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Comparative Study of Treatment Methods of Haemorrhoids

(title)

Student **Sarah Shakura ADAMS, VI year, 2 group**

Department/ Clinic (where the defence procedure will be taking place) **Institute of Clinical
Medicine, Clinic of Gastroenterology, Nephrourology and Surgery**

Supervisor

Prof. dr. Tomas Poškus

(academic and scientific degree name surname)

Consultant (if applicable)

The Head of Department/Clinic

Prof. habil. Kestutis Strupas, MD, PhD

(academic and scientific degree name surname)

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Email of the student: sarah.adams@mf.stud.vu.lt

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ABSTRACT

BACKGROUND: Haemorrhoids can be defined as the symptomatic engorging or displacement of the anal cushions [1,2]. Across the world, haemorrhoids still remain one of the most prevalent diseases of the anorectal area, contributing to significant morbidity due to poor symptom control.

In determining the appropriateness of treatment modality, several factors, including the degree of prolapse and severity of symptoms are taken into account, as well as patients' age and pre-existing comorbidities.

OBJECTIVES: This study aimed to identify currently studied treatment options for symptomatic haemorrhoids; highlight the drawbacks as well as advantages of each treatment modality based on the randomised controlled trials (RCTs), and, thirdly, to provide recommendations based on research.

METHODS: A comprehensive PubMed search was conducted to identify Randomised Controlled Trials which compared various treatment methods for haemorrhoidal prolapse. Several inclusion and exclusion criteria were applied to the search results, and the data from the trials eligible for inclusion was subsequently analysed. A Cochrane Risk of Bias assessment was conducted on the available studies to assess the quality of evidence.

RESULTS: 87 Randomised Controlled Studies were included in this review with a total of 9493 participants. The techniques analysed were Stapled hemorrhoidopexy, Transanal Haemorrhoidal dearterialisation (THD), Laser haemorrhoidoplasty, Hemorrhoidal artery ligation (HAL), Radiofrequency, Mucopexy, Lord's (anal dilation), Rubber Band Ligation, Milligan-Morgan (the 'open') haemorrhoidectomy, Ferguson (the 'closed') haemorrhoidectomy, Milligan-Morgan with Ligasure, Milligan-Morgan with Harmonic Scalpel, and Park's haemorrhoidectomies.

In total, 31 randomised controlled studies contained good quality evidence, 52 studies carried some concerns, and 4 studies had a high risk of bias.

CONCLUSION: The decision to treat haemorrhoids (of any degree), whether non-invasively or invasively, lies mainly with patients' presenting complaints, such as pain on evacuation and the extent of morbidity in day-to-day activities. For symptomatic low grade haemorrhoids, as well as the advanced prolapse, lifestyle and diet modifications form the important foundation of the management strategy, and are prescribed as the initial step in the management. If not sufficient alone, minimally invasive techniques, such as radiofrequency ablation can be tried first, as they offer promising results with reduced pain scores and fast return to daily activities. As recurrence rates, however, are higher with these techniques compared to traditional haemorrhoidectomy, some patients may experience relapses and need re-operating on.

The data extracted from the trials suggests Stapled haemorrhoidopexy to be a highly efficient technique for grades 3 and 4 haemorrhoids, with reduced pain scores, shorter hospital stays, reduced healing times and return to normal activities, and overall high patient satisfaction. Alternatively, laser haemorrhoidoplasty delivers similar satisfactory results, is associated with lower pain scores and accelerated return to normal activities. However, evidence suggests that these techniques are associated with significantly higher recurrence rates, compared to excisional haemorrhoidectomy.

From the available data, Milligan-Morgan procedure accounts for longer operative times, higher pain scores, increased healing times and delayed return to normal activities. However, this technique, especially when facilitated by LigaSure sealing device or Harmonic Scalpel, has the lowest recurrence rates and still remains the gold standard for managing haemorrhoids of advanced degree (especially 4th degree).

INTRODUCTION

Haemorrhoids are swollen and engorged vessels in the lower rectum. They can be also defined as the symptomatic engorging or displacement of the anal cushions [1,2]. Across the world, haemorrhoids still remain one of the most prevalent diseases of the anorectal area. Because many sufferers can often present asymptomatic or are reluctant to seek medical attention due to the delicate nature of the condition, the exact epidemiologic prevalence remains limited [3].

In determining the appropriateness of a treatment modality, the degree of prolapse along with severity of symptoms and patient's adherence to the treatment is taken into account, as well as the patient's age and any pre-existing comorbidities.

This study aimed to review the data from randomised controlled trials that compared the efficacy of different treatment modalities for haemorrhoids, with an objective to find the most commonly performed procedures, secondly, to identify the advantages as well as the drawbacks of each treatment method, and thirdly, to provide recommendations for treatment modalities based on findings.

In addition, this review provides a brief background information on pathophysiology of haemorrhoidal disease, its diagnosis, grading and management.

BACKGROUND INFORMATION

Incidence and Demographics

A historic study published in 1975 examined a sky-rocketing incidence of haemorrhoids in the Developed World contrasted by its low rates in rural communities of the developing countries [3].

From historic self-reported studies conducted in 1990 in the United States [4], the prevalence rate stood at 4.4%, or 10 million new cases per year [4]. New century observational study from South Korea [5] reports a rate of 14.4%, whereas a 2012-conducted Austrian study of adults undergoing a routine colorectal cancer screening observed a whopping 38.9% prevalence of haemorrhoids, with over a half of those patients (55%) being asymptomatic [6]. A British community-based study revealed that between 13 and 36% of the British population are affected, with actual figures estimated to be considerably higher as only a small fraction of affected individuals willingly self-reported their condition [7]. A similar American report claimed that around 75% of the adult American population will develop haemorrhoids at some point in life [8]. Women are known to be slightly more susceptible to developing haemorrhoids than men, and pregnancy is understood to increase a risk of developing the condition [9, 10]. With age, the incidence of haemorrhoids does not exhibit any gender preference, invariably affecting both genders with a peaking incidence ranging from 45 to 65 years [11]. In addition, the condition neither interlinks with the socio-economic status, nor expresses familial traits.

Aetiology and Pathophysiology

In the human body, the internal haemorrhoidal plexi give rise to normal structures of the anorectum, called the venous haemorrhoid cushions, also known as internal haemorrhoids or anal cushions. Likewise, the external haemorrhoidal plexi gives rise to the external haemorrhoids [12, 13]. The pectinate line (also known as the dentate line) is the anatomical boundary dividing the internal and external plexi [14, 15]. Clinically, the term ‘internal haemorrhoids’ refers to the pathologic engorgement and enlargement of the anal cushions, specifically when they become symptomatic, characterised by bleeding, pruritus/discomfort or prolapse [18].

The pathophysiological mechanism leading to the pathological conditions is somewhat obscure and is rather implied by its multifactorial constituents. As described below, pathophysiology is rather complex and often comprehends an interlocked cascade of events.

A couple of theories, such as the theory of the vascular hyperplasia and the theory of internal sphincter hypertonia partially explain the pathological findings [2, 15, 17, 19]. However, the widely accepted proposition remains the cushion theory, which hypothesises the pathological slippage of the haemorrhoidal cushions into the anal canal, which, in turn, becomes consistent with the characteristic clinical symptoms [17].

