteonecrosis of the femoral head (ONFH), with an incidence of 40.6% in the bikini incision group and 40.3% in the longitudinal incision group. The second common diagnosis was congenital dysplasia of the hip, with an incidence of 22.8 % in the bikini incision group and 23.8% in the

Table I. — MINORS score.

Study	Stated aim	Inclusion of patients	Collection of data	Endpoints appropriate to the aim	Unbiased assessment of the study endpoint	Follow -up	Loss to follow up less than 5%	Prospective calculation of the study size	An adequate control group	Contemporary groups	Baseline equivalence of groups	Adequate statistical analyse
Zhang	2	2	2	2	2	2	2	2	2	2	2	2
Di Martino	2	2	2	2	0	2	2	2	2	2	2	2
Sang	2	2	2	2	1	2	2	2	2	2	2	2
Wang	2	2	2	2	0	2	2	2	2	2	2	2
Leuning	2	2	2	2	2	2	1	2	2	2	2	2
Leuning	2	2	2	2	1	2	2	2	2	2	2	2
Manrique	2	2	2	2	1	2	2	2	2	2	2	2
Dai	2	2	2	2	1	2	2	2	2	2	2	2
Menzies-Wilson et al	2	2	2	2	1	2	2	2	2	2	2	2

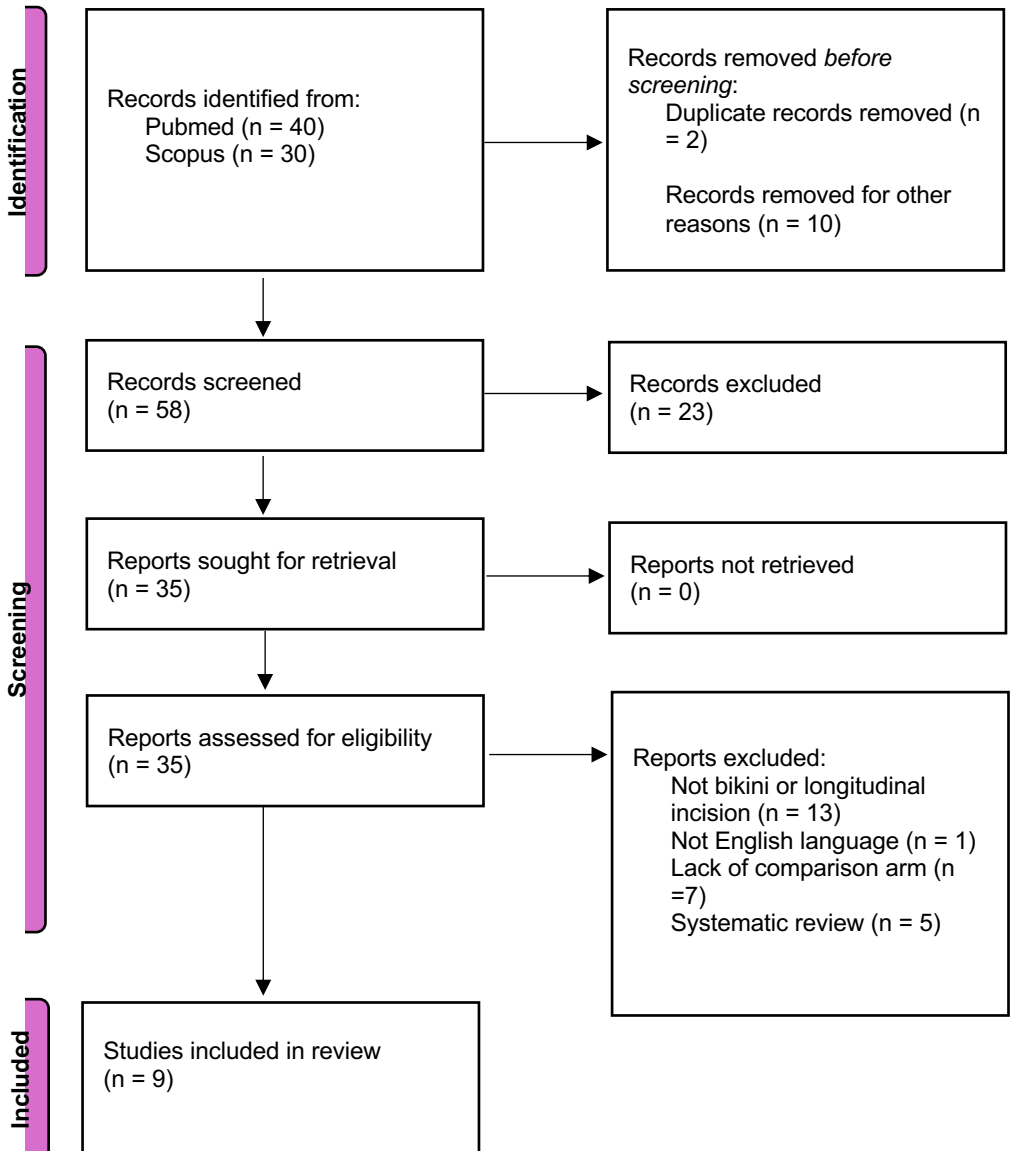

Fig. 2 — PRISMA 2020 flow diagram.

longitudinal incision group. Other diagnoses included in the study were femoral fracture with an incidence of 22% in the bikini group and 22.4% in the longitudinal incision group; Osteoarthritis (OA) with an incidence of 13.3% in the bikini incision group and 13.4% in the longitudinal incision group; Rheumatoid arthritis with an incidence of 1.2% in the bikini incision group. The mean follow-up was 9.4 months, ranging from 6 to 48 months.

Table II summarizes study characteristics and patient demographics.

Surgical information

Seven studies reported surgical information. Three studies compared incision length between patients with bikini vs longitudinal incision following DAA THA[18,20,25]. A retrospective study by Zhang et al.[20] found that there was no statistically significant difference in incision length between two group. Leuning et al.[13] and Dai et al.[25] reported a minimal difference of about 1 cm between patients with bikini vs longitudinal incision following DAA THA in favor of bikini incision group. Intraoperative estimated blood loss was reported by three studies[20,24,25] with no statistically significant difference between two group. Five studies analyze implant information with cup inclination and anteversion. A retrospective study by Zhang et al.