

# Systematic Review and Meta-Analysis of Laser Haemorrhoidectomy versus Conventional Surgical Haemorrhoidectomy in Management of II- and III-Degree Haemorrhoid

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**Introduction:** Hemorrhoidal disease (HD) is a widespread anorectal condition affecting millions of people around the world and representing a major medical and socioeconomic issue, severely influencing patients' quality of life. Laser hemorrhoidoplasty (LHP) is a new minimal invasive, safe and effective procedure for day-surgery treatment of symptomatic haemorrhoids.

**Aim of work:** This review seeks to establish, through the available literature that compare between laser haemorrhoidoplasty and conventional surgical haemorrhoidectomy in management of II- and III-degree haemorrhoid as regard to operative time, postoperative pain, clinical outcomes and complication.

**Patients and methods:** A systematic review of literature was conducted including all relevant randomized controlled trials and prospective comparative cohort studies on laser hemorrhoidoplasty versus conventional surgical haemorrhoidectomy in management of II- and III-degree haemorrhoid.

**Results:** Laser hemorrhoidoplasty in II-III degree haemorrhoids is a good, safe, and effective alternative to conventional hemorrhoidectomy, with a shorter operative time, reduced intraoperative bleeding, and less postoperative pain. The postoperative anal stenosis and urine retention are also reduced in the LH group. Our study didn't find statistically significant difference between both groups regarding acute thrombosis and recurrence rate.

**Conclusion:** Our findings suggest that laser hemorrhoidoplasty is a minimally invasive technique that can be safely applied in suitable grade II–III patients, offering lower postoperative pain rates up till the first postoperative month, fewer complications, and improved postoperative quality of life compared to conventional surgical hemorrhoidectomy, and therefore LHP seems to be superior in terms of patient satisfaction in the early postoperative period.

**Key words:** Laser Hemorrhoidectomy; conventional surgical hemorrhoidectomy; II- and III-degree hemorrhoid.

## Introduction

Hemorrhoidal disease (HD) is a widespread anorectal condition affecting millions of people around the world and representing a major medical and socioeconomic issue, severely influencing patients' quality of life. Hemorrhoids or hemorrhoidal columns are submucosal cushions containing venules, arterioles and smooth muscle fibers. They along with the internal anal sphincter are essential in the maintenance of continence by providing soft-tissue support and keeping the anal canal closed tightly.<sup>1</sup>

Their dilatation under the effect of multiple factors can generate symptoms dominated by rectal bleeding, anal discomfort, anus pruritus, or anal swelling. They become a concern in 4% of the patients and require medical or instrumental treatment, which have a suspensive effect on haemorrhoidal symptoms with high degree of recurrence.<sup>2</sup>

The treatment options for symptomatic haemorrhoids have varied over time. Measures have included conservative medical management, non-surgical treatments and various surgical techniques. The various non-surgical treatments include rubber band ligation (RBL), injection sclerotherapy, cryotherapy and infrared coagulation: all of which

may be performed as outpatient procedures without anaesthesia. These nonsurgical methods are considered to be the primary option for grades one to three (grade I-III) haemorrhoids. The indications for the surgical treatment include the presence of asignificant external component, hypertrophied papillae, associated fissure, extensive thrombosis or recurrence of symptoms after repeated RBL. The technique employed may be open (Milligan–Morgan) or closed (Ferguson) and the instruments used are scalpel, scissor, electrocautery or laser.<sup>3</sup>

Management depends on patient factors and grading; surgery is usually indicated after failure of conservative measures or higher grades (III and IV), classified by grading scales such as the Banov, Goligher, or BPRST classification. Conventional open haemorrhoidectomy (CoH), initially described by Milligan-Morgan (MM), is still regarded by literature in the modern era as the current gold standard surgical treatment.<sup>4</sup>

However, postoperative pain, hemorrhage, urinary retention, and abscess formation are the most common side effects associated with MM. The long-term complications include stool incontinence, fistula formation, and stenosis.<sup>5</sup>

Therefore, for the fear of postoperative pain and

complications, mildly symptomatic patients often hesitate and delay undergoing to surgical treatment for this benign disease. Laser hemorrhoidoplasty (LHP) is a new minimal invasive and painless procedure for day-surgery treatment of symptomatic hemorrhoids determining the shrinkage of the hemorrhoidal piles by mean of a diode laser.<sup>1</sup>

Intrahemorrhoidal laser coagulation or laser hemorrhoidoplasty (LHP) was first described in 2009, and reported in larger series of patients in 2010. A few case series, including our own experience, as well as the experience of Weyand suggested this method to be a technically simple, minimally invasive, safe, and effective procedure for symptomatic haemorrhoids.<sup>6</sup>

### **Aim of work**

This review seeks to establish, through the available literature that compare between laser haemorrhoidoplasty and conventional surgical haemorrhoidectomy in management of II- and III-degree haemorrhoid as regard to operative time, postoperative pain, clinical outcomes and complication.

### **Patients and methods**

#### **Search strategy**

A systematic review of literature was conducted including all relevant randomized controlled trials (RCTs) and prospective comparative cohort studies (CCSs) on laser haemorrhoidectomy versus conventional surgical haemorrhoidectomy in management of II- and III-degree haemorrhoid in accordance with the PRISMA guidelines. Articles published in MEDLINE/Pubmed, Embase, and Cochrane Central Register of Controlled Trials in the Cochrane Library were searched until 2022 using the medical subject headings (MeSH) terms "open haemorrhoidectomy"; "laser haemorrhoidectomy", "closed haemorrhoidectomy", "Milligan–Morgan haemorrhoidectomy"; "surgical haemorrhoidectomy" "conventional haemorrhoidectomy" Boolean operators (AND, OR, NOT) were appropriately utilized to narrow and widen the search results. Search was limited only to human studies and to articles published in English.

#### **Inclusion and exclusion criteria**

The published titles from the resultant search were tested closely and their suitability was determined for potential inclusion into this study. The references from selected published articles were also checked as a further search tool to find additional studies. For inclusion in the meta-analysis, a study had to meet the following criteria: randomized, controlled trial, prospective comparative cohort studies, comparison between CH and LHP, evaluation of post-operative

pain, trials in surgical patients who had undergone procedure for second degree and third-degree haemorrhoids, the last search year were 2022.

#### **Exclusion criteria**

Studies that described emergency procedures for painful or thrombosed hemorrhoids, concurrent anorectal diseases (fissures, fistulas, abscesses), combined treatment modalities with laser were excluded to minimize bias, case reports, eligible studies were then finalized by consensus between two investigators.

Initial screening for eligibility was performed by two investigators based on the titles, abstracts and keywords of citations from electronic databases. Thereafter, full texts of all relevant records were assessed based on the inclusion criteria.

#### **Outcomes of interest**

Data from individual studies were tabulated, including study design, name of author, clinical parameters of patients, HD grade according to the Banov grading scale and procedural details. The characteristics of included studies. The primary and secondary outcomes of this study were defined based on the repeatedly reported disadvantages of postoperative pain and complications and the advantage of low disease recurrence associated with CoH, to objectively assess and compare LHP against it. The primary outcome assessed was postoperative pain, measured with the visual analogue scale (VAS) on days 1, 7 and 1 month after surgery, as all included studies reported according to this timeline to provide common timepoints of comparison. Secondary outcomes included intraoperative characteristics, postoperative outcome and complications. Postoperative complications included acute urinary retention (ARU), significant postoperative bleeding, recurrence, thrombosis and anal stenosis. Recurrence was defined as recurrent internal or prolapsed haemorrhoids at the studies' maximum follow-up period.

#### **Data extraction and synthesis**

Relevant studies were identified by two authors through title and abstract screening. Further selection was based on full text. Any discrepancy was resolved by the senior author after discussion. Aforementioned data parameters were collected independently through a predetermined standardized data extraction form.

#### **Risk of methodological bias assessment**

Quality assessment of included studies was done using the modified New Castle-Ottawa (NCO) Quality Scale for cross sectional studies (Modesti et al., 2016).

## Statistical analysis

Statistical analysis was done using the Comprehensive Meta-Analysis© version 3.3 (Borenstein M, Hedges L, Higgins J, & Rothstein H. Biostat, Englewood, NJ 2022). Studies scored 8 to 9 out of 10 points on the modified NCO Quality Scale were considered at low risk of methodological bias. Studies scored 6 to 7 were considered at medium risk, while those scored 5 or less were considered at high risk of bias (Dreier et al., 2014).

## Meta-analysis

Quality assessment of included studies was done using the modified New Castle-Ottawa Quality Scale

## Assessment of heterogeneity

Studies included in meta-analysis were tested for heterogeneity of the estimates using the following tests: Cochran Q chi square test: A statistically significant test (P-value <0.1) denoted heterogeneity among the studies, I-square (I<sup>2</sup>) index which is interpreted as follows: I<sup>2</sup> = 0% to 40%: unimportant heterogeneity, I<sup>2</sup> = 30% to 60%: moderate heterogeneity, I<sup>2</sup> = 50% to 90%: substantial heterogeneity, I<sup>2</sup> = 75% to 100%: considerable heterogeneity.

## Assessment of publication bias

Publication bias was assessed by examination of funnel plots of the estimated effect size on the horizontal axis versus a measure of study size (standard error for the effect size) on the vertical axis, Begg's rank correlation test, Egger's regression test.