The risk factors for developing haemorrhoidal disease are known to be multiple, and in most cases involve chronic conditions that elevate the intra-abdominal pressure, such as chronic constipation and the associated straining during the attempt of the evacuation; lifting of the heavy weights, such as in powerlifting; chronic diarrhoea; pregnancy and childbirth; chronic cough, to name but a few. Interestingly, it is the chronic diarrhoea that weakens the connective tissue within the haemorrhoidal cushion; in particular, chronic diarrhoea impedes the drainage of the venous sinusoids, resulting in their engorgement and congestion, a hallmark of haemorrhoidal pathology [26]. Notably, it is believed that chronic diarrhoea rather than constipation poses a stronger risk for the development of the haemorrhoidal pathology [26, 27].

Pathophysiology of symptoms

According to a study published by Riss, Weiser, Schwameis, et al. (2012), only 4 out of 10 patients with haemorrhoidal disease are symptomatic [6]. Whilst it is not certain why the symptoms develop, it is thought to be attributed to the slippage of the haemorrhoidal cushions down the anal canal [20, 28]. Bleeding is the most common presenting complaint [9].

Internal haemorrhoids

Due to the lack of the cutaneous pain fibres, internal haemorrhoids present with a painless (painless, unless complicated by thrombosis, ischaemia, haemorrhoidal strangulation or incarceration) bright red arterial bleeding, resulting from the congestion of the sinusoids within the connective tissues of the anal cushions. On a proctoscopic exam, prolapsed internal haemorrhoids can be distinctively found above the dentate line (as they originate and

drop down from the mucosa of the upper anal canal); below the dentate line, but still within the anatomical anal canal; or in extreme cases, may protrude outside the anal verge [12, 20].

Prolapsed internal haemorrhoids may present painful if incarcerated or strangulated, as they are spasmed by the anal sphincter complex [13,18]. Accompanying external thrombosis manifests as acute cutaneous pain and, in such catastrophic events, appropriate emergency management is indispensable [13, 15, 18, 31].

External haemorrhoids

External haemorrhoids are innervated by the branches of the pudendal nerve and therefore are capable of exhibiting pain symptoms when the external haemorrhoidal vein becomes acutely thrombosed. Acute pain due to an immediate dilation of the skin may persist for the duration of the thrombus organisation, which takes about 7 to 14 days. Although the thrombosis subsides and so do the pain symptoms, the stretched skin may persist as skin tags, and because of the historic damage to the underlying venule, recurrence is seen in around 40 to 50% of cases [32].

DIAGNOSIS

History

History taking is regarded as indispensable in diagnosing haemorrhoidal pathology, as a vast number of anorectal pathologies with analogous presentation may mimic haemorrhoid disease. The other two integral constituents of diagnosis are symptoms/presentation and a physical examination, including the digital rectal exam [1, 2]. The commonest anorectal conditions with a similar presentation to haemorrhoids are abscesses, colorectal cancer, condyloma, fissure, fistula, inflammatory bowel disease, polyps, proctitis, rectal prolapse, and skin tags.

A clinical picture with adequate history should be consistent with the disease-specific symptoms: a gradual onset, painless rectal bleeding on evacuation, grape-like prolapse, unintentional soiling, mucous discharge, pruritus and discomfort in the perianal area and undermined anal hygiene are the most classical presentations [33]. A change in toilet habits, frequency and consistency of bowel movements, any difficulties in bowel emptying, as well as dietary practices in terms of hydration and fibre intake should be assessed. In addition to the above history, the patient's coagulability records should be evaluated [33].

Physical Exam

The physical exam includes a general physical exam, as well as a rectal digital exam and proctoscopy, to visualise the rectum for haemorrhoidal prolapses, anal fissures, inflamed perianal area, or thromboses. If other colorectal aetiology is suspected, colonoscopy or sigmoidoscopy might be appropriate to evaluate for rectal bleeding or in the presence of risk factors for colorectal malignancy or when anorectal exam alone proves inconclusive [1, 2].

Grading of internal haemorrhoids

To-date grading of haemorrhoids is based on a proposed model by Banov et al (1985), which classifies internal haemorrhoids based on their degree of protrusion into the anal canal [30]:

Grade I internal haemorrhoids protrude into the anal canal and might occasionally bleed, but do not prolapse;

Grade II haemorrhoids might bleed on evacuation and might protrude down the anal canal and appear on the anal verge during evacuation or upon straining, however, they spontaneously reduce on cessation of straining;

Grade III haemorrhoids might also bleed and protrude spontaneously or with straining, but need to be manually reduced into the anal canal;

Grade IV haemorrhoids tend to chronically prolapse and persist in the anal canal, cannot be manually reduced and are composed of the external and internal tissue constituents. This class of haemorrhoids might become acutely strangulated or thrombosed.

MANAGEMENT

Conservative management is advised as a first-line approach for most of the patients irrespective of the grade of prolapse.

In-office and surgical treatment modalities for haemorrhoids are vast and aimed at the advanced-grade-prolapse symptomatic patients in whom lifestyle and diet modifications have failed to produce fruitful improvements.

Conservative management

Conservative measures of symptomatic patients are aimed at lifestyle and dietary modifications. In cases where patients fail to modify their lifestyle and diet, the rates of haemorrhoid recurrence remain somewhat high even after the surgical interventions [35]. The emphasis of the conservative treatment is put on the modification of undesirable habits, such as tackling the sedentary lifestyle and the lack of physical activity, ensuring adequate hydration and including more fibre in the diet. Fibre supplementation is side effect-free and cuts the risk of prolapse and the associated bleeding by a half [36, 37] If appropriate, supplemental laxatives might be prescribed, such as lactulose, to help soften the stools.

Some over-the-counter haemorrhoid remedies available on the market include corticosteroids, topical anaesthetics, astringents, known as ‘witch hazel’ water, topical creams and suppositories, such as zinc oxide and phenylephrine. Although these treatments might provide initial short-term relief, there is a lack of clinical data on their effectiveness on a long-term scale [41].

A one-time botulinum toxin injections into the anal sphincter are popular for providing pain relief for thrombosed external haemorrhoids [45].

In-office Procedures

In-office procedures is the minimally invasive management of mainly I-II, and rarely III grades of prolapse which are refractory to conservative treatments [33]. These techniques do not require a general anaesthetic and can be effectively executed with or without the local anaesthesia. The central objective herein is to reduce the blood delivery into the haemorrhoidal sacculi. Amongst the above, **rubber band ligation, injection sclerotherapy, infrared coagulation/photocoagulation, bipolar diathermy and direct-current electrotherapy, with the rubber band ligation being the most utilised.** While showing high effectiveness and sparing major complications, overall recurrence rates are high compared to surgical excision of haemorrhoids.

Surgical procedures

Surgical treatment is reserved for symptomatic patients with recurring symptoms when the conservative management methods have failed to produce satisfactory results. While specific contraindications depend on the type of the surgical procedure, some of the relative contraindications are listed below:

- Severe haemostatic disorders and coagulopathies; Crohn's disease; lesion of the anal sphincter and anal incontinence [100, 101].

