World Journal of Pharmaceutical and Life Sciences

Impact Factor: 8.21 www.wjpls.org Coden USA: WJPLA7

FINGER-GUIDED HEMORRHOIDAL ARTERY LIGATION FOR HEMORRHOIDAL DISEASE: A COMPREHENSIVE REVIEW

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DOI: https://doi.org/10.5281/zenodo.21715664

How to cite this Article: Dr. Abhinandan Manhas[1*], Dr. Arjun Gupta[2], Dr. Rahul Gupta[3], Dr. Sugandha Sharma[4], Dr. Kamalpreet Kaur[5], Dr. Sushant Padha[6] (2026). Finger-Guided Hemorrhoidal Artery Ligation For Hemorrhoidal Disease: A Comprehensive Review. World Journal of Pharmaceutical and Life Sciences, 12(8), 60–66.

Article Received on 07/07/2026 **Article Revised on 28/07/2026** **Article Published on 01/08/2026**

ABSTRACT

Hemorrhoidal disease is one of the most common proctological conditions affecting millions worldwide. While various treatment modalities exist, the quest for a minimally invasive, effective, and patient-friendly approach has led to the development of finger-guided hemorrhoidal artery ligation. This comprehensive review examines the pathophysiology of hemorrhoidal disease, the evolution of surgical management, and the role of finger-guided hemorrhoidal artery ligation as a cost-effective alternative to Doppler-guided techniques. The mechanism of dearterialization, surgical technique, clinical outcomes from recent studies, and comparison with conventional hemorrhoidectomy, stapled hemorrhoidopexy, and other minimally invasive techniques are presented. The available evidence suggests that finger-guided hemorrhoidal artery ligation offers comparable efficacy to Doppler-guided hemorrhoidal artery ligation at significantly reduced cost, making it particularly valuable in resource-limited settings. However, careful patient selection remains crucial for optimal outcomes.

KEYWORDS: Hemorrhoids, Finger-Guided Hemorrhoidal Artery Ligation, Dearterialization, Minimally Invasive Surgery, Hemorrhoidal Artery Ligation.

INTRODUCTION

Hemorrhoidal disease is one of the most frequently encountered anorectal conditions in clinical practice, affecting approximately 4.4% of the global population.[1] The disease significantly impacts the quality of life, with symptoms ranging from painless rectal bleeding to painful prolapse, thrombosis, and mucus discharge. Despite being considered a benign condition, the social stigma and discomfort associated with hemorrhoids often lead patients to delay seeking medical attention until the disease reaches advanced stages.[2]

The management of hemorrhoidal disease has evolved considerably over the past century. While conservative measures remain the first line of treatment for mild cases, surgical intervention becomes necessary for grade III and IV hemorrhoids or when conservative management fails.[3] Conventional hemorrhoidectomy, though considered the gold standard, is associated with significant postoperative pain, prolonged recovery, and potential complications such as anal stenosis and incontinence.[4]

In recent years, minimally invasive techniques have gained popularity due to their favorable safety profile and reduced postoperative morbidity. Among these, hemorrhoidal artery ligation was first described by Morinaga et al. in 1995 using a Doppler-guided approach.[5] Subsequently, finger-guided hemorrhoidal artery ligation was developed as a cost-effective alternative that eliminates the need for expensive Doppler equipment while maintaining comparable clinical outcomes.[6] This review aims to comprehensively examine the role of finger-guided hemorrhoidal artery ligation in the management of hemorrhoidal disease, with particular emphasis on its

mechanism of action, technique, clinical outcomes, advantages, and limitations.

MATERIALS AND METHODS

search strategy

This comprehensive review was conducted following a systematic approach to literature search and analysis. A thorough search of electronic databases including PubMed, Scopus, Google Scholar, and Cochrane Library was performed using the following search terms: "finger-guided hemorrhoidal artery ligation," "FGHAL," "hemorrhoidal artery ligation," "dearterialization," "transanal hemorrhoidal dearterialization," "minimally invasive hemorrhoid surgery," and "Doppler-guided hemorrhoidal artery ligation." The search was limited to articles published in English between 1995 and 2025.

inclusion and exclusion criteria

Inclusion criteria comprised original research articles, systematic reviews, meta-analyses, and comparative studies evaluating finger-guided hemorrhoidal artery ligation or related dearterialization techniques for hemorrhoidal disease. Exclusion criteria included case reports with fewer than 10 patients, non-English language publications, letters to the editor without original data, and articles focusing solely on Doppler-guided techniques without comparison to finger-guided methods.

data extraction and quality assessment

Data extraction focused on study design, sample size, hemorrhoid grade, surgical technique details, postoperative outcomes including pain scores, bleeding resolution, prolapse reduction, recurrence rates, return to normal activities, complication rates, and cost-effectiveness. The quality of included studies was assessed based on study design, sample size, follow-up duration, and methodological rigor.