## Pooling of estimates

Binary outcomes are expressed as proportions 95% confidence intervals (95% CI). Estimates from included studies were pooled using the DerSimonian-Laird random-effects model (REM).

## Input results

Continuous data were pooled as mean difference (MD) and 95% confidence interval, while dichotomous outcomes were pooled as odds ratio (OR) and 95% confidence interval.

## Results

The initial search revealed a total of 157 studies, of which 60 were duplicates and 97 were original studies. Non relevant articles were excluded based on title and abstract screening, resulting in 20 studies. After examination by full text, 11 studies were excluded, leaving 9 studies (**Fig. 1**), of which 3 were RCTs with 301 total patients, and 6 studies were comparative cohort study, with 1355 total patients. Sample sizes for individual studies ranged from 25 to 1000 patients (**Table 1**).

## Meta-analysis

Nine studies were included in the present meta-analysis that involved total of 1656 patients. There were three studies at medium risk of methodological bias (**Table 2**), whereas the other six trials were at low risk of bias (**Table 2**). Details of Quality assessment of included studies using the modified New Castle-Ottawa Quality tools are shown in Table 2.

Articles are categorized as low ROB with an allocation of 8 to 9/10 stars, medium ROB with 6 to 7 stars and high ROB with 5 or less stars allocated. The full quality assessment can be obtained from the authors on request.

## Meta-analysis for operative time "min"

Seven studies provided data on Std. mean difference of operative time with a total of 550 patients (**Fig. 2**)

There was a statistically significant heterogeneity [I<sup>2</sup>=83.6% and Cochran Q p-value <0.001]. Pooled operative time was Std. Diff. in means (-2.164; 95% C.I, -2.715 to -1.613; z=7.704; p<0.001), there was a statistically significant difference between both groups regarding operative time (**Fig. 2**).

There is no evidence of publication bias. Begg's test p=0.602, Egger's test p=0.391. Under the random effects model the point estimate and 95% confidence interval for the combined studies is (-2.164; 95% C.I, -2.715 to -1.613). Using Trim and Fill these values are unchanged.

Seven included trials contributed to the combined calculation of this variable as shown in (**Fig. 3**). There was a statistically significant heterogeneity [Tau<sup>2</sup>=0.435, Chi<sup>2</sup>=36.567, df=6, p-value <0.001; I<sup>2</sup>=83.6%] among trials, in the random effects model the Pooled operative time was Std. Diff. in means (-2.164; 95% C.I, -2.715 to -1.613; z=7.704; p<0.001), there was a statistically significant lower mean of pooled operative time in LH group than CH group, and the results were different in both groups.

## Primary outcome [VAS score for pain among population of the study]

### Meta-analysis for VAS score for pain at day 1

Eight studies provided data on Std. mean difference of VAS score for Pain at day 1 with a total of 1550 patients (**Fig. 4**).

There was a statistically significant heterogeneity [I<sup>2</sup>=95.6% and Cochran Q p-value <0.001]. Pooled VAS score at day 1 was Std. Diff. in means (-2.538; 95% C.I, -3.361 to -1.715; z=6.044; p<0.001), there was a statistically significant difference between both groups regarding VAS score at

day 1 (**Fig. 4**).

There is no evidence of publication bias. Begg's test  $p=0.711$ , Egger's test  $p=0.449$ . Under the random effects model the point estimate and 95% confidence interval for the combined studies is (-2.538; 95% C.I, -3.361 to -1.715). Using Trim and Fill these values are unchanged.

Eight included trials contributed to the combined calculation of this variable as shown in (**Fig. 5**). There was a statistically significant heterogeneity [ $\text{Tau}^2=1.275$ ,  $\text{Chi}^2=160.356$ ,  $\text{df}=7$ ,  $p\text{-value}<0.001$ ;  $I^2=95.6\%$ ] among trials, in the random effects model the Pooled VAS score at day 1 was Std. Diff. in means (-2.538; 95% C.I, -3.361 to -1.715;  $z=6.044$ ;  $p<0.001$ ), there was a statistically significant lower mean pooled of VAS score for pain at day 1 in LH group than CH group, and the results were different in both groups. Meta-analysis for VAS score for Pain at day 7

Three studies provided data on Std. mean difference of VAS score for Pain at day 7 with a total of 150 patients (**Fig. 6**)

There was a statistically significant heterogeneity [ $I^2=83.2\%$  and Cochran Q  $p\text{-value}=0.003$ ]. Pooled VAS score at day 7 was Std. Diff. in means (-4.723; 95% C.I, -6.298 to -3.149;  $z=5.879$ ;  $p<0.001$ ), there was a statistically significant difference between both groups regarding VAS score at day 7 (**Fig. 6**).

There is no evidence of publication bias. Begg's test  $p=0.601$ , Egger's test  $p=0.948$ . Under the random effects model the point estimate and 95% confidence interval for the combined studies is (-4.723; 95% C.I, -6.298 to -3.149). Using Trim and Fill these values are unchanged.

Three included trials contributed to the combined calculation of this variable as shown in (**Fig. 7**). There was a statistically significant heterogeneity [ $\text{Tau}^2=1.602$ ,  $\text{Chi}^2=11.882$ ,  $\text{df}=2$ ,  $p\text{-value}=0.003$ ;  $I^2=83.2\%$ ] among trials, in the random effects model the Pooled VAS score at day 7 was Std. Diff. in means (-4.723; 95% C.I, -6.298 to -3.149;  $z=5.879$ ;  $p<0.001$ ), there was a statistically significant difference lower mean pooled of VAS score for pain at day 7, and the results were different in both groups.

#### **Meta-analysis for VAS score for pain at 1 month**

Five studies provided data on Std. mean difference of VAS score for Pain at 1 month with a total of 375 (**Fig. 8**)

There was a statistically significant heterogeneity [ $I^2=91.5\%$  and Cochran Q  $p\text{-value}<0.001$ ]. Pooled

VAS score at 1 month was Std. Diff. in means (-2.215; 95% C.I, -3.235 to -1.195;  $z=4.257$ ;  $p<0.001$ ), there was a statistically significant difference between both groups regarding VAS score at 1 month (**Fig. 8**).

There is no evidence of publication bias. Begg's test  $p=0.142$ , Egger's test  $p=0.062$ . Under the random effects model the point estimate and 95% confidence interval for the combined studies is -2.215; 95% C.I, -3.235 to -1.195). Using Trim and Fill these values are unchanged.

Four included trials contributed to the combined calculation of this variable as shown in (**Fig. 9**). There was a statistically significant heterogeneity [ $\text{Tau}^2=1.223$ ,  $\text{Chi}^2=46.987$ ,  $\text{df}=4$ ,  $p\text{-value}<0.001$ ;  $I^2=91.5\%$ ] among trials, in the random effects model the Pooled VAS score at 1 month was Std. Diff. in means (-2.215; 95% C.I, -3.235 to -1.195;  $z=4.257$ ;  $p<0.001$ ), there was a statistically significant lower mean pooled of VAS score for pain at 1 month, and the results were different in both groups.

#### **Secondary outcomes (Complications)**

##### **Meta-analysis for bleeding**

Eight studies provided data on Std. mean difference of bleeding with a total of 1550 patients (**Fig. 10**)

There was a statistically significant heterogeneity [ $I^2=88.8\%$  and Cochran Q  $p\text{-value}<0.001$ ]. Pooled bleeding was (RR, 0.415; 95% C.I, 0.206 to 0.838;  $z=2.452$ ;  $p=0.014$ ), there was a statistically significant difference between both groups regarding bleeding (**Fig. 10**).

There is no evidence of publication bias. Begg's test  $p=0.805$ , Egger's test  $p=0.080$ . Under the random effects model the point estimate and 95% confidence interval for the combined studies is (0.415; 95% C.I, 0.206 to 0.838). Using Trim and Fill these values are unchanged.

Eight included trials contributed to the combined calculation of this variable as shown in (**Fig. 11**). There was a statistically significant heterogeneity [ $\text{Tau}^2=0.672$ ,  $\text{Chi}^2=62.511$ ,  $\text{df}=7$ ,  $p\text{-value}<0.001$ ;  $I^2=88.8\%$ ] among trials, in the random effects model the Pooled bleeding was (RR, 0.415; 95% C.I, 0.206 to 0.838;  $z=2.452$ ;  $p=0.014$ ), there was a statistically significant higher pooled frequency of bleeding in CH group than LH group, and the results were different in both groups.

##### **Meta-analysis for acute thrombosis**

Two studies provided data on Std. mean difference of Acute Thrombosis with a total of 120 patients (**Fig. 12**)

There is no statistically significant heterogeneity [ $I^2=0\%$  and Cochran Q p-value = 0.875]. Pooled acute thrombosis was (RR, 5.941; 95% C.I, 0.734 to 48.093;  $z=1.670$ ;  $p=0.095$ ), there is no statistically significant difference between both groups regarding Acute Thrombosis (**Fig. 12**).

There is no funnel plot for acute thrombosis. There must be at least three papers to run publication bias procedures.

Two included trials contributed to the combined calculation of this variable as shown in (**Fig. 13**). There is no statistically significant heterogeneity [ $Tau^2=0.000$ ,  $Chi^2=0.025$ ,  $df=1$ ,  $p\text{-value}=0.875$ ;  $I^2=0.0\%$ ] among trials, in the random effects model the Pooled acute thrombosis was (RR, 5.941; 95% C.I, 0.734 to 48.093;  $z=1.670$ ;  $p=0.095$ ), there is no statistically significant difference between both groups regarding Acute Thrombosis, and the results were no different in both groups.