The intended objectives of the surgical haemorrhoidectomy is to excise only the symptomatic haemorrhoidal tissue, preserving the sensitive anoderm for continence, reduce the prolapsing tissues that are responsible for pain and bleeding and minimise postoperative complications. As a general occurrence, surgical management of haemorrhoids yields the most desirable outcomes in terms of recurrence and symptom management. Nonetheless, this provision comes at a price of increased rates of post-procedural complications — such as postoperative pain, bleeding, injury to the anal sphincter, urinary retention and anal incontinence are to name but a few — compared to the minimally invasive techniques [100, 101].

METHODS

This review aimed at identifying and selecting relevant randomised controlled trials held on publicly available databases.

A comprehensive PubMed search was conducted on 13 March 2023, and the following criteria were applied:

"hemorrhoidectomy"[MeSH Terms] OR hemorrhoidectomy[Text Word] was written in the search field. A publication year was set to include all studies between 1990 and 2023. The initial search brought up 1271 results. Following this, a search filter was applied to include "Randomised Controlled Trials" only, narrowing the search down to 264 results. The generated results were then applied a language filter, selectively excluding trials not available in English, after which the number of studies decreased to 242.

The retrieved searches were scrutinised under several rounds of screening. The inclusion criteria were as follows: Randomised Controlled Trials published between 1990 - 2023; trials comparing excisional haemorrhoidectomy to other modalities; trials comparing one excisional haemorrhoidectomy technique to another. The parameters evaluated (compared) in

qualifying trials were the amount of postoperative pain, post-operative complications, symptom reduction, symptom recurrence, effectiveness of the technique, and overall patient satisfaction.

The exclusion criteria applied to articles which were not Randomised Controlled Trials (RCTs); any RCTs published before the year 1990; articles written in languages other than English; trials which were performed in primary care settings, trials which involved only one specific population (for example, young healthy patients only); trials describing de-novo, or not previously described procedures; trials found to be retracted by a Publisher due to “retraction of unreliable publication ”; any protocols/trial proposals; trials with conflicts of interest, any other trials irrelevant to the current review, such as trials with main objectives other than objectives sought in this review.

ROUND 1 SIFTING

The titles of these 242 results were systematically reviewed to dismiss irrelevant articles (many of such articles had ‘hemorrhoidectomy’ in the title but their abstracts expressed different study goals; eg many articles compared epidural anaesthesia to nerve blocks; several trials studied the efficacy of pain relief medications post haemorrhoidectomy, etc, or procedures carried out in day-care settings; new techniques being described and tested;) → after this, 112 articles passed the first round screening. .

ROUND 2 SIFTING

The abstracts of the above 112 articles were further scanned to discard the following publications:

Trials which are not randomised controlled trials;

trials which were performed in primary care settings, such as level 1 outpatient offices and clinics;

Trials which involved only one specific population, e.g. young healthy people without comorbidities;

Trials describing de-novo, or not previously described procedures

1 article published in year 2013 was found to be retracted by PubMed due to “retraction of unreliable publication ”

1 article was a protocol (PMC4289313, Watson AJ)

ROUND 3 SIFTING

After careful review of the abstracts of the 112 articles, some have been found to meet the exclusion criteria, and consequently were excluded from the study; the full texts of the remaining **92** articles were closely analysed.

A further 5 RCTs were excluded upon a thorough inspection of their full texts:

1. Watson et al, 2016- this study was excluded due to being a repetition of a 2017 study by the same author. In their 2017-published study, the authors presented the results for the same participants who were followed up for one more year.
2. Denoya et al, 2013 - this study was excluded due to being a repetition of a 2014 study by the same author. In their 2014-published study, the authors presented the data for the same participants who were followed up for one more year.
3. Sakr et Moussa, 2010- this study was excluded due to being retracted by the author themselves.
4. Wong et al, 2008 - this trial was excluded as it involved comparing stapled vs. conventional hemorrhoidectomy for patients with **acute thrombosed haemorrhoids**.
5. Khubchandani, 2005 - this study was excluded as neither abstract, nor a full text could be located across PubMed or the linked/third party databases.

The remaining **87** articles fulfilled the criteria for inclusion on the review and were therefore studied to extract the relevant data.

A flow diagram below (Table 1) summarises studies' selection process:

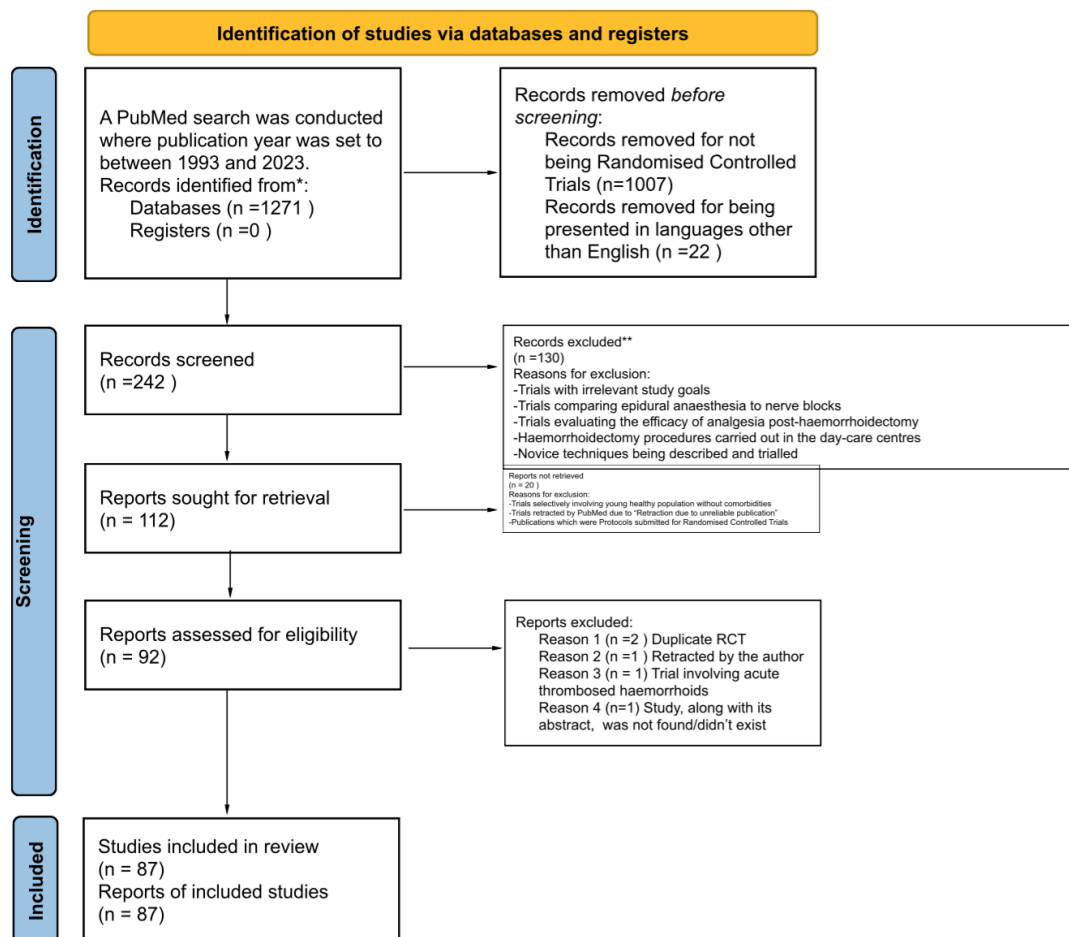


Table 1. A Flow diagram that summarises studies' selection process.