[20] reported a lateral acetabular inclination angle of about 42°, within the safe zone with an acetabular anteversion in the longitudinal incision group of about 12°. A retrospective study of Di Martino et al.[21] of 52 bikini and 58 longitudinal incision DAA THA patients reported a cup placement closer to Lewinnek's safe zone for the BK group. Leuning et al.[13,18] reported no

Table II. — Demographic data.

Study	Type of study	LOE	Approach	N.	Sex	BMI	Follow-up (m)	Mean age	Diagnosis
Zhang et al (2022)(20)	RSC	III	Bikini	47	29 M/ 18F	25.03	6	56.83	17 Osteonecrosis of the femoral head (ONFH), 15 Femoral neck fracture, 15 Congenital dysplasia of the hip
			Daa	47	28 M/ 19F	25.12	6	56.69	16 Osteonecrosis of the femoral head, 14 Femoral neck fracture, 17 Congenital dysplasia of the hip
Di Martino et al (2023) (21)	RSC	III	Bikini	52	52 F	24.5	6	56.9	nr
			Daa	58	58 F	25.6	6	59.8	nr
Sang et al (2021) (22)	RCT	II	Bikini	99	32 M/ 67 F	23.22	18	60.7	53 ONFH, 28 Congenital Dysplasia of the hip, 14 Femoral neck fracture, 4 Rheumatoid arthritis (RA)
			Daa	96	33 M/ 63 F	24.7	18	61.38	60 ONFH, 23 Congenital Dysplasia of the hip, 8 Femoral neck fracture, 5 RA
Wang et al (2020) (23)	RCT	II	Bikini	49	26 M/ 23 F	24.3	6	56.8	29 ONFH, 14 Crowe type I dysplasia, 3 Crowe type II dysplasia, 3 Severe osteoarthritis
			Daa	50	31 M/ 19 F	24.2	6	55.9	28 ONFH, 16 Crowe type I dysplasia 4, Crowe type II dysplasia, 2 Severe osteoarthritis
Leuning et al (2018) (18)	RSC	III	Bikini	398 (41%)	171 M/ 227 F	25.6	24-48	66	nr
			Daa	556 (59%)	300 M/ 256 F	25.8		67	nr
Leuning et al (2013)(13)	RSC	III	Bikini	26	6 M/ 20 F	25	6	70	Osteoarthritis (OA)
			Daa	33	23 M/ 10F	28	6	66	OA
Manrique et al (2019)(24)	RSC	III	Bikini	86	10 M/ 76 F	25.26	21	61.97	nr
			Daa	230	30 M/ 200 F	26.09		63.3	nr
Dai et al (2024) (25)	RSC	III	Bikini	116	64 M/ 52 F	30.98	12	61.91	45 Femoral neck fracture, 38 ONFH, 17 Congenital Dysplasia of the hip, 16 OA
			Daa	136	67 M/ 69 F	31.14	12	62.55	58 Femoral neck fracture, 40 ONFH, 25 Congenital Dysplasia of the hip, 13 OA
Menzies-Wilson et al (2019)(26)	RSC	III	Bikini	89	56 M/ 33 F	nr	6	65.49	nr
			Daa	124	70 M/ 54 F	nr	6	67.44	nr