#### Meta-analysis for anal stenosis

Two studies provided data on Std. mean difference of Anal Stenosis with a total of 1140 patients (**Fig. 13**).

There is no statistically significant heterogeneity [ $I^2=0\%$  and Cochran Q p-value= 0.448]. Pooled anal stenosis was (RR, 0.067; 95% C.I, 0.013 to 0.356;  $z=3.172$ ;  $p=0.002$ ), there was a statistically significant difference between both groups regarding anal stenosis (Figure 13).

There is no evidence of publication bias. Begg's test  $p=0.117$ , Egger's test  $p=0.255$ . Under the random effects model the point estimate and 95% confidence interval for the combined studies is (0.067; 95% C.I, 0.013 to 0.356). Using Trim and Fill these values are unchanged.

Four included trials contributed to the combined calculation of this variable as shown in **Fig. 16**. There was a statistically significant heterogeneity [ $Tau^2=7.130$ ,  $Chi^2=14.262$ ,  $df=3$ ,  $p\text{-value}=0.003$ ;  $I^2=79\%$ ] among trials, in the random effects model the Pooled recurrence was (RR, 0.629; 95% C.I, 0.033 to 12.083;  $z=0.307$ ;  $p=0.759$ ), there is no statistically significant difference between both groups regarding recurrence, and the results no different in both groups.

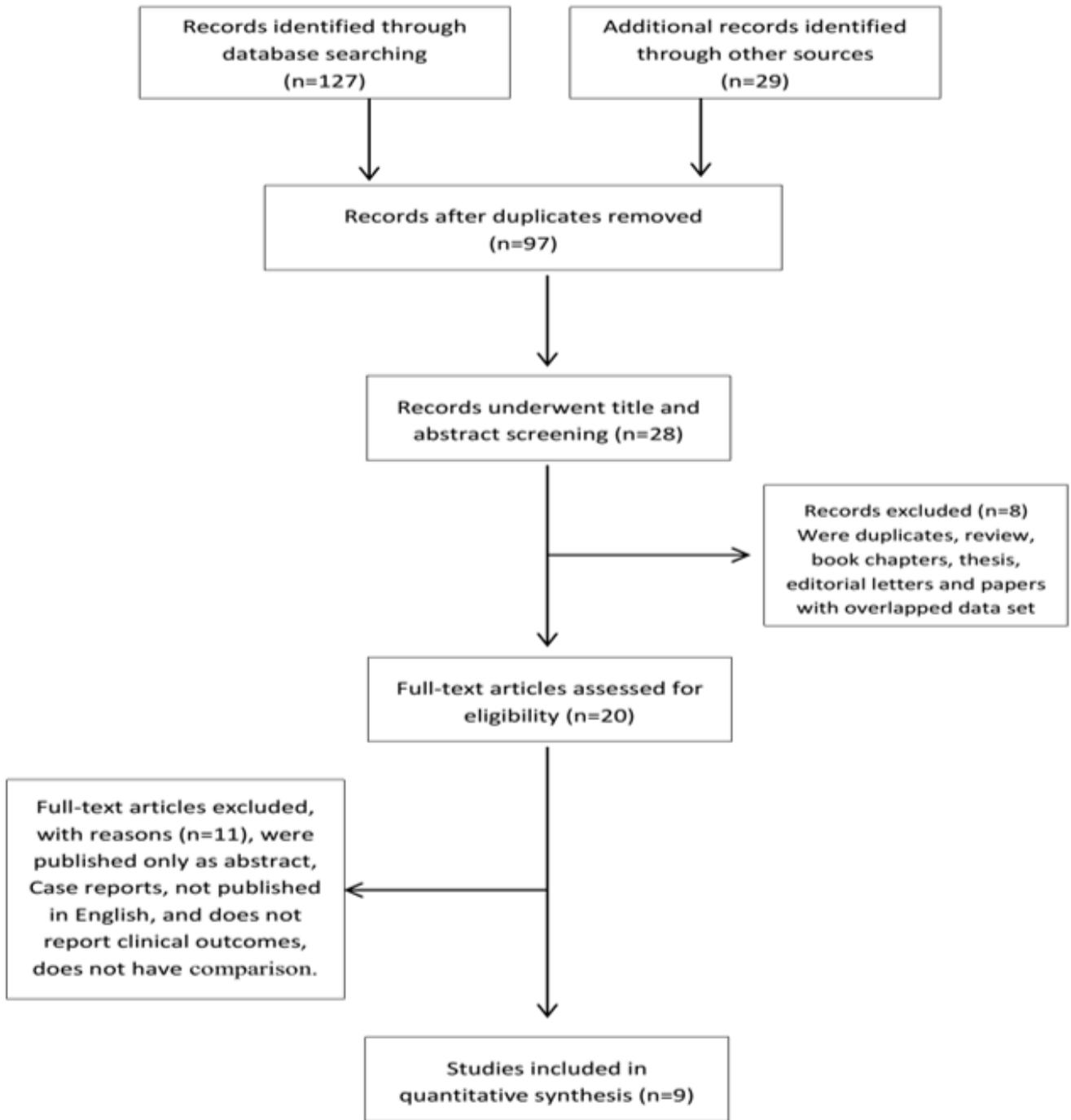
#### Meta-analysis for urinary retention

Four studies provided data on Std. mean difference of urinary retention with a total of 1200 patients (**Fig. 17**)

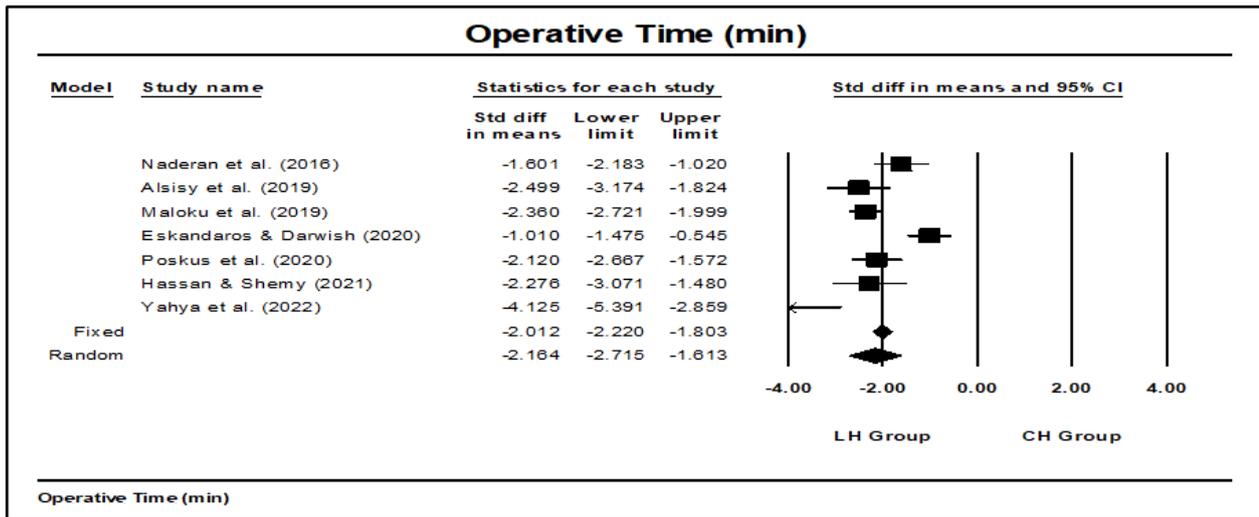
There is no statistically significant heterogeneity [ $I^2=0\%$  and Cochran Q p-value= 0.854]. Pooled urinary retention was (OR, 0.142; 95% C.I, 0.036 to 0.559;  $z=2.792$ ;  $p=0.005$ ), there was a statistically significant difference between both groups regarding urinary retention (**Fig. 17**).

There is no evidence of publication bias. Begg's test  $p=1.000$ , Egger's test  $p=0.140$ . Under the random effects model the point estimate and 95% confidence interval for the combined studies is (0.142; 95% C.I, 0.036 to 0.559). Using Trim and Fill these values are unchanged.