RESULTS AND DISCUSSION

anatomy and pathophysiology of hemorrhoidal disease

The anal canal contains three main vascular cushions located at the right anterior (7 o'clock), right posterior (11 o'clock), and left lateral (3 o'clock) positions in the lithotomy position.[7] These cushions are composed of vascular plexuses, smooth muscle fibers (Treitz's muscle), supportive connective tissue, and overlying mucosa. The hemorrhoidal plexus receives arterial blood supply primarily from the terminal branches of the superior rectal artery, which typically enter the hemorrhoidal tissue at positions corresponding to 1, 3, 5, 7, 9, and 11 o'clock around the anal circumference.[8] The vascular nature of hemorrhoids has been well characterized, with the superior rectal artery and its branching pattern playing a crucial clinical role in ligation techniques.[9]

The currently accepted sliding anal cushion theory proposes that hemorrhoids develop when the supporting tissues of the anal cushions disintegrate or deteriorate, leading to abnormal downward displacement of the anal cushions.[10] Recent research has highlighted the role of vascular hyperperfusion in the pathogenesis of hemorrhoidal disease. Aigner et al. demonstrated that the terminal branches of the superior rectal artery supplying the anal cushions in patients with hemorrhoids had significantly larger diameter, greater blood flow, higher peak velocity, and acceleration velocity compared to healthy volunteers.[12] These abnormal findings correlated with the severity (grade) of hemorrhoids, supporting the concept that arterial hyperperfusion contributes to the development and progression of the disease.[13]

Furthermore, studies have revealed increased microvascular density in hemorrhoidal tissue, suggesting that neovascularization may be another important phenomenon in hemorrhoidal disease.[14] Overexpression of matrix metalloproteinases (MMP-2 and MMP-9) has been documented in hemorrhoidal tissue, leading to degradation of extracellular matrix components including elastin and collagen, which compromises the structural integrity of the anal cushions.[11] These pathophysiological insights have formed the basis for dearterialization procedures, which aim to reduce arterial inflow to the hemorrhoidal plexus.[15]

evolution of surgical management

The surgical treatment of hemorrhoids dates back to ancient civilizations, but modern operative techniques were established in the 20th century. Milligan et al. described the open hemorrhoidectomy in 1937, which involved excision of the hemorrhoidal tissue with preservation of the anal skin.[16] Ferguson and Heaton later popularized the closed technique, which involved closure of the mucosal defects after hemorrhoid excision, resulting in reduced wound healing time.[17]

Despite modifications, conventional hemorrhoidectomy remained associated with significant postoperative pain, leading to the development of alternative approaches. In 1995, Morinaga et al. introduced Doppler-guided hemorrhoidal artery ligation, which represented a paradigm shift from tissue excision to targeted interruption of arterial blood supply.[5] This minimally invasive approach was based on the recognition that reducing arterial inflow could achieve symptom resolution without the morbidity associated with tissue excision.[15]

The development of stapled hemorrhoidopexy by Longo in 1998 provided another minimally invasive option, particularly for patients with circumferential prolapse.[18] However, concerns about serious complications, including pelvic sepsis and staple-line complications, have limited its widespread adoption.[19] More recently, energy-based procedures such as laser hemorrhoidoplasty have emerged as additional minimally invasive options.[20]