RSC Retrospective Study, RCT Randomized clinical trial, LOE Level of Evidence, N number, y years, m months, ONFH Osteonecrosis of the Femoral Head, OA Osteoarthritis, RA Rheumatoid Arthritis, nr Not reported, DAA Direct anterior approach.

differences in cup inclination angle between between patients with bikini vs longitudinal incision following DAA THA. A recent retrospective cohort study of Dai et al.[25] found that 75.9% cup anteversion and 95.7% cup inclination in the bikini incision DAA group were inside the "safe zone." While 82.4 % cup anteversion and 89% cup inclination in the longitudinal incision DAA group were inside the "safe zone" (Tab. III).

Operative time was evaluated in 5 studies and showed no significant differences between Bikini and DAA (MD 6.00, 95% CI −6.01 to 18.01, p = 0.33) (Figure 3).

Table III. — Surgical data.

Study	Operating time	Incision lenght	Lenght of hospital stay (days)	Intraoperative estimated blood loss	Cup inclination	Cup anteversion
Zhang et al (2022)(20)	83.29 ± 4.93 min	8.78	9.23 ± 2.01	168.29	42°	nr
	81.98 ± 4.38 min	8.98	11.87 ± 2.31	165.93		12°
Di Martino et al (2023)[21]	84.3 ± 12.8 min	nr	8.5 ± 1.5	nr	38.4° ± 4.2◦	nr
	87.76 ± 22.1 min	nr	10 ± 3	nr	35.3° ± 7.1◦	nr
Sang et al (2021)(22)	nr	nr	nr	nr	nr	nr
	nr	nr	nr	nr	nr	nr
Wang et al (2020)[23]	67.1 ± 10.1 min	nr	nr	nr	nr	nr
	66.8 ± 6.2 min	nr	nr	nr	nr	nr
Leuning et al (2018)(18)	nr	nr	nr	nr	41.2°	nr
	nr	nr	nr	nr	41.3°	nr
Leuning et al (2013)[13]	75 m	8.7	nr	nr	44°	nr
	73 m	9.8	nr	nr	43°	nr
Manrique et al (2019)(24)	44.06 (10.81)	nr	nr	130.81	nr	nr
	44.65 (14.72)	nr	nr	134.04	nr	nr
Dai et al (2024) (25)	96.85 ± 14.03	7.26	4.06 ± 1.08	176.98	39.89 ° ± 5.80	10.76 ± 6.53
	64.74 ± 12.62	8.35	4.01 ± 1.18	180.38	38.99 ° ± 6.89	11.55 ± 6.35
Menzies-Wilson et al (2019)(26)	nr	nr	nr	nr	nr	nr
	nr	nr	nr	nr	nr	nr

Length of stay was reported in 3 studies and was lower in the Bikini group, but without significant differences (MD -1.33, 95% CI −3.06 to 0.41, p = 0.13) (Figure 4).