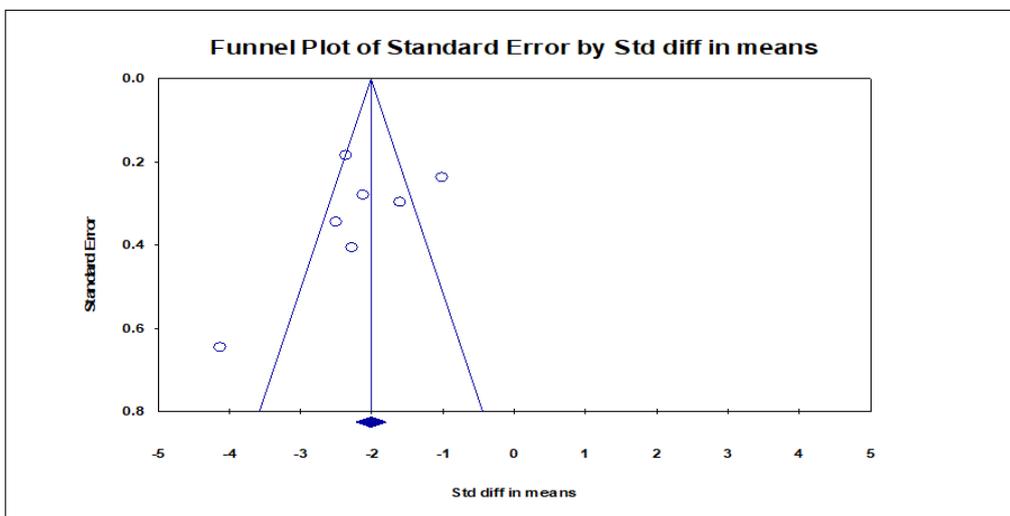
Four included trials contributed to the combined calculation of this variable as shown in (**Fig. 18**). There is no statistically significant heterogeneity [ $Tau^2=0.000$ ,  $Chi^2=0.780$ ,  $df=3$ ,  $p\text{-value}=0.854$ ;  $I^2=0.0\%$ ] among trials, in the random effects model the Pooled urinary retention was (OR, 0.142; 95% C.I, 0.036 to 0.559;  $z=2.792$ ;  $p=0.005$ ), there was a statistically significant lower pooled frequency of urinary retention in LH group than CH group, and the results were different in both groups.



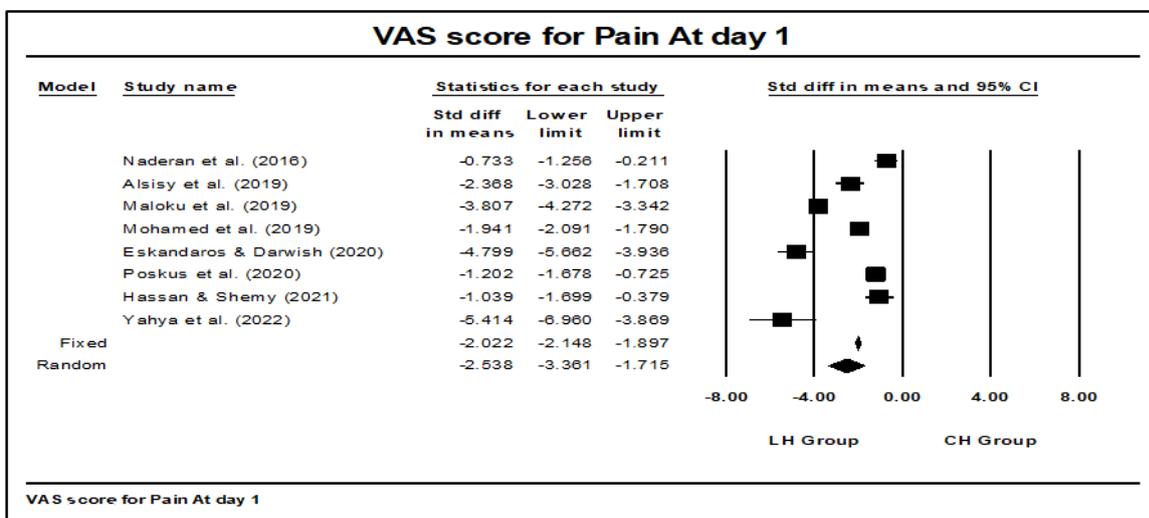
**Fig 1: PRISMA flow diagram showing process of studies selection.**



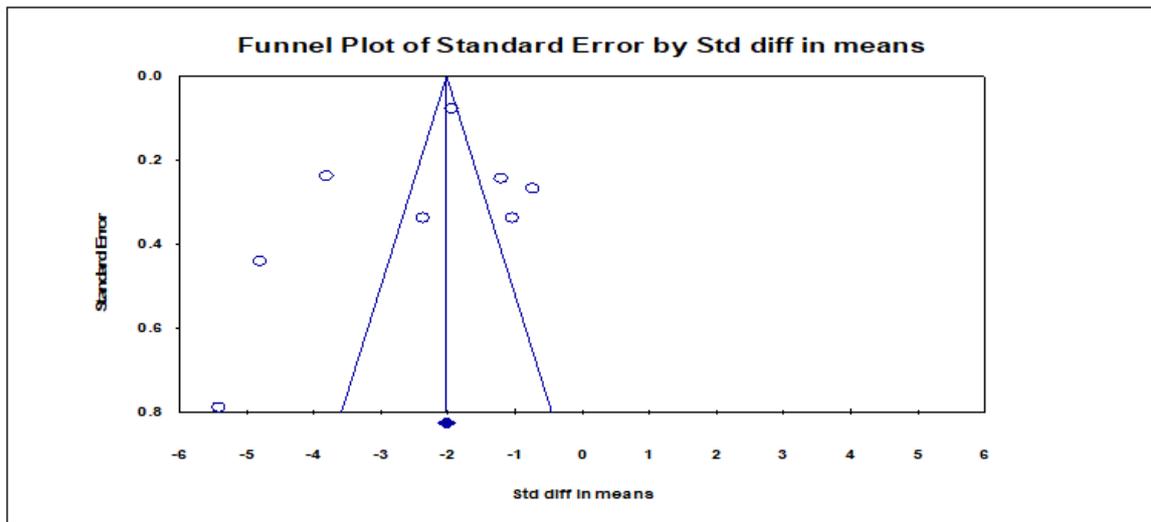
**Fig 2:** Forest plot for operative time "min" following LH group versus CH Group. Std. Difference in means is shown with 95% confidence interval.



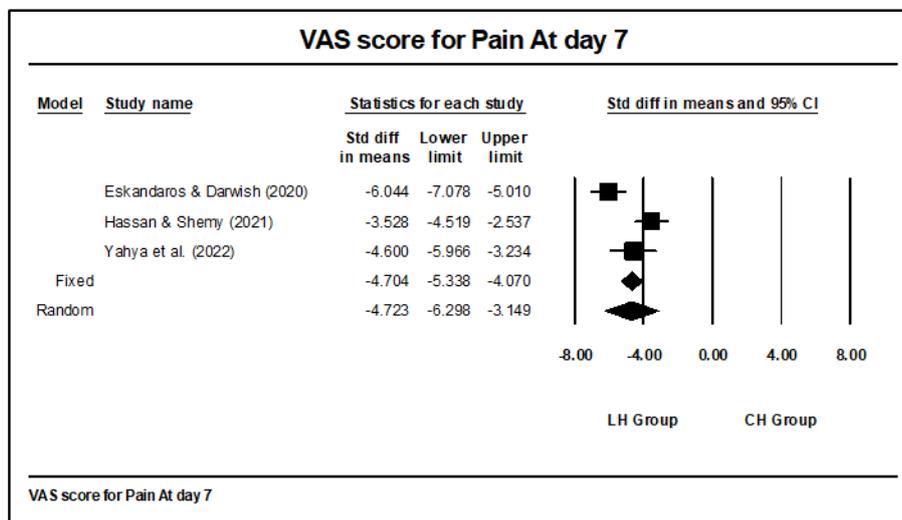
**Fig 3:** Funnel plot for operative time "min". There is no evidence of publication bias. Begg's test  $p=0.602$ , Egger's test  $p=0.391$ . Under the random effects model the point estimate and 95% confidence interval for the combined studies is (-2.164; 95% C.I, -2.715 to -1.613). Using Trim and Fill these values are unchanged.



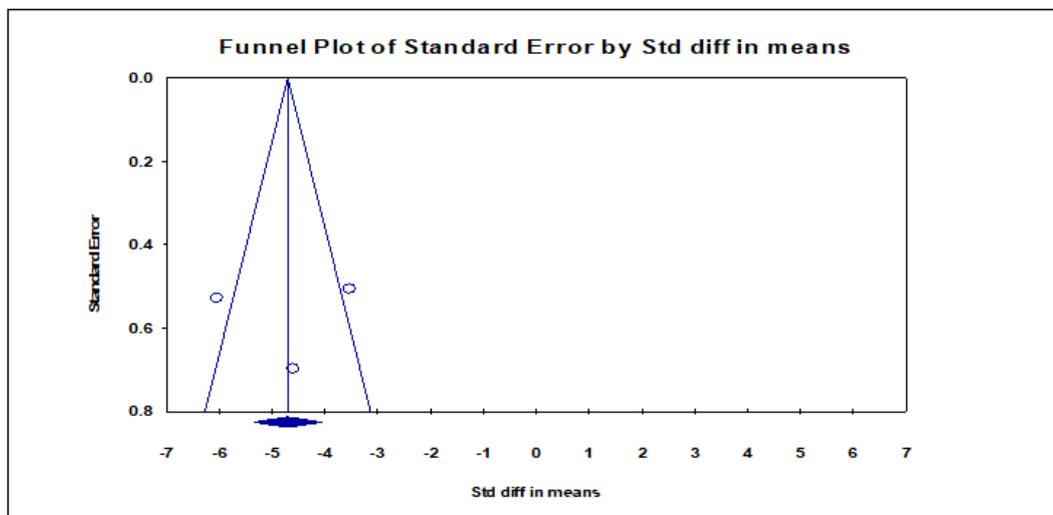
**Fig 4:** Forest plot for VAS score at day 1 following LH group versus CH Group. Std. Difference in means is shown with 95% confidence interval.