The concept of finger-guided hemorrhoidal artery ligation evolved from the observation that the terminal branches of the superior rectal artery follow relatively constant anatomical patterns. Several researchers demonstrated that skilled surgeons could reliably locate these arterial branches through digital palpation, eliminating the need for Doppler guidance while maintaining comparable outcomes.[6] This realization led to the development of finger-guided hemorrhoidal artery ligation as a simplified, cost-effective alternative to Doppler-guided hemorrhoidal artery ligation, particularly suitable for centers with limited resources.[21]

surgical technique and procedure

Patient selection is crucial for successful outcomes with finger-guided hemorrhoidal artery ligation. The procedure is most suitable for patients with grade II and III internal hemorrhoids, particularly those presenting with bleeding as the predominant symptom.[22] Preoperative evaluation includes a detailed history, digital rectal examination, and anoscopy to confirm the diagnosis and grade the hemorrhoids. Colonoscopy or flexible sigmoidoscopy should be performed in patients with alarm symptoms or those not up-to-date with colorectal cancer screening.[23]

Contraindications include grade IV hemorrhoids with irreducible prolapse, significant external hemorrhoids or large skin tags requiring excision, concomitant anorectal pathology such as fissure or fistula, and patients with bleeding diathesis or on anticoagulation that cannot be safely discontinued.[24] Patients should receive appropriate bowel preparation, typically with an enema on the morning of the procedure.

The procedure is performed under local, regional, or general anesthesia depending on patient preference and institutional practice. The patient is positioned in the lithotomy position, and the perineal region is prepared and draped in a sterile manner. A modified anoscope or proctoscope without Doppler attachment is introduced into the anal canal.[21]

The fundamental principle involves identifying the terminal branches of the superior rectal artery through careful digital palpation. The surgeon inserts a finger alongside the proctoscope to palpate the arterial pulsations at the typical locations (1, 3, 5, 7, 9, and 11 o'clock positions) approximately 2-4 cm above the dentate line.[6] The arteries are most commonly found in the submucosal plane at these positions, and their pulsations can be appreciated as rhythmic tapping sensations against the examining finger.[25]

Once the artery is identified at a given position, a figure-of-eight or Z-shaped transfixion ligature is placed using absorbable suture material (typically 2-0 or 3-0 polyglactin or polydioxanone).[6] The suture incorporates the mucosa and submucosa at the site of maximal pulsation, ensuring ligation of the feeding artery while avoiding full-thickness bites that could penetrate the rectal wall. The ligature is secured firmly to achieve hemostasis but not so tight as to cause tissue necrosis.[21]

For patients with mucosal prolapse, mucopexy can be performed in conjunction with the ligation. The suture is continued as a running stitch from the ligation site distally toward the hemorrhoidal apex, plicating the redundant mucosa and anchoring it to the underlying muscularis.[22] This maneuver serves to both ligate any accessory arterial branches and to reposition the prolapsed tissue to its anatomical location. Care must be taken to keep the last stitch at least 5 mm proximal to the dentate line to avoid placement in the somatically innervated anoderm, which would result in significant postoperative pain.[23]

The procedure is repeated at all positions where arterial pulsations are identified, typically involving 4-6 ligations.[24] The surgeon verifies hemostasis before withdrawing the proctoscope. The entire procedure typically takes 20-40 minutes depending on the number of ligations required and the complexity of the case.[26]

Patients are typically discharged on the same day or after an overnight stay depending on the institutional protocol and individual patient factors. Oral analgesics (non-steroidal anti-inflammatory drugs and paracetamol) are usually sufficient for pain control. Laxatives and dietary advice to maintain soft stools are prescribed to prevent straining during defecation.[27] Patients are advised to avoid heavy lifting and strenuous activity for 2 weeks. Follow-up is typically scheduled at 1 week, 1 month, and 3 months postoperatively, or sooner if complications develop.[28]

mechanism of action: dearterialization

The primary therapeutic mechanism of finger-guided hemorrhoidal artery ligation is dearterialization, which involves interruption of the arterial blood supply to the hemorrhoidal plexus.[15] This concept is based on the hemodynamic theory of hemorrhoidal pathogenesis, which posits that increased arterial inflow contributes to the engorgement and enlargement of the hemorrhoidal cushions.[12]

The terminal branches of the superior rectal artery provide the main arterial supply to the hemorrhoidal plexus. By ligating these vessels proximal to the hemorrhoidal tissue, finger-guided hemorrhoidal artery ligation effectively reduces the hydrostatic pressure within the sinusoidal spaces.[29] This reduction in arterial inflow leads to several physiological changes: reduction in sinusoidal pressure, tissue fibrosis and fixation, mucosal plication effect, and preservation of venous drainage.