The information source used to retrieve studies is PubMed (available at: <https://pubmed.ncbi.nlm.nih.gov>), first accessed on 20 August 2022, with last access made on 30 March. Revised Cochrane risk of bias tool for randomised trials (RoB 2.0) was used

in assessing the identified trials. The summary of the risk of bias assessment was presented by using the *ROBVIS* tool [239] and Excel spreadsheets.

RESULTS

After several rounds of screening, the total number of identified studies was finalised at 87. Within these studies, between two to four treatment techniques were described. The total number of participants across all the 87 studies was 9493.

The aforementioned studies were found to describe the following non-resectional techniques, as shown in Table 2 and Table 3 below:

Non-resectional procedure	Number of studies identified
1. Stapled hemorrhoidopexy	26
2. Transanal Haemorrhoidal dearterialisation	10
3. Laser haemorrhoidoplasty	5
4. Hemorrhoidal artery ligation (HAL)	3
5. Radiofrequency	3
6. Mucopexy	2
7. Lord's	1
8. Rubber Band Ligation	1

Table 2. Identified non-resectional procedures

Also, the excisional techniques identified, as shown in Table 3 below, were as follows :

Excisional procedure	Number of studies identified
1. Milligan-Morgan (aka 'open')	64
2. Ferguson (aka 'closed')	25
3. Milligan-Morgan with Ligasure	20
4. Milligan-Morgan with Harmonic Scalpel	14
5. Park's	2

Table 3. Identified excisional techniques

The following table (Table 4) lists all the Randomised Controlled Trials that were included in the review, their main objectives, risk of bias assessment, and limitations and/ or remarks:

Study	Participant 1	Technique studied	Domain 1	Domain 2	Domain 3	Domain 4	Domain 5	Overall	Limitations/Remarks	Outcomes
Mert, 2023	100(50/50)	laser hemorrhoidoplasty (LH) with Ferguson hemorrhoidectomy (FH)	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Song et al, 2023	186 (93/93)	modified Park's submucosal (MPS) over Milligan-Morgan (MM) hemorrhoidectomy	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Assessors blinded to operative techniques	
Zhai et al, 2022	123 (60/63)	suture-fixation mucopexy with Milligan-Morgan hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Low risk	No details on blinding of assessors	
Lim et al, 2022	76(37/39)	laser hemorrhoidoplasty (LHP) only versus LHP with hemorrhoidal artery ligation (HAL)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Double-blinded (patients and assessors) RCT; Patients with hemorrhoids requiring emergency surgery are excluded	
Almeid et al, 2021	60 (30/30)	harmonic scalpel versus Milligan-Morgan technique	Low risk	Low risk	Low risk	Some conc	Some conc	Some conc	No details on conduct, blinding and post-op assessment	
Lehmann et al, 2020	151 (77/74)	Milligan-Morgan with Ferguson's	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment; Patient-reported outcomes	
Rovik et al, 2020	99 (50/49)	transanal hemorrhoidal dearterialisation with open hemorrhoidectomy	Low risk	Low risk	Low risk	High risk	Low risk	High risk	No blinding was included in this study (aka open-label)	
Polkusa et al, 2020	121(40/40)	laser hemorrhoidoplasty (LHP), excisional hemorrhoidectomy (EH), and sutured mucopexy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No information on patient or assessor blinding; The 2 groups did not contain equal numbers of grade III and IV hemorrhoids	
Trenč et al, 2019	80(39/41)	transanal hemorrhoidal dearterialisation with mucopexy vs. vessel-sealing device hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No blinding of physicians-assessors was included in this study	
Carvajal Lopez et al, 2020	40 (20/20)	hemorrhoid artery ligation with recto-anal repair (HAL-RAR) vs. excisional hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on blinding and post-op assessment	
Lai et al, 2019	90	MM hemorrhoidectomy with LigaSure™ vs. MM hemorrhoidectomy with Vioport™	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on assessor and patient blinding	
Genova et al, 2019	107	Transanal hemorrhoidal dearterialisation (THD) vs. MM hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No blinding of physicians-assessing post-op pain & complications was included in this study	
Giarratano et al, 2018	100 (50/50)	transanal hemorrhoidal dearterialisation (THD) versus stapled hemorrhoidectomy (SH)	Low risk	Low risk	Low risk	High risk	Low risk	High risk	No blinding was included in this study (aka open-label)	
Watson et al, 2017	774(388/388)	stapled hemorrhoidectomy (SH) and traditional hemorrhoidectomy (TH)	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	Double-blinded RCT	
Naderan et al, 2017	60 (30/30)	transanal Doppler-guided hemorrhoid dearterialisation with mucopexy (DM) vs. hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	Randomised, assessor-blinded; 2 independent assessors	
Tanoda et al, 2017	44	transanal Doppler-guided hemorrhoid dearterialisation with mucopexy (DM) vs. hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No information on patient and assessor blinding	
Talha et al, 2017	180 (80/60)	Ligasure vs. Harmonic Scalpel vs. diathermy hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No information on patient and assessor blinding	
Venuti et al, 2016	70 (35/35)	stapled anorectal anastomosis (SAA) and transanal hemorrhoidal dearterialisation with anorectal (THD)	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No information on patient and assessor blinding	
Watson et al, 2016	480(240/240)	tissue-selecting therapy stapler (TST) and Milligan-Morgan hemorrhoidectomy (M-M)	Some conc	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Rennett et al, 2015	180(60/60)	Stapled rectal mucosectomy vs. semiclosed hemorrhoidectomy vs. open hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	Assessor and patient-blinded	
Majeed et al, 2015	364	open hemorrhoidectomy (Milligan-Morgan) vs. closed (Ferguson) hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on blinding and post-op assessment	
Blign et al, 2015	99 (48/51)	harmonic scalpel hemorrhoidectomy (HSH) vs. stapler hemorrhoidectomy (SH)	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	Independent blinded assessor	
Wang et al, 2015	480(240/240)	tissue selecting therapy stapler (TST) and Milligan-Morgan hemorrhoidectomy (M-M)	Some conc	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Eliashy et al, 2015	200(100/100)	ligation anorectal anastomosis (LAA) vs. conventional hemorrhoidectomy (C-H)	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	Blinded patients, surgeons, assessors	
Denoys et al, 2014	40	dearterialisation with mucopexy vs. hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Qarabaki et al, 2014	688	Circumferential excisional hemorrhoidectomy (CEH) vs. Ferguson hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	Post-op assessor blinding unclear	
De Nardi et al, 2014	50	Doppler-guided transanal hemorrhoidal dearterialisation with mucopexy and excisional hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Bulus et al, 2014	151	Harmonic scalpel (HS) and Ferguson's with electrocautery hemorrhoidectomy (EH)	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Lu et al, 2013	192	MM hemorrhoidectomy with anal cushion suspens and partial intern sphincter resect vs. traditional hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Kim et al, 2013	122	stapled hemorrhoidectomy compared with the Milligan-Morgan procedure	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	Info not withheld from participants	
Elmer et al, 2013	40 (20/20)	transanal hemorrhoidal dearterialisation with anorectal vs. open hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Denoys et al, 2013	EXCLUDED	dearterialisation with mucopexy vs. hemorrhoidectomy	Some conc	Low risk	Low risk	Some conc	Low risk	Some conc	Example of non-random sequence generation: "Patients born on even days were assigned to Treatment A"	
Zampieri et al, 2012	114(40/68)	transanal hemorrhoidal dearterialisation (THD) hemorrhoidectomy or LigaSure-vessel sealer	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	Double blinded	
Armatauro et al, 2012	79 (39/40)	stapled hemorrhoidectomy (SH) using a circular stapler vs. Milligan-Morgan hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Arslani et al, 2012	98 (46/52)	Stapled hemorrhoidectomy (SH) vs. Ligasure hemorrhoidectomy (LH)	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Franceschilli et al, 2011	210(110/100)	Radiofrequency (ligasure TM) vs. conventional diathermy Milligan-Morgan hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	Patent blinded	
Gentile et al, 2011	52	transanal diathermy vs. LigaSure™ hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Sakr et al, 2010	68 (34/34)	Ligasure hemorrhoidectomy (LH) and Stapled hemorrhoidectomy (SH)	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	single blinded (pts only)	
Falinger et al, 2010	22	Ferguson operation with the RF scalpel vs. traditional diathermy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Sakr, 2010	84 (42/42)	LigaSure hemorrhoidectomy (LH) vs. conventional open hemorrhoidectomy (MM)	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	Pts blinded, post-op assessors blinded	
Abou-hashed et al, 2011	64 (32/32)	Harmonic Scalpel Hemorrhoidectomy vs. Bipolar Electrocautery Hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	single blinded (pts only)	
Fareed et al, 2009	80	LigaSure hemorrhoidectomy vs. closed Ferguson technique	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Castellvi et al, 2009	36 (19/17)	conventional diathermy hemorrhoidectomy under spinal anaest vs. Ligasure diathermy hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Ozer et al, 2009	87(22/22)	open Harmonic scalpel vs. closed Harmonic Scalpel vs. Milligan-Morgan vs. Ferguson	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Bessa, 2008	110 (55/55)	Ligasure hemorrhoidectomy vs. conventional diathermy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Altomare et al, 2008	273(146/127)	Milligan-Morgan hemorrhoidectomy using radiofrequency dissection (Ligasure) vs. conventional hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Wong et al, 2008	EXCLUDED	ACUTE stapled vs. conventional hemorrhoidectomy for patients with acute thrombosed hemorrhoids	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Huang et al, 2007	596(300/296)	stapled hemorrhoidectomy (SH) vs. Ferguson hemorrhoidectomy (FH) for treating hemorrhoids	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Ho et Ho, 2006	74	stapled vs. Milligan-Morgan (open) hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	Assessors blinded	
Piochjo et al, 2006	74	stapled vs. Milligan-Morgan (open) hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	Assessors blinded	
Pattna-Arun et al, 2005	45 (22/23)	closed hemorrhoidectomy and Ligasure hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Wang et al, 2006	84 (42/42)	LigaSure hemorrhoidectomy vs. conventional Ferguson by diathermy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	Independent assessor	
Gupta et al, 2006	80	LigaSure hemorrhoidectomy vs. Milligan-Morgan hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	Independent assessor	
Khubchandani, 2005	NOT FOUND	open vs. closed hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Kremer et al, 2005	50	stapling hemorrhoidectomy or LigaSure hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Gravie et al, 2005	134	stapled hemorrhoidectomy (SH) vs. Milligan-Morgan (MM)	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	Pts unblinded after consenting; Examined by the surgeon, self-questionnaire	
Chung et al, 2005	88	Harmonic Scalpel hemorrhoidectomy vs. stapled hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Ortiz et al, 2005	31 (15/16)	stapled hemorrhoidectomy vs. conventional diathermy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Kwok et al, 2005	47 (24/23)	Ligasure hemorrhoidectomy vs. Harmonic Scalpel hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	Double blinded + independent assessor	
Basdian et al, 2005	95 (50/45)	stapled vs. open hemorrhoidectomy using Ligasure	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Bikhchandani et al, 2004	84 (42/42)	stapled technique vs. conventional Milligan Morgan (open) hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
You et al, 2005	80 (40/40)	open vs. closed hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Gupta, 2004	60 (31/29)	radiofrequency ablation and plication vs. MM hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	Independent observer	
Sengapure et al, 2004	186(77/79)	Stapled hemorrhoidectomy vs. Ferguson hemorrhoidectomy	Low risk	Low risk	Low risk	High risk	Low risk	High risk	No details on conduct, blinding and post-op assessment. The Project was funded by Ethicon Endosurgery.	
Racalibuto et al, 2004	100(50/50)	stapled hemorrhoidectomy vs. Milligan-Morgan hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Buracas et al, 2004	60 (30/30)	Doppler-guided hemorrhoid artery ligation vs. closed scissors hemorrhoidectomy	Some conc	Low risk	Low risk	Some conc	Low risk	Some conc	Randomisation based on the date of 1st visit. No details on conduct, blinding and post-op assessment.	
Gupta, 2003	40 (21/19)	radiofrequency ablation vs. Milligan-Morgan hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	Assessor blinded	
Franklin et al, 2003	34 (17/17)	Ligasure system vs. conventional diathermy for hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Chen et al, 2003	48	Anal cushion resection vs. Milligan-Morgan hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Peng et al, 2003	55 (25/30)	rubber band ligation vs. stapled hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Palmimeto et al, 2003	74 (37/37)	Stapled vs. open hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Chung et al, 2003	81	LigaSure hemorrhoidectomy vs. conventional Ferguson hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	Randomisation based on alternation; No details on conduct, blinding and post-op assessment	
Wilson et al, 2002	89(59/30)	stapled anorectal vs. open hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Correa-Rovelo et al, 2004	84 (42/42)	stapled rectal mucosectomy vs. closed hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	Very short follow-up (6 months); no details on post-op assessment	
Ramadan et al, 2002	54 (28/26)	harmonic scalpel hemorrhoidectomy (HS) vs. Milligan-Morgan procedure (MM)	Some conc	Low risk	Low risk	Some conc	Low risk	Some conc	Randomisation based on pt identification numbers; No details on conduct, blinding and post-op assessment	
Chung et al, 2002	86	bipolar scissors, Harmon Scalp hemorrhoidectomy vs. MM hemorrhoidectomy using scissors	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	Randomisation envelopes; double blind – pt, assessor unaware	
Hetzer et al, 2002	38	stapled vs. excision hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	Patent blinded	
Pavlidis et al, 2002	80	stapled Longo procedure vs. Milligan-Morgan hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	Assessors blinded	
Mikuri et al, 2002	34 (17/17)	open and semi-closed (semi-open) hemorrhoidectomy	Some conc	Low risk	Low risk	Some conc	Low risk	Some conc	Randomisation by envelopes; assessor blinded	
Gencsomanglu et al, 2002	80 (40/40)	Open hemorrhoidectomy vs. closed	Some conc	Low risk	Low risk	Some conc	Low risk	Some conc	Randomisation according to the last digit of pt identification number; No details on conduct, blinding and post-op assessment	
Tan et al, 2002	50	diathermy vs. Harmonic Scalpel hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	Randomisation by envelopes; No details on conduct, blinding and post-op assessment	
Armstrong et al, 2001	50	Harmonic Scalpels and electrocautery hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Ho et al, 2000	119(62/57)	conventional open diathermy vs. stapled hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Konsten et al, 2001	138	closed (Ferguson) hemorrhoidectomy vs. anal dilatation (original Lord's procedure)	Some conc	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Arbman et al, 2000	77 (38/39)	closed (Ferguson) hemorrhoidectomy vs. open (Milligan-Morgan) hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	Independent assessor, blinded	
Ibrahim et al, 1998	91 (44/47)	Ferguson with diathermy dissection vs. Ferguson with scissors dissection	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	Independent assessor, blinded	
Hochi et al, 1992	34	Parks vs. Milligan-Morgan	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	Independent assessor, blinded	
Sengapure et al, 1993	86 (51/35)	Ferguson with Nd:YAG laser vs. Ferguson with scalpel excision	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	Independent assessor, blinded	
Andrews et al, 1993	20 (10/10)	diathermy hemorrhoidectomy vs. scissor dissection Milligan-Morgan hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	Independent assessor, blinded	
Reis Neto, 1992	300	open hemorrhoidectomy vs. semi-open hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	
Wang et al, 1991	88	Nd:YAG laser phototherapy vs. closed Ferguson hemorrhoidectomy	Low risk	Low risk	Low risk	Some conc	Low risk	Some conc	No details on conduct, blinding and post-op assessment	