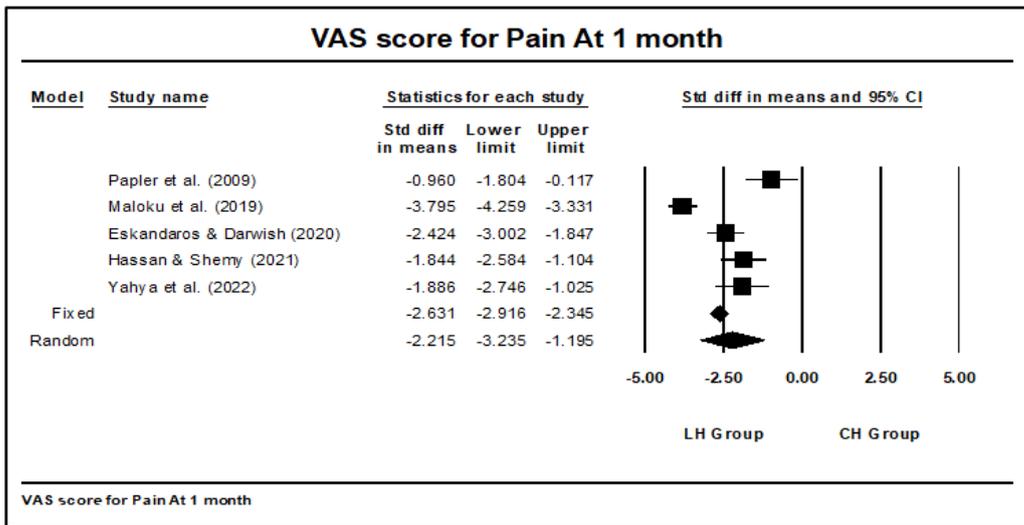
**Fig 5:** Funnel plot for VAS score at day 1. There is no evidence of publication bias. Begg's test  $p=0.711$ , Egger's test  $p=0.449$ . Under the random effects model the point estimate and 95% confidence interval for the combined studies is (-2.538; 95% C.I, -3.361 to -1.715). Using Trim and Fill these values are unchanged.



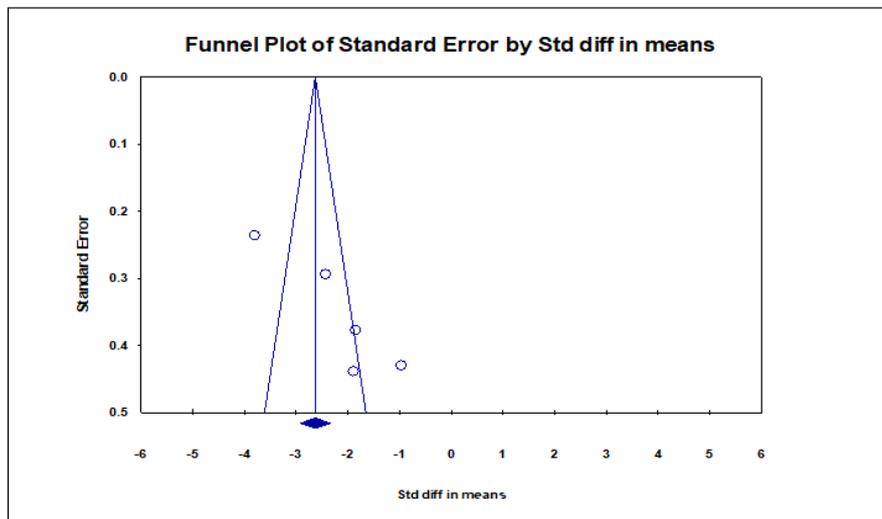
**Fig 6:** Forest plot for VAS score at day 7 following LH group versus CH Group. Std. Difference in means is shown with 95% confidence interval.



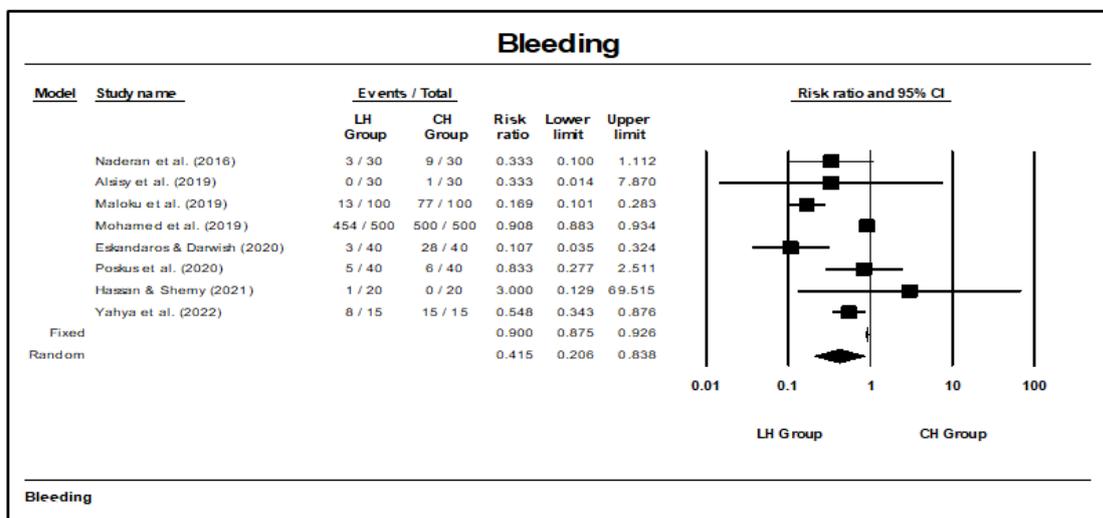
**Fig 7:** Funnel plot for VAS score at day 7. There is no evidence of publication bias. Begg's test  $p=0.601$ , Egger's test  $p=0.948$ . Under the random effects model the point estimate and 95% confidence interval for the combined studies is (-4.723; 95% C.I, -6.298 to -3.149). Using Trim and Fill these values are unchanged.



**Fig 8: Forest plot for VAS score at 1 month following LH group versus CH Group. Std. Difference in means is shown with 95% confidence interval.**



**Fig 9: Funnel plot for VAS score at 1 month. There is no evidence of publication bias. Begg's test  $p=0.142$ , Egger's test  $p=0.062$ . Under the random effects model the point estimate and 95% confidence interval for the combined studies is (-2.215; 95% C.I, -3.235 to -1.195). Using Trim and Fill these values are unchanged.**



**Fig 10: Forest plot for Bleeding following LH group versus CH Group. Risk ratios are shown with 95% confidence interval.**

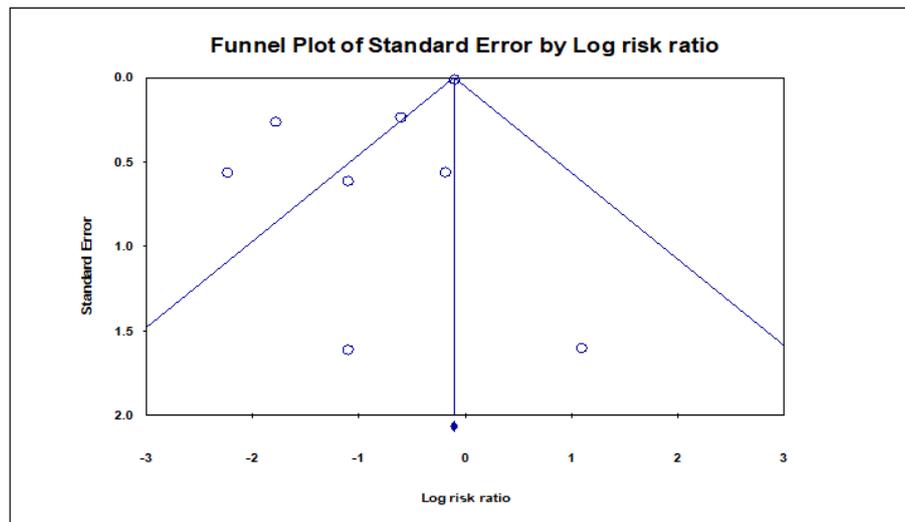


Fig 11: Funnel plot for bleeding. There is no evidence of publication bias. Begg's test  $p=0.805$ , Egger's test  $p=0.080$ . Under the random effects model the point estimate and 95% confidence interval for the combined studies is (0.415; 95% C.I, 0.206 to 0.838). Using Trim and Fill these values are unchanged.