Complications

Only 2 studies reported intraoperative fracture. Leuning et al.[18] reported only 1 case of intraoperative fracture (0.25%) in the bikini incision group and 2 cases of intraoperative fracture (0.36%) in the longitudinal incision group. Dai et al.[25] reported 1 case (0.9%) in the bikini incision group and 1 case of intraoperative fracture (0.7%) in the longitudinal incision group. Di Martino et al.[21] described only 1 case (0.62%) of dislocation in both groups. Leuning et al.[18] reported 2 cases (0.5%) of dislocation in the bikini incision group and 1 case (0.18%) of dislocation the longitudinal incision group. Postoperative wound-related complications were evaluated by 4 studies. Wang et al.[23] demonstrated that patients in the bikini group tended to show lower incidence of delayed wound healing (1 case 2% vs 6 cases 12%). A study by Manrique et al.[24] showed that bikini incision group had a lower rate of wound complications of 2.3% as compared to 6.1% in the longitudinal DAA group. Dai et al.[25] showed a 2.6% rate of wound dehiscence in the Bikini DAA group. Menzies-Wilson et al.[26] reported 1 superficial wound infection in each group which equated to 1.1% in the bikini-incision group versus 0.8% in the longitudinal DAA group. In terms of periprosthetic joint infection, Leunig et al.[18] showed 2 cases (0.36%) of early infection in in the longitudinal DAA group and 1 case (0.25%) in bikini-incision group. Manrique et al.[24] showed that one patient (0.43%) developed an acute periprosthetic joint infection and required revision surgery (Table IV).

LCFN apraxia was assessed in 8 studies and provided no statistical difference between the two groups (OR 0.92, 95% CI 0.45 to 1.89, p = 0.82) (Figure 4).

The rate of revisions was reported in 4 studies and was lower in the Bikini group, but without significant differences (OR 0.58, 95% CI 0.25 to 1.34, p = 0.20) (Figure 5).

Outcomes

HHS was investigated in 3 studies and presented similar results between the two groups (MD 0.09, 95% CI −0.82 to 1.00, p = 0.85) (Figure 7).

OHS was analyzed in 3 studies and did not show significant differences between Bikini and DAA (MD -0.97, 95% CI −4.02 to 2.08, p = 0.53) (Figure 7).

DISCUSSION

The main finding of this systematic review and meta-analysis was to evaluate whether there was any difference in postoperative outcomes and

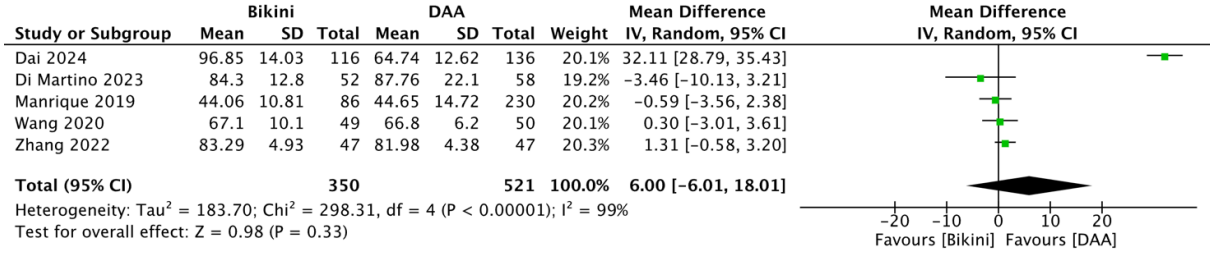

Fig. 3 — Operative time.

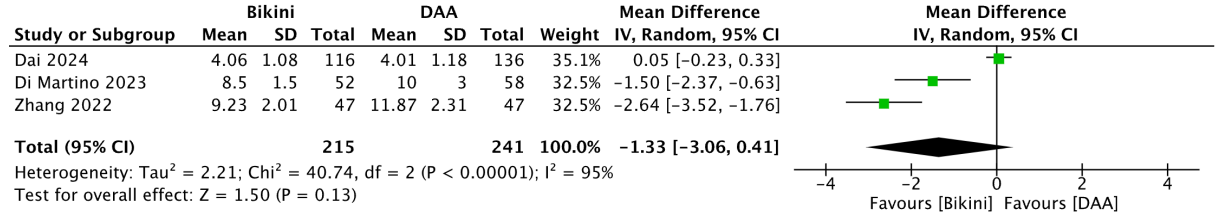

Fig. 4 — Length of stay.