Ratto et al. demonstrated that the dearterialization effect is most pronounced when ligation is performed at the point where the Doppler signal is maximal, typically

corresponding to the most distal accessible point of the arterial branch within the submucosal layer.[31] This principle, while originally described using Doppler guidance, can be effectively replicated through careful digital palpation and anatomical knowledge, as the arterial branches follow predictable patterns.[21]

The combination of dearterialization and mucopexy addresses both the vascular and mechanical components of hemorrhoidal disease. While dearterialization targets the hyperperfusion that leads to cushion engorgement, mucopexy corrects the connective tissue degeneration and prolapse that characterize advanced disease.[32] This dual mechanism explains why the addition of mucopexy to artery ligation significantly improves outcomes in patients with grade III hemorrhoids compared to ligation alone.[33]

clinical outcomes and efficacy

Multiple studies have evaluated the clinical outcomes of finger-guided hemorrhoidal artery ligation and its variants. While direct comparison studies between finger-guided and Doppler-guided approaches remain limited, available evidence suggests comparable efficacy between the two approaches.[21] The most consistently reported outcome across studies is the resolution of rectal bleeding. Gupta et al. reported that finger-guided hemorrhoidal artery ligation combined with laser hemorrhoidoplasty achieved complete resolution of bleeding in 93% of patients with grade II-IV hemorrhoids.[20] Das et al., in their prospective observational study of 74 patients treated with the combination of finger-guided hemorrhoidal artery ligation and laser hemorrhoidoplasty, reported excellent efficacy with a 90% overall success rate.[6] The bleeding resolution rates with finger-guided hemorrhoidal artery ligation are comparable to those reported with Doppler-guided hemorrhoidal artery ligation, which range from 85% to 95% in the literature.[34]

When combined with mucopexy, finger-guided hemorrhoidal artery ligation achieves good results in controlling hemorrhoidal prolapse. The mucopexy component addresses the mechanical prolapse by plicating the redundant mucosa and restoring the anatomical position of the anal cushions.[22] Studies reporting on Doppler-guided hemorrhoidal artery ligation with mucopexy have demonstrated prolapse resolution rates of 70-90%, and finger-guided hemorrhoidal artery ligation appears to achieve similar outcomes when mucopexy is properly performed.[35]

One of the principal advantages of finger-guided hemorrhoidal artery ligation over conventional hemorrhoidectomy is the significantly reduced postoperative pain. Since the procedure is performed above the dentate line in the autonomically innervated rectal mucosa, somatic pain fibers are not directly stimulated.[31] Postoperative pain scores measured on the Visual Analog Scale (VAS) typically range from 1-3 out of 10 in the first 24 hours, compared to 6-9 following conventional hemorrhoidectomy.[36] Most patients require only oral analgesics for 2-4 days postoperatively.[27]

Patients undergoing finger-guided hemorrhoidal artery ligation typically return to normal activities within 3-7 days, significantly faster than the 2-3 weeks required after conventional hemorrhoidectomy.[28] This rapid recovery is attributed to the absence of open wounds in the somatically innervated anoderm and the minimally invasive nature of the procedure.[29]

Recurrence remains the most significant concern with artery ligation techniques. Reported recurrence rates with Doppler-guided hemorrhoidal artery ligation range from 5% to 20% depending on the grade of hemorrhoids, length of follow-up, and whether mucopexy was performed.[37] The recurrence rates with finger-guided hemorrhoidal artery ligation appear to be similar, with studies reporting rates of 8-18% at 1-2 year follow-up.[6] Higher recurrence rates are consistently observed with grade IV hemorrhoids and when mucopexy is not performed.[38]

comparison with other surgical modalities

A systematic review and meta-analysis by Xu et al. comparing transanal hemorrhoidal dearterialization with Doppler guidance versus transanal hemorrhoidal dearterialization without Doppler guidance found no statistically significant differences in bleeding at 6 months, prolapse recurrence at one year, postoperative pain, or operative time between the two approaches.[39] The authors concluded that Doppler guidance may not be necessary for effective hemorrhoidal artery ligation, and that finger-guided techniques can achieve comparable results.

A recent systematic review and meta-analysis of 10 randomized clinical trials by Tutino et al. involving 961 patients similarly found no statistically significant differences between Doppler-guided and digitally guided hemorrhoidal artery ligation regarding