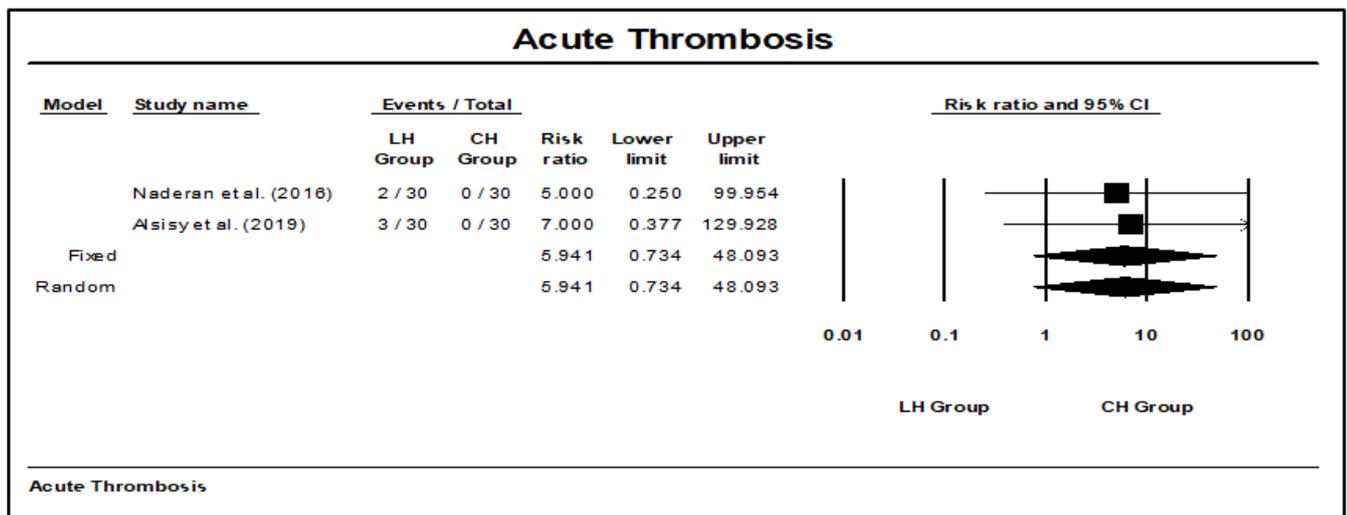


Fig 12: Forest plot for acute thrombosis following LH group versus CH Group. Risk ratios are shown with 95% confidence interval.

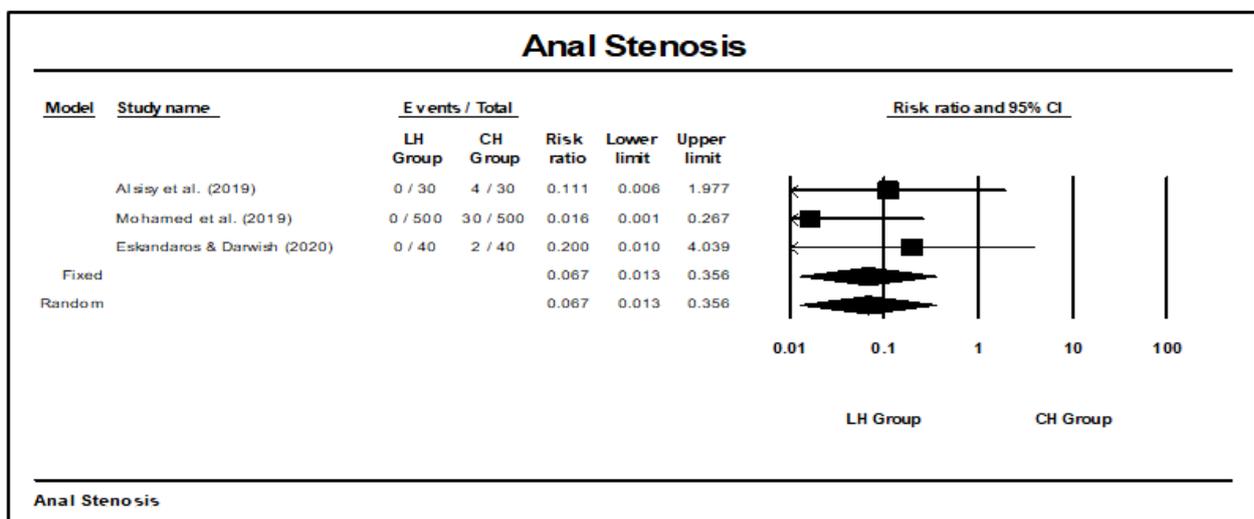
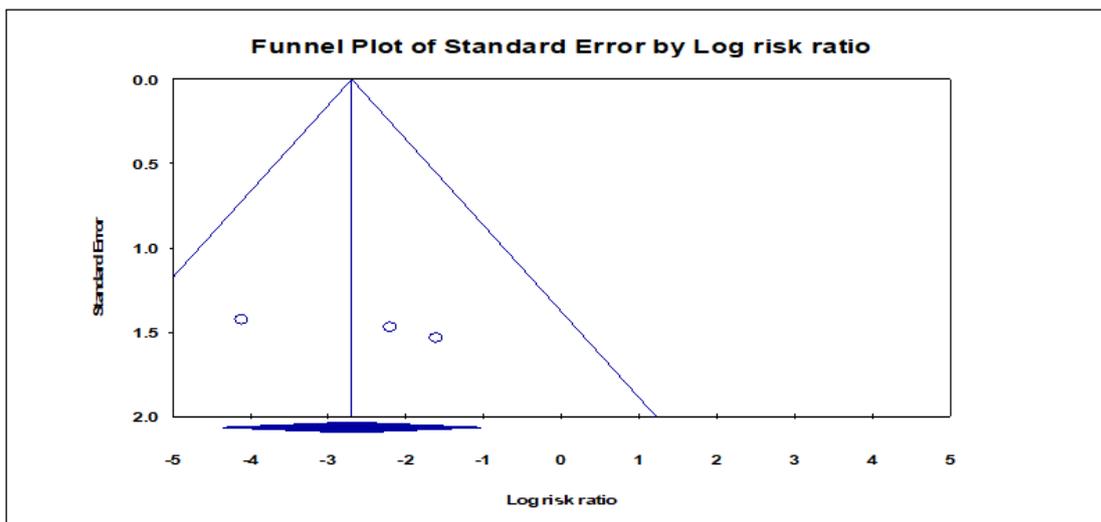
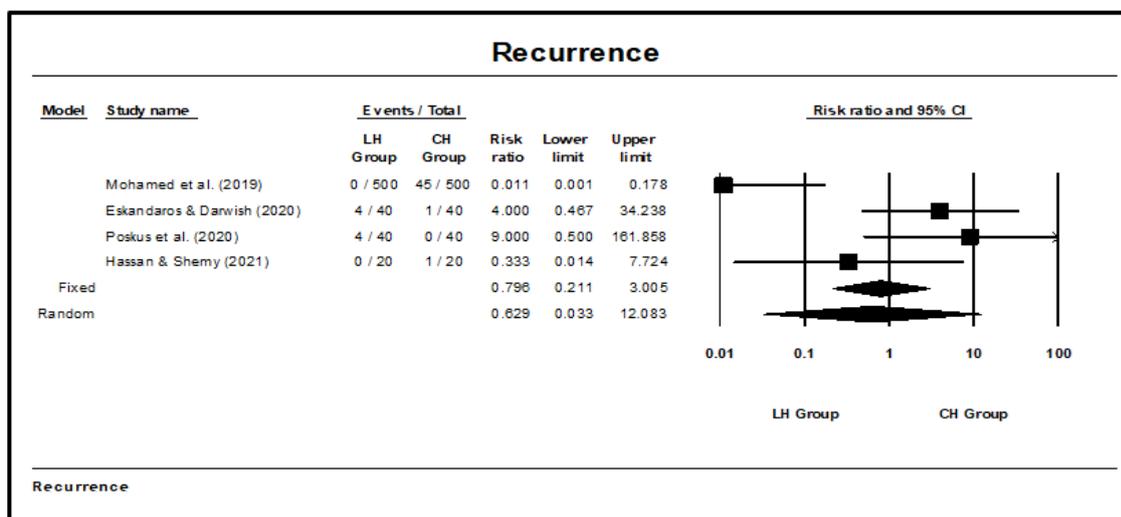


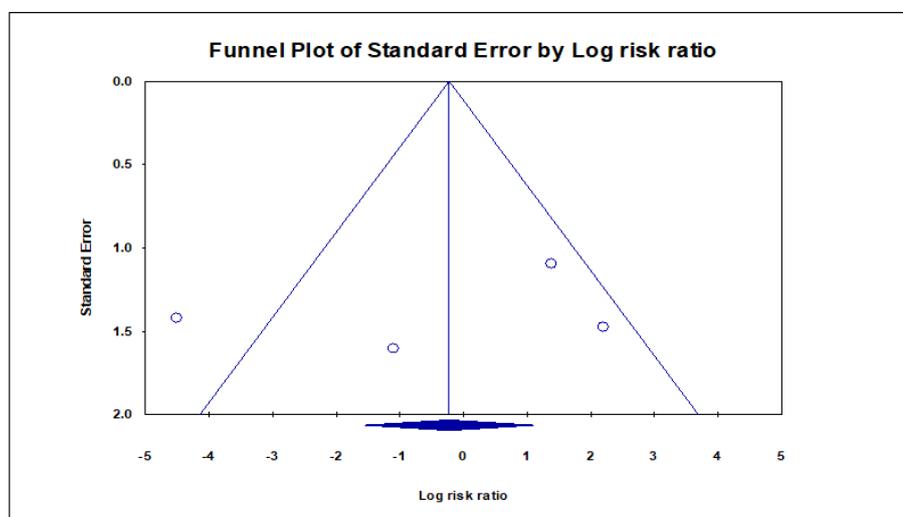
Fig 13: Forest plot for anal stenosis following LH group versus CH Group. Risk ratios are shown with 95% confidence interval.