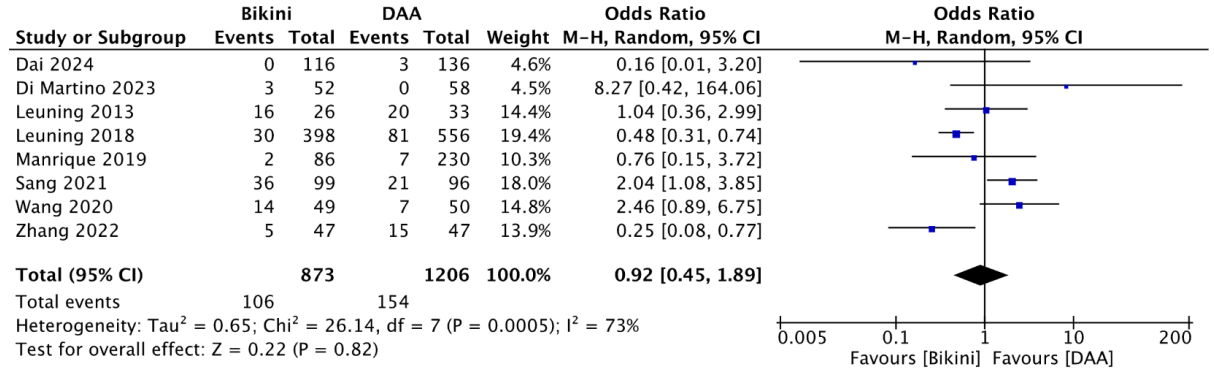

Fig. 5 — LCFN apraxia.

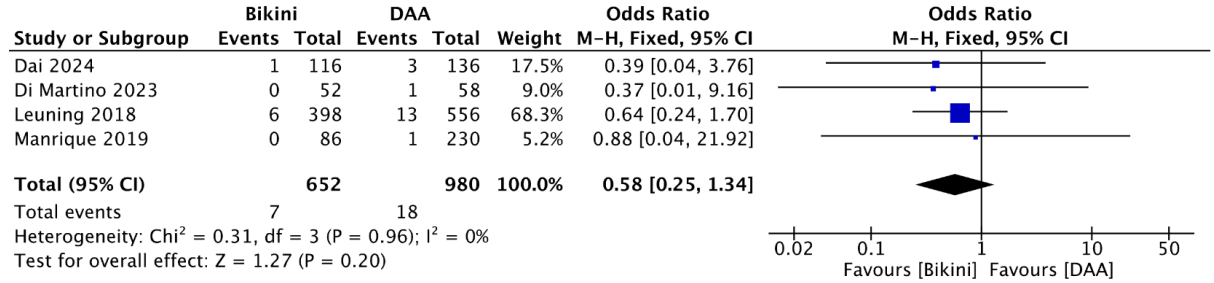

Fig. 6 — Revision.

complication associated with DAA in THA using anterior longitudinal incision vs bikini incision.

The current body of evidence indicates no significant differences in clinical outcomes, including patient-reported outcome measures (PROMs) such as the Oxford Hip score (OHS), and Harris Hip Score, no significant differences in revision rate and complication such as LCFN apraxia.

The Direct Anterior Approach (DAA) is a safe and effective muscle-sparing technique[27,28] although it is associated with a significant learning curve[29]. The potential advantages of the anterior approach include favorable clinical outcomes, quicker recovery, accurate component positioning, and a low rate of complications, making it a viable option compared to other established techniques[30-32]. However, a notable drawback is that the perpendicular skin incision may lead to wider scars and greater patient discomfort.

Table IV. — Complication.

Study	Intraoperative fracture	LCFN apraxia	Dislocation	Aseptic mobilization	Infection	Haematoma	Wound complication	Revision aetiology
Zhang et al (2022)(20)	nr	5 (10.6%)	0	nr	nr	nr	nr	nr
	nr	15 (32%)	0	nr	nr	nr	nr	nr
Di martino et al (2023) (21)	nr	3 (5.77%)	nr	1 (1/52 1.92%) (1/160 0.62%)	nr	nr	nr	nr
	nr	nr	1 (1/58 1.7%)- (1/160 0.62%)	nr	nr	nr	nr	1 cup revision
Sang et al (2021)(22)	nr	36 (36.6%)	nr	nr	nr	nr	nr	nr
	nr	21 (21.88%)	nr	nr	nr	nr	nr	nr
Wang et al (2020)(23)	nr	14 (28.6%)	nr	nr	0	nr	1 (2%)	nr
	nr	7 (14.0%)	nr	nr	0	nr	6 (12%)	nr
Leuning et al (2018) (18)	1 (0.25%)	30 (7.5%)	2 (0.5%)	nr	1 (0.25%)	nr	nr	1 infection 2 dislocation, 1 periprosthetic fracture, 1 acetabular loosening, 1 acetabular malpositioning
	2 (0.36%)	81 (14.5%)	1 (0.18%)	nr	2 (0.36%)	1,00	nr	2 infection 1 dislocation, 2 periprosthetic fracture, 2 femoral loosening, 1 acetabular loosening, 2 acetabular malpositioning, 2 leg length discrepancy 1 haematoma
Leuning et al (2013) (13)	nr	16 (61.5 %)	nr	nr	nr	nr	nr	nr
	nr	20 (60.6%)	nr	nr	nr	nr	nr	nr
Manrique et al (2019) (24)	nr	2 (2.3%)	nr	nr	nr	nr	2 (2.3%)	nr
	nr	7 (3%)	nr	nr	1 (0.43%)	nr	14 (6.1%)	1 (acute periprosthetic joint infection)
Dai et al (2024)(25)	1 (0.9%)	nr	nr	nr	nr	nr	3 (2.6%)	1 debridement (wound complications)
	1 (0.7%)	3 (2.2%)	nr	nr	nr	3 (2.2%)	nr	3 (2.2%) infection and haematoma
Menzies-Wilson et al (2019)(26)	nr	nr	nr	nr	nr	nr	1 (1.1%)	nr
	nr	nr	nr	nr	nr	nr	1 (0.8%)	nr