Total number of participants across all the above studies: 9493
Total number of studies included: 87

Table 4: A list of Randomised Controlled Trials that were included in the review, along with their main study objectives, risk of bias assessment, and limitations/ remarks.

Laser Haemorrhoidoplasty

4 Studies with a total of 385 participants report Laser haemorrhoidoplasty to be shorter or of similar operating times compared to excisional haemorrhoidectomy; being less painful [154], or carrying similar median pain scores [155]; allowing earlier return to normal activities and carrying more patient satisfaction than the excisional technique [154]. On the other hand, data obtained from these studies shows laser haemorrhoidectomy to carry a higher recurrence rate compared to the excisional haemorrhoidectomy [154; 155; 156].

Stapled haemorrhoidopexy

16 studies with a total of 2712 participants report Stapled haemorrhoidopexy to carry less short-term pain, shorter wound healing time, shorter length of hospital stay, earlier return to work and short-term high patient satisfaction [157; 158; 159; 160; 161; 162; 163; 164; 165; 166; 167; 168; 169; 170; 171; 172]. Contrastingly, other studies reported a higher incidence of intraoperative bleeding in the stapled haemorrhoidopexy group [173; 174], and an introduction of a new symptom - tenesmus [175].

In 4 other studies involving 988 patients, long-term follow-up has indicated more favourable results in MMH group and higher recurrence rate in Stapled haemorrhoidopexy group (158; 167; 173; 175). In these studies, the recurrence rates, symptoms, re-interventions and quality-of-life measures all favoured excisional haemorrhoidectomy.

6 studies with a total of 441 patients [160; 161; 164; 165; 171; 176] suggest stapled haemorrhoidopexy to be of similar effectiveness to Milligan Morgan procedure for 3rd degree haemorrhoids.

In a study of 100 participants, Stapled haemorrhoidopexy was shown to be more effective in reducing prolapse and obstructed defecation symptoms in fourth-degree haemorrhoids than THD [177]; in addition, Stapled haemorrhoidopexy showed more favourable results in terms of lower rate of recurrence, lower postoperative pain, quicker return to work, and higher patient satisfaction in a separate study involving 70 patients [178].

Peng et al [179] report a study of 55 patients, compared to Rubber Band Ligation, stapled haemorrhoidopexy was reported to show no difference in terms of continence scores, patient satisfaction, or quality of life. Stapled hemorrhoidectomy was also associated with more pain and minor morbidity than rubber band ligation in the treatment of Grade III and small Grade IV piles [179].

Transanal Haemorrhoidal Dearterialisation (THD)

3 studies of 229 total patients report higher pain score and recurrence rates of THD compared to open haemorrhoidectomy [180; 181; 182].

Overall, for 3rd and 4th grade haemorrhoids, THD resulted in lower incidence of postoperative pain and faster recovery and return to work activities and social life compared to MM cases [181], while there has been recurrence of 4th grade haemorrhoids 3 years post procedure [182].

Another four studies totalling 284 patients, report similar short-term results between THD and excisional haemorrhoidectomy in terms of postoperative complications rate, use of laxatives, patient satisfaction, Vaizey score, haemorrhoids symptoms score, return to work, and quality of life compared with excisional haemorrhoidectomy [183; 184; 185; 186].

Compared to Stapled haemorrhoidopexy, THD was found, in a study of 70 patients, to be less effective in reducing prolapse and obstructed defecation symptoms in fourth-degree haemorrhoids than stapled haemorrhoidopexy [177]. In another randomised controlled trial recruiting 100 participants, THD showed less favourable results in terms of lower rate of recurrence, lower postoperative pain, quicker return to work, and higher patient satisfaction [178].

Haemorrhoidal Artery Ligation with Recto-Anal Repair (HAL-RAR)

When comparing HAL-RAR with laser haemorrhoidoplasty, one study containing 76 total participants reported no difference in operating time and no significant difference in severity of bleeding. The incidence of postoperative perianal swelling was similar in both groups. There was no difference in median pain scores [156].

In addition, when compared to excisional haemorrhoidectomy for grade 2 and 3 haemorrhoids, two studies involving a total of 240 patients reported HAL-RAR achieved resolution of hemorrhoidal symptoms with shorter operative times, earlier mobilisation and less postoperative pain. No differences in morbidity and recurrence rate were observed between HAL-RAR and the excisional haemorrhoidectomy after 12 months of follow-up [187; 188].

Suture Fixation Mucopexy

A total of 123 participants across two studies found no significant difference in clinical efficacy (operation time and hospital stay) between the suture-fixation mucopexy and Milligan Morgan procedure [154; 189].

The suture-fixation mucopexy had a lower pain score and a better anal function protection. The rate of recurrence and patient satisfaction was similar between the suture-fixation mucopexy and the Milligan-Morgan group in one study [189], while in another, [154], suture-fixation mucopexy was less effective than laser haemorrhoidoplasty and conventional haemorrhoidectomy, and had shorter operative times.

Radiofrequency Ablation

A report which contains two separate studies with a 100 total participants claims radiofrequency ablation to have a shorter hospital stay and rapid physical recovery and return to normal activities, compared to Milligan Morgan haemorrhoidectomy [190].

Ligation Anopexy

A study recruiting 200 patients to compare ligation anopexy with conventional haemorrhoidectomy was conducted by Elshazly et al [188]. Ligation anopexy was concluded to have shorter operative times, earlier return to normal activities and lower pain scores, and it was shown to be as effective as the conventional haemorrhoidectomy.

Rubber Band Ligation

A study of 55 participants conducted by Peng et al, [179] comparing rubber band ligation with stapled haemorrhoidectomy, found no difference between the two techniques in terms of continence scores, patient satisfaction or quality of life. Rubber band ligation was associated with less pain and minor morbidity than stapled haemorrhoidopexy in the treatment of 3rd and small 4th degree prolapse. However, rubber band ligation was associated with a higher recurrence rate in comparison to stapled technique.

Lord's

In a study of 138 patients by Konsten et Baeten [191] anal dilation was found to be associated with a high percentage of symptoms of faecal incontinence. The authors, therefore, remarked the procedure should now be abandoned.

Milligan-Morgan (Open) haemorrhoidectomy

64 Randomised Controlled Trials involving 7710 patients compared Milligan-Morgan haemorrhoidectomy to other techniques.

In three randomised controlled trials including 369 patients, Milligan-Morgan excisional procedure was compared against (THD). Pain was found to be more severe in MM group, along with increased operative time and prolonged wound healing [189; 192; 193], however, Milligan-Morgan group saw least symptom recurrence than THD.

In an additional study of 121 patients, comparing MM technique to other minimally invasive procedures, Milligan-Morgan group was concluded to have the least symptom recurrence than THD, laser haemorrhoidoplasty and sutured mucopexy [154].

Three randomised controlled trials of 190 patients, comparing Harmonic Scalpel haemorrhoidectomy with excisional Milligan-Morgan technique or with electrocautery, found Harmonic Scalpel group to be associated with lower pain scores and faster return to normal activities [167; 194; 195]. Similarly in a 50-participant study, Harmonic Scalpel haemorrhoidectomy compared with conventional diathermy produced similar outcomes in postoperative pain and complications [196].

Diathermy Milligan-Morgan compared to scissors Milligan Morgan found no significant benefits of one technique over the other in terms of postoperative pain and hospital stay in a small, 20-patient study [197].

A further comparison of open Milligan-Morgan haemorrhoidectomy (MM) with a semi-closed technique (aka semi-open), conducted on 34 participants, found almost equivalent outcomes, with pain scores slightly lower in the MM group [198].

While a separate 300-patient study by [199] comparing the open and the semi-closed techniques found the semi-closed Milligan-Morgan group to have significantly reduced operative times and analgesia consumption, and earlier establishment of the bowel habits, compared to the open Milligan-Morgan group. In the same study, the open MM group also had significantly higher postoperative complication rates than the semi-closed group.

In three trials, collectively involving 171 patients, where Milligan-Morgan haemorrhoidectomy was compared with THD [181; 182; 185], THD was found to have a lower pain score, faster recovery and return to normal activities, however, a 3-year recurrence rate stood at 15% with THD, compared to no recurrence at 3 years with Milligan-Morgan technique. Also, the authors conclude that MM is superior over THD, especially for grade 4 haemorrhoids [182].

On the other hand, a small study of 40 participants [200] found no significant difference in recurrence rates of 4th degree haemorrhoids over a 3 year period between THD and excisional haemorrhoidectomy; and it found chronic complications to have occurred only after excisional haemorrhoidectomy.

Another large scale trial conducted by Watson et al, [158] surveyed 774 patients who underwent either stapled haemorrhoidopexy or traditional haemorrhoidectomy for symptomatic treatment of haemorrhoids. The post-procedural results favoured standard haemorrhoidectomy over stapled haemorrhoidopexy due to lower recurrence rates, reduced

symptoms and increased quality of life. Nevertheless, this study highlighted that stapled haemorrhoidopexy had less postoperative pain compared to the MM procedure.

In a study of 77 haemorrhoids patients, the data obtained from open and closed techniques indicated no significant differences in pain scores or rates of complications were seen, although faster wound healing was observed in the closed haemorrhoidectomy group [201].

LigaSure haemorrhoidectomy

A randomised controlled trial surveying 50 patients who were assigned to either LigaSure or Vojant haemorrhoidectomy, found LigaSure to be less painful than Vojant technique [202], with LigaSure patients seen recovering from the operation and returning to normal activities faster than their Vojant counterpart.

Fareed et al, [203] and Wang et al [204] report two separate studies with a total of 164 patients, where LigaSure technique is deemed equally acceptable compared to Ferguson's haemorrhoidectomy as it was shown to contribute to reduced post-operative pain and faster wound healing times, and overall increased patient satisfaction.

Another 46-participant trial assessing the effectiveness of the same techniques found no significant difference in post-operative pain scores, complications, or wound healing times between LigaSure and the closed haemorrhoidectomy [205].

Several other authors, evaluating a total of 514 patients, concluded LigaSure to be as effective in long-term symptom control as conventional diathermy haemorrhoidectomy, and to result in less postoperative pain [206], faster wound healing and return to normal activities [207; 208; 209; 210].

Trialling LigaSure and Harmonic Scalpel in a study of 47 participants, LigaSure haemorrhoidectomy, compared with Harmonic Scalpel, was found to take less operative time and result in lower pain scores and less analgesic consumption. Nevertheless, no difference was found in complication rates and overall patient satisfaction [211].

Basdanis et al [173] conducted a trial which compared LigaSure open haemorrhoidectomy with stapled haemorrhoidopexy in 95 patients. LigaSure haemorrhoidectomy was found to have lower operative times, lower incidence of intraoperative bleeding as well as no recurrence of haemorrhoids.

Ferguson (Closed) technique

Mert's trial involving 100 haemorrhoid patients found Ferguson's technique to have higher pain scores, and delay in healing and return to normal activities, compared to laser haemorrhoidoplasty [155];

Comparing Closed with the open (Milligan-Morgan) excisional techniques, a trial of 364 participants shows no significant difference in healing times and post-operative complications [212]; While a smaller study of 80 patients found less pain and faster wound healing with Ferguson's technique [213].

Three further studies which recruited 260 patients [214; 215; 216], evaluated Harmonic

Scalpel open technique with Ferguson's (closed) technique. All three concluded Harmonic Scalpel procedure to cause less postoperative pain, blood loss and postoperative complications, in contrast to Ferguson's technique [213].

When comparing Ferguson's with diathermy versus Ferguson's with scissors, no significant differences were found, and diathermy was associated with lower pain scores [217].

Evaluation of Ferguson's with ND:YAG to Ferguson's with scalpel excision found no significant benefits of the ND:YAG laser compared to the scalpel Ferguson's group [169].

Park's Technique

Compared with Milligan-Morgan haemorrhoidectomy, a study of 186 participants that evaluated Modified Parks technique found no significant difference in immediate post-operative time, and at day 14, but at day 7 postoperatively, less occurrence of pain and reduced severity was observed in Modified Park's haemorrhoidectomy [192].

Another small-scale study recruiting 34 participants looked into Park's technique and compared it to conventional Milligan-Morgan haemorrhoid resection. The investigation concluded both procedures equally satisfactory, with Park's technique causing less patient postoperative discomfort, shorter hospital stay and sooner return to work [218].