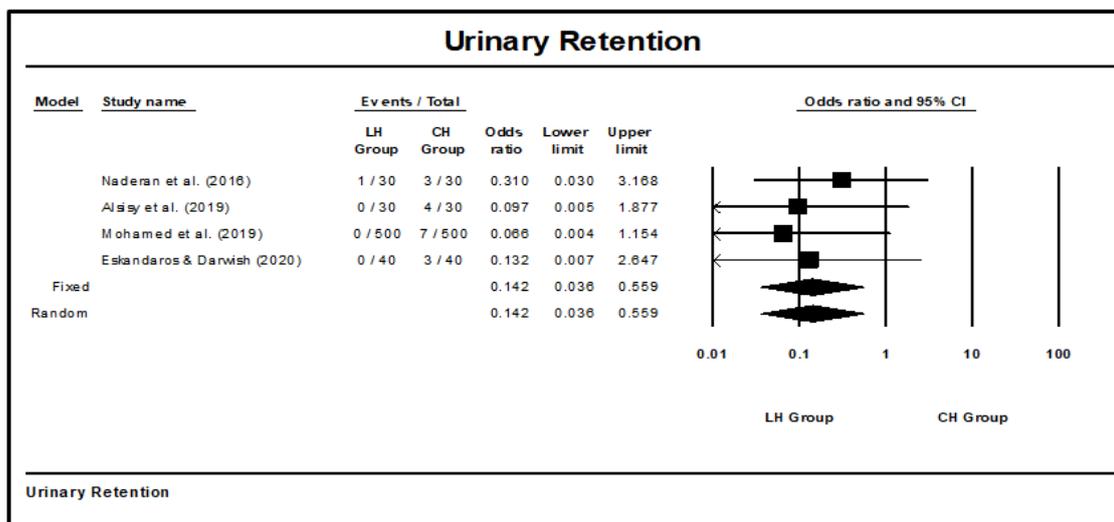
**Fig 14: Funnel plot for Anal Stenosis. There is no evidence of publication bias. Begg’s test  $p=0.117$ , Egger’s test  $p=0.255$ . Under the random effects model the point estimate and 95% confidence interval for the combined studies is (0.067; 95% C.I, 0.013 to 0.356). Using Trim and Fill these values are unchanged.**



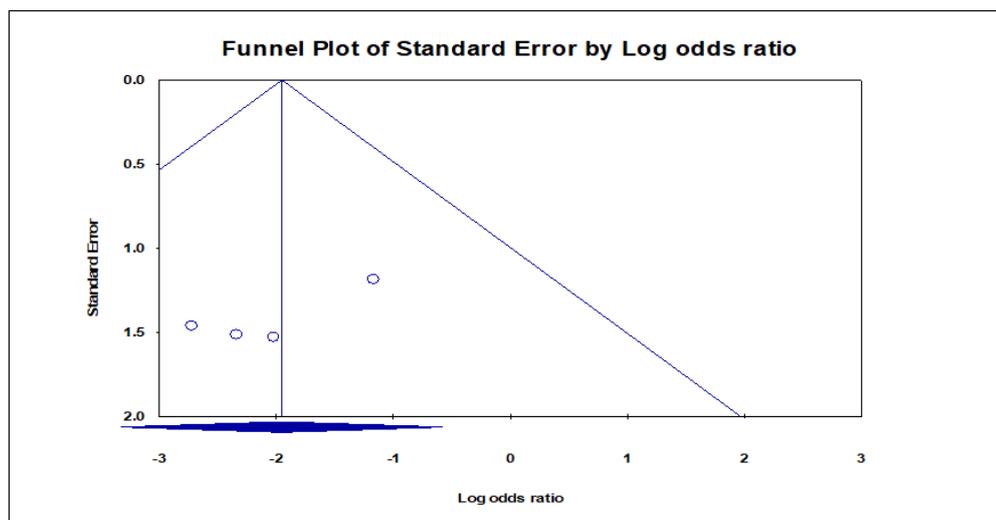
**Fig 15: Forest plot for recurrence following LH group versus CH Group. Risk ratios are shown with 95% confidence interval.**



**Fig 16: Funnel plot for recurrence. There is no evidence of publication bias. Begg’s test  $p=0.497$ , Egger’s test  $p=0.608$ . Under the random effects model the point estimate and 95% confidence interval for the combined studies is (0.629; 95% C.I, 0.033 to 12.083). Using Trim and Fill these values are unchanged.**



**Fig 17: Forest plot for urinary retention following LH group versus CH Group. Odds ratios are shown with 95% confidence interval.**



**Fig 18: Funnel plot for urinary retention. There is no evidence of publication bias. Begg's test  $p=1.000$ , Egger's test  $p=0.140$ . Under the random effects model the point estimate and 95% confidence interval for the combined studies is (0.142; 95% C.I, 0.036 to 0.559). Using Trim and Fill these values are unchanged.**

**Table 1: Summary of findings of studies included in the systematic review**

N	Study	Year	study duration	study type	No. of patient		Age(yr)	male Sex		female sex		Grade	operative time		duration of follow up	primary outcome		secondary outcomes		type of laser				
					LH	CH		LH	CH	LH	CH		LH	CH		LH	CH	LH	CH					
1	Hassan AM, Sherry GS.	2021	2019-2020	CCS	40	20	20	47±12.6	49±12.3	12	11	8	9	III	III	15.90±3.5	26.80±5.8	2-6m	day 1 (0-1.5 (2-5)15 (<5)0)	(0-1)0 (2-5)18 (>5)2	bleeding	1	0	1470nm diode laser
																			day 7 (0-10)9 (2-5)1 (<5)0	recurrence 6m	0	1		
																			1m (0-1)20	stricture	0	1		
																			(0-1)18 (2-5)2	oedema	1	3		
																			1m (0-1)20	abscess	1	0		
2	Makouh H et al.	2019	2014-2015	CCS	200	100	100	47±12.6	49±12.3	57	64	43	36	III	III	15.94±3.9 (10-20)m	27.24±6.5 (12-36)m	2m	day 1 (2.2±0.3)	4.5±0.8	scale bleeding day 1	13%	7%	980±30nm diode laser
																			1m (0-1)20	scale bleeding day 7	10%	33%		
3	Yahya WM et al.	2022	2020-2021	CCS	30	15	15	35.73±8.39	36.03±7.32	11	10	4	5	II(4)-III (11)	II(5)-III (10)	14.60±3.13	29.53±4.05	6m	day 1 (5.53 ±0.79 (4-3) 21)	9.53±0.51	bleeding 1w	8	15	980nm diode laser
																			day 7 (3.66±0.72 (1-3) 11)	bleeding 2w	0	7		
																			1m (0.04±0.0)	urine retention d1	0	4		
4	Alsayy AA et al.	2019	2016-2017	CCS	60	30	30	34.73±10.17	33.67±10.22	18	15	12	15	II (13)-III (17)	II (17)-III (13)	30.63±4.90	50.50±10.12	3m	day 1 mild (4-3) 21	4	bleeding day 1	0	1	980nm diode laser
																			Moderate (4-5) 6	urine retention d1	0	4		
																			sever (>10) 3	acute thrombosis	3	0		
																			anal discharge	anal discharge	0	3		
																			anal stenosis	anal stenosis	0	4		
5	Papier H et al.	2009	2007	CCS	25	15	10	na	25-45	na	na	na	na	na	na	na	na	1m	average 284 (0.94±1.13)	1.78±0.68	scars	4	0	810nm diode laser
																			skin tag	skin tag	5	0		
6	Pedaki T et al.	2020	2016-2017	RCT	121	40	40	47±13	45±12	27	21	13	19	II(0)-III (30)	II(7)-III (33)	15(0-20)	29(20-38)	12m	mean post-operative (3.1)	5	recurrence 1y	4	0	1470nm diode
																			bleeding	bleeding	5	6		
																			prolapse	prolapse	6	2		
7	Eshardous MS, Damsi JA	2020	2017-2019	RCT	120	40	40	40.8±8.8	41.3±8.8	27	29	13	11	III	III	22.8±3.9	27.5±5.3	12m	day 7 (0.8±0.5)	6.9±1.1	bleeding 1m	3	27	1470nm diode
																			bleeding 1m	bleeding 1m	0	1		
																			1m (0)	urine retention	0	3		
																			recurrence 1y	recurrence 1y	4	1		
																			anal stenosis 1y	anal stenosis 1y	0	2		
8	Mohamed M et al.	2019	2014-2018	CCS	1000	500	500	na	na	350	388	150	132	II-III	II-III	na	na	3y	day 1 mild (96.5%)	60.80%	bleeding day 1 mild	89.80%	97.60%	980nm diode laser
																			day 1 moderate severe (1.4%)	39.20%	bleeding day 1 mod to s	1%	2.40%	
																			day 7 (na)	na	infection mild	25.20%	37.40%	
																				moderate	1.60%	14.60%		
																				sever	1%	3%		
																				fistula	0.40%	3%		
																				stenosis	0	6%		