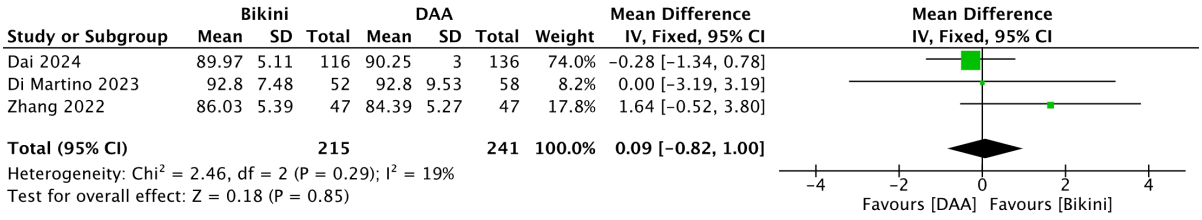

Fig. 7 — HHS.

Table V. — Outcomes.

Study	HHS pre	HHS post (6 m)	Womac post	Vas post	OHS	UCLA post (1 m)	UCLA post (3 m)	UCLA post (6m)
Zhang et al (2022)(20)	nr	86.03 ± 5.39	nr	nr	nr	nr	nr	nr
	nr	84.39 ± 5.27	nr	nr	nr	nr	nr	nr
Di Martino et al (2023) (21)	48.9 ± 9	92.8 ± 7.48	nr	nr	nr	nr	nr	nr
	49.9 ± 17.3	92.8 ± 9.53	nr	nr	nr	nr	nr	nr
Sang et al (2021)(22)	nr	nr	nr	nr	nr	nr	nr	nr
	nr	nr	nr	nr	nr	nr	nr	nr
Wang et al (2020)(23)	nr	nr	nr	4.8	25.8 ± 7.2	4.6 ± 0.6	6.1 ± 0.5	7.0 ± 0.5
	nr	nr	nr	4.8	26.2 ± 7.4	4.6 ± 0.8	6.2 ± 0.6	6.8 ± 0.7
Leuning et al (2018)(18)	nr	nr	nr	nr	46.1 ± 3.9	nr	nr	nr
	nr	nr	nr	nr	45.3 ± 5.1	nr	nr	nr
Leuning et al (2013)(13)	nr	nr	6.3	nr	16.9	nr	nr	6.2
	nr	nr	13	nr	19.4	nr	nr	6.5
Manrique et al (2019)(24)	nr	nr	nr	nr	nr	nr	nr	nr
	nr	nr	nr	nr	nr	nr	nr	nr
Dai et al (2024) (25)	34.29 ± 4.39	89.97 ± 5.11	nr	nr	nr	nr	nr	nr
	34.78 ± 6.57	90.25 ± 3.00	nr	nr	nr	nr	nr	nr
Menzies-Wilson et al (2019)(26)	nr	nr	nr	nr	32.89 ± 4.56	nr	nr	nr
	nr	nr	nr	nr	36.2 ± 5.66	nr	nr	nr

HHS Harris Hip Score, VAS Visual Analogue Scale, OHS Oxford Hip Score, UCLA University Of California at Los Angeles.

In contrast, the 'bikini' incision aligns with Langer's lines, reducing scar visibility and improving aesthetic outcomes, particularly for patients prioritizing appearance[33]. This technique has been shown to reduce scar width by over 50%, demonstrating a significant cosmetic benefit without increasing the risk of complications or negatively affecting clinical outcomes and component positioning[13]. Nevertheless, the bikini approach has faced criticism for its increased technical complexity, which may lead to worse clinical outcomes and early failures[34]. Additionally, the bikini incision poses a higher risk of nerve injury and infection, as the groin area is more susceptible to contamination compared to the lateral thigh[35].

In a single-center study by Zhang et al.[20] no significant differences in clinical outcomes or complications were observed between the bikini and standard anterior approach groups, demonstrating the safety and efficacy of both techniques. However, the bikini group exhibited a shorter hospital stay (9.23 vs. 11.87 days; $P < 0.001$), better scar aesthetics, and a lower incidence of lateral femoral cutaneous nerve (LFCN) injury (10.64% vs. 31.91%; $P < 0.05$). Nonetheless, the study had limitations, including a small sample size of only 94 patients and a short follow-up period, restricting the ability to assess long-term outcomes such as chronic nerve dysfunction or early implant failure. Similarly, Leunig et al. (18) reported lower rates of LFCN hypoesthesia with the 'bikini' incision compared to the longitudinal incision, while maintaining comparable radiographic outcomes and high patient satisfaction.

Conversely, in their retrospective study, Di Martino et al.[21] reported a higher rate of minor complications in the bikini group compared to the direct anterior and posterolateral approaches, including LFCN paresthesia. However, these issues did not compromise scar aesthetics, clinical outcomes, or recovery. Despite promising findings, the study's generalizability is limited due to the small number of total hip arthroplasties (THAs) performed using the bikini approach, which primarily focused on young, slim female patients. Similarly, Sang et al.[22] documented a higher incidence of LFCN injury in the bikini group compared to the longitudinal incision group, however by six months postoperatively, 81% of affected patients experienced complete recovery or significant symptom improvement, though persistent symptoms remained possible in a small subset. The reliance on ultrasound-based nerve injury identification introduced operator-dependent variability, and the short follow-up period prevented analysis of late recovery or the incidence of chronic neuropathy.

The study population is often heterogeneous across studies, with some authors focusing exclusively on a specific segment of the population when utilizing the bikini incision, typically favoring young, slim

women. Even though the study population is key when analyzing the outcomes of the bikini incision, as demonstrated by Manrique et al.[24], who suggested a potential benefit of the horizontal incision in reducing wound complications in patients with a BMI >30, without compromising the safety of this approach in obese individuals.

Despite these encouraging findings, the direct anterior approach is often considered suitable for a limited patient population due to the increased risk of complications and suboptimal acetabular component alignment observed in obese patients REF. However, a recent study by Dai et al.[25] introduced a novel endoscopic arthroplasty technique using a mini-open direct anterior approach. This method was compared with the bikini and traditional anterior incisions. The Endoscopic DAA (Endo-DAA) reduced wound-related complications, achieved more accurate acetabular component alignment, minimized postoperative pain at 24 hours, and improved early functional scores. It also demonstrated superior short-term outcomes in obese patients and a lower complication rate compared to both the bikini and conventional DAA approaches.

While the bikini incision yields clinical outcomes comparable to other approaches, the potential for LFCN injury could negatively impact patient satisfaction, counterbalancing its cosmetic advantages. Evaluating clinical outcomes should therefore always include an assessment of patient satisfaction.

A recent randomized controlled trial by Wang et al. [23]reported a higher incidence of LFCN dysesthesia in the bikini group compared to the traditional longitudinal incision but also noted high patient satisfaction rates and no significant differences in overall complication rates.

Few limitations should be considered: lack of RCT's that directly compare Longitudinal Incision and Bikini incision for DAA THA, high heterogeneity across studies in terms of design, outcome measures, and evaluation methods and the absence of long-term biomechanical studies.

CONCLUSION

This systematic review and meta-analysis revealed no significant differences in postoperative outcomes, patient-reported outcomes, or complication rates between the bikini and longitudinal incisions. Both techniques demonstrated comparable safety and efficacy, making them viable options for DAA THA. Future studies should focus on long-term outcomes, including chronic nerve dysfunction, implant longevity, and patient satisfaction, to establish strongest evidence for optimal incision selection in DAA THA.

Funding: The authors declare that no funds, grants, or other support were received during the preparation of this manuscript.

Competing interests: The authors declare that they have no financial or non-financial interests to disclose.

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