DISCUSSION

This review aimed to:

1. identify currently studied treatment options for symptomatic haemorrhoids,
2. highlight the drawbacks as well as advantages of each treatment modality based on the randomised controlled trials (RCTs), and, thirdly,
3. to provide recommendations based on the findings.

The study reviewed 87 Randomised Controlled Trials with a total of 9493 participants who had haemorrhoidal disease of various degree, ranging from I to IV.

In total, 31 trials were of high quality, 52 studies carried some degree of concern, whereas 4 studies were concluded to carry a high risk of bias.

The low-risk-of-bias studies were judged to be of good quality if all 5 risk-of-bias domains yielded satisfactory evidence. Namely, the appropriateness of randomisation techniques (e.g. a computer-based randomisation with both, patients and surgeons, blinded to the assignment groups up until the time of operation); the adherence of a study to the intended interventions; availability of outcome data; risk of bias in measurement of the outcome (e.g. blinding of the assessors to intervention techniques); and risk of bias in selection of the reported results.

The most common reason for a large proportion of studies judged as having "some concerns" was inadequate reporting of methods of the studies by authors. In particular, many randomised controlled trials did not sufficiently describe the randomisation process by which participants were assigned to particular techniques. On the other hand, in a few abstracts,

some authors claimed their patient samples to be adequately randomised, but upon a thorough investigation of full texts it was clear that some authors performed randomisation based on the day of hospital admission, whereas others “randomised” their patients on the date of birth.

Likewise, trials given a “High Risk” status those where no blinding was performed (also known as the “open label” studies) [180; 182; 178], and studies where patients received cash incentives to complete satisfaction questionnaires [169].

The following list of haemorrhoid interventions shows the number of studies having low, intermediate and high risk of bias by the technique:

The evidence on **Milligan- Morgan** procedure was found to contain 23 low-risk of bias studies, 38 somewhat concerning, and 2 high-risk of bias studies.

The evidence on **Stapled Haemorrhoidopexy** included 9 low-risk, 15 somewhat concerning, and 3 high-risk-of-bias studies.

The evidence on **LigaSure (Milligan-Morgan with LigaSure)** haemorrhoidectomy incorporated 6 low-risk of bias and 14 somewhat concerning studies.

The evidence on **Harmonic Scalpel (Milligan-Morgan with Harmonic Scalpel)** included 5 low-risk studies and 8 studies with some concerns.

The evidence on **Ferguson’s** haemorrhoidectomy included 7 low-risk of bias studies, 17 somewhat concerning studies, and 1 of high risk of bias studies;

The evidence on **Park’s** technique included 1 low-risk of bias studies

The evidence on **Radiofrequency ablation** included 3 low-risk of bias studies.

The evidence on **Suture Fixation Mucopexy** included 1 low-risk of bias studies and 2 somewhat concerning studies.

The evidence on **HAL-RAR** included 2 low-risk and 1 somewhat concerning risk of bias **Transanal Haemorrhoidal Dearterialisation (THD)** trials had 1 good quality evidence, 7 somewhat concerning, and 2 studies with a high-risk of bias.

Laser Haemorrhoidoplasty studies revealed 3 trials with good quality evidence , and 2 trials with some concerns.

A study on **Lord’s procedure** carried some concerns, whereas trials on **Rubber Band Ligation** and **Ligation Anopexy** carried a low risk of bias.

Table 4 (page 11) lists all the Randomised Controlled Trials that were included in the review, their main objectives, risk of bias assessment, and limitations/ remarks.

Based on the available data extracted by analysing the 87 included Randomised Controlled Trials , the following recommendations can be given:

In all patients irrespective of the degree of haemorrhoidal prolapse, conservative management techniques should be explored first. Patients should be advised on lifestyle and dietary modification and followed up and supported regularly. While proving sufficient in the

majority of cases, some may still require a certain degree of intervention in addition to conservative management.

Symptomatic patients with the first and second degree prolapse in whom conservative treatment methods fail to yield satisfactory results can be offered either radiofrequency ablation or rubber band ligation, in addition to ongoing lifestyle and dietary adjustments. Trials looking into these techniques report high effectiveness, shorter wound healing times and faster return to daily activities. The recurrence rates, however, are higher for those of excisional procedures.

For patients with 3rd (and possibly small 4th) degree of prolapse, stapled haemorrhoidopexy can be recommended as procedure of choice, as majority of trials have shown this technique to have lower pain scores, shorter healing times and accelerated return to normal activities, compared to the traditional excisional haemorrhoidectomy.

Despite the promising results, stapled haemorrhoidopexy has not yet gained its superiority over Milligan-Morgan procedure, and patients undergoing stapled haemorrhoidectomy need to be made aware that this procedure carries a significantly higher rate of recurrence and the need for re-intervention, compared to the excisional haemorrhoidectomy, which is especially true for grade 4 prolapse.

Milligan-Morgan (the open) haemorrhoidectomy can be recommended in patients with the “endstage” haemorrhoids, as this procedure still remains the gold standard for treating haemorrhoidal symptoms of advanced degree (3rd, and especially 4th degree). This excisional technique boasts the lowest recurrence rates compared to any other invasive and non-invasive techniques, and carries a high rate of long-term patient satisfaction.

It is well-documented that Milligan-Morgan procedure, however, is associated with higher degree of post-operative pain, longer healing times and more delayed return to normal activities. Nevertheless, when combined with adjuncts, such as LigaSure and Harmonic Scalpel, this procedure tends to have lower postoperative discomfort scores and earlier return to daily activities [161; 203; 206; 210].

CONCLUSION

A thorough investigation and careful assessment of haemorrhoids is of paramount importance when selecting a particular treatment modality. In addition, severity of the symptoms and the degree of prolapse should be taken into consideration, along with individual comorbidities and personal wishes. From the procedural perspective, the technique complexity and success rates need to be weighed against the recurrence risks when deciding on a suitability of a particular method.

Nevertheless, long-term lifestyle modifications, such as physical activity, increased fibre and fluid intake are prescribed as an initial conservative management or an adjunct to surgical intervention regardless of the degree of prolapse.

Conservative treatment is recommended for grades I, II and selected grades III. Minimally invasive interventions might be offered in particularly symptomatic low-grade cases

refractory to conservative treatment. In such cases, radiofrequency ablation, rubber band ligation, and Transanal Haemorrhoidal Dearterialisation (THD) are advised.

Grade III and grade IV haemorrhoid prolapse is generally managed by surgical techniques, such as stapled haemorrhoidopexy (grade III), doppler-guided haemorrhoidal artery ligation or excisional 'open' hemorrhoidectomy (especially using LigaSure or Harmonic Scalpel), with the latter technique conferring the best long-term results, having demonstrated the lowest recurrence rates and, although being associated with the highest postoperative pain scores, it is praised for high overall patient satisfaction.

KEYWORDS

Haemorrhoids, management, surgical, conservative, rubber band ligation, sclerotherapy, anal dilation, excisional haemorrhoidectomy, (EH), stapled haemorrhoidopexy, doppler-guided haemorrhoidal artery ligation with recto-anal repair (DG-HAL RAR), anorectal.

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