**Table 2: Quality assessment of included studies using the modified New Castle-Ottawa Quality Scale**

Study	Selection			Comparability	Outcome		Risk of bias		
	Representativeness of the sample	Sample size justified	Non-respondents	Ascertainment of exposure (max**)	Confounding controlled (max**)	Outcome assessment (max**)	Statistics	Score out of 10	Risk of bias
Papler et al. (2009)	*	*	-	**	**	**	*	9	Low
Naderan et al. (2016)	*	*	-	**	*	*	*	7	Medium
Alsisy et al. (2019)	*	*	-	**	**	**	*	9	Low
Maloku et al. (2019)	*	-	-	**	**	*	-	6	Medium
Mohamed et al. (2019)	*	*	-	**	**	**	*	9	Low
Eskandaros & Darwish (2020)	*	*	-	**	**	**	*	9	Low
Poskus et al. (2020)	*	*	-	**	**	**	*	9	Low
Hassan & Shemy (2021)	*	*	-	**	**	**	*	9	Low
Yahya et al. (2022)	*	-	-	**	*	*	*	6	Medium

## Discussion

Hemorrhoidal disease is a prevalent condition that poses a challenge in terms of typical treatment options. Milligan-Morgan (MM) hemorrhoidectomy which is the most well-known and frequently applied surgical treatment method, and Laser hemorrhoidoplasty (LH) are among the accepted treatment methods in Grade 2-3 HD where medical treatment is insufficient.<sup>7</sup> Management depends on patient factors and grading; surgery is usually indicated after failure of conservative measures or higher grades (III and IV), classified by grading scales such as the Banov, Goligher, or BPRST classification.<sup>4</sup>

Conventional open haemorrhoidectomy (CoH), initially described by Milligan-Morgan, is still regarded by literature in the modern era as the current gold standard surgical treatment.<sup>8,9</sup> Unfortunately, it is associated with significant postoperative pain and risk of postoperative complications.<sup>10</sup> Alternative operations such as the Ferguson closed haemorrhoidectomy, rubber-band ligation, and stapled haemorrhoidopexy were subsequently developed in efforts to mitigate said complications associated with CoH but they were found to be compromised by pelvic sepsis, postoperative bleeding, and higher recurrence.<sup>4</sup>

Non-excisional laser haemorrhoidoplasty (LHP) is a relatively novel minimally invasive modality, comprising of laser probe introduced through a small incision at the ano-cutaneous junction and anodermis into the haemorrhoid.<sup>11</sup> Thermal energy

causes closure of the haemorrhoidal plexus by venous thrombosis and obliteration of downstream haemorrhoidal cushions, with adherence of the rectal mucosal and submucosal layers to the underlying muscular layer whilst avoiding injury to the inner lining of the anal canal. This initiates fibrosis and tissue remodelling, causing volume reduction and eventual obliteration of the haemorrhoidal tissue. An anorectal mucopexy can also be performed in the same setting with absorbable sutures to hitch up any remaining prolapse after the laser coagulation.<sup>12,13</sup>

Previous studies have demonstrated reduced postoperative pain and risk of bleeding post-LHP, recommending it for grade II and III HD with satisfactory long-term outcomes compared to CH.<sup>12-14</sup>

There have been two randomized controlled trials that have compared LH with conventional hemorrhoidectomy (CH) and the results have been promising. Compared to patients in the CH arm, individuals in the LH arm returned to normal activities earlier and experienced less postoperative discomfort. Both trials showed similar rates of symptom recurrence at a 1-year follow-up.<sup>6,15</sup>

This study is the second systematic review and meta-analysis after Wee et al. (2023)<sup>16</sup> specifically comparing LH against CH for grade II or III hemorrhoids. LH was demonstrated to have several advantages over CH both intraoperatively and postoperatively in the short as well as medium term.

The primary outcome assessed was postoperative pain, measured with the visual analogue scale (VAS) on days 1, 7, and 1 month after surgery. Secondary outcomes included intraoperative characteristics, postoperative short and moderate-term outcome, and complications.

It is preferable for both the patient and the surgeon to have an uncomplicated hemorrhoidectomy. Nearly all of the suggested hemorrhoidectomy approaches are anticipated to improve the patient's quality of life following surgery by lowering postoperative pain, bleeding, and length of stay as well as facilitating the patient's prompt return to normal activities. In order to ensure that the surgical outcome is both gratifying and beneficial, the surgeon's training and expertise must be considered when choosing the surgical method.

### **Meta-analysis for Operative time**

Our pooled analysis revealed that LHP was associated with shorter operative time ( $p < 0.001$ ) the same results were seen by Lie et al. (2022)<sup>17</sup> and Wee et al. (2023).<sup>16</sup>

### **Primary outcome [VAS score for Pain among population of the study]**

In the current study, LHP was found to have resulted in significantly lower postoperative pain compared to CoH in the immediate period up to the first postoperative month ( $p < 0.001$ ), where the highest limitation in function and QoL occurs. Our findings are consistent with existing literature, where reduced pain is the greatest benefit of LHP.<sup>4,10,14,17,16</sup>

Importantly, pain is not limited to discomfort, but its effects expand into a myriad of sequelae associated with increased morbidity and mortality.<sup>18,19</sup>

### **Secondary outcomes (Complications)**

#### **Meta-analysis for bleeding**

Our pooled analysis revealed that the risk of postoperative bleeding was also lower in the LH group ( $p < 0.001$ ), which is consistent with the other two systematic reviews made by Tan et al. (2022) and Wee et al. (2023).<sup>4,16</sup>

#### **Meta-analysis for Acute Thrombosis**

Our study didn't find statistically significant difference between both groups regarding acute thrombosis ( $p=0.095$ ).

One specific concern related to intrahemorrhoidal laser treatment is thrombosis of external hemorrhoids. However, the incidence of thrombosis was found to be low, and even if present, thrombosis can be managed successfully with medical treatment.<sup>15,20,21</sup>

### **Meta-analysis for Anal Stenosis**

Our pooled analysis revealed that the risk of postoperative anal stenosis was also lower in the LH group ( $p < 0.002$ ), which is consistent with the other two systematic reviews made by Lie et al. (2022).

### **Meta-analysis for recurrence**

There was no significant difference between LHP and CoH in terms of recurrence rate ( $P=0.759$ ), this results was also found by Lie et al. (2022) and Tan et al. (2022).<sup>4,17</sup>

Alternative surgeries such as stapled haemorrhoidectomy and Doppler-guided transanal haemorrhoid artery ligation (HAL) had higher rates of recurrence than CoH (Giordano et al., 2009, Sajid et al., 2012, Simillis et al., 2015).<sup>10,22,23</sup> Therefore, whilst several of these options provided similar benefits to LHP over CoH, patients had to weigh these advantages against elevated recurrence risk.

### **Meta-analysis for urinary retention**

There was a statistically significant difference between both groups regarding urinary retention where CoH had higher rates ( $p=0.005$ ), which is consistent with Lie et al. (2022) and Tan et al. (2022) findings.<sup>4,17</sup>

LHP has been reported to have advantages over hemorrhoidectomy both intraoperatively and postoperatively (Wee et al., 2023).<sup>16</sup> It has been reported that patients who undergo LHP have less postoperative pain and morbidity. Reduction in postoperative pain leads to a decrease in drug complications resulting from analgesic use and increased patient satisfaction. Patients after LHP have less postoperative pain and can return to work or daily activities earlier (Chierici and Frontali 2021).<sup>24</sup> This may be explained by the fact that in LHP, tissue excision is not performed below the dentate line where pain fibers are dense.<sup>25</sup>

The main advantage of LHP is a faster return to work and normal life. Several studies have reported that all patients return to their normal daily activities within two days after LHP.<sup>1</sup> LHP has a significantly shorter operative time and less intraoperative blood loss compared to conventional hemorrhoidectomy. In a meta-analysis, the mean operation time for LHP was reported to be 12 minutes, while intraoperative blood loss was reported to be 19 ml on average.<sup>16</sup>

In a meta-analysis comparing laser hemorrhoidoplasty with conventional hemorrhoidectomy, Wee et al. reported that the risks of bleeding ( $p>0.999$ ), prolapse ( $p=0.240$ ), and complete resolution ( $p=0.240$ ) were not statistically significant at the 12-month follow-up.<sup>16</sup>

Varying recurrence rates have been described in the

literature at different follow-up periods after LHP. Weyand et al., 2019 have reported a recurrence rate of 8.8% in a six-month follow-up period, while Faes et al. (2019)<sup>12</sup> have reported a recurrence rate of 34% in a five-year follow-up period. It is clear that the recurrence rate increases as the follow-up period increases.<sup>26</sup>

Despite the well-known short-term effects of CH, including significant postoperative pain, this technique does result in a low risk of symptom recurrence, at 2% to 8% at 1 year.<sup>22,27</sup> Intuitively, an excisional procedure such as hemorrhoidectomy would have a lower recurrence rate compared to an ablative procedure, including LH, which does not involve tissue removal. While there was a trend toward higher hemorrhoidal symptom recurrence for LH compared to CH (28.6% vs. 20.0%) at postoperative 1 year, this result was not statistically significant.<sup>16</sup>

Further prospective trials with larger numbers of patients and a longer follow-up duration are required to draw definitive conclusions regarding hemorrhoidal recurrence rates between these modalities.

## Conclusion

Our findings suggest that laser hemorrhoidoplasty is a minimally invasive technique that can be safely applied in suitable grade II–III patients, offering lower postoperative pain rates up till the first postoperative month, fewer complications, shorter return to work and normal activity times and improved postoperative QoL compared to conventional surgical hemorrhoidectomy, and therefore LHP seems to be superior in terms of patient satisfaction in the early postoperative period. It also provides the surgeon shorter operative time. However, the moderate-term recurrence rate is equivalent to CH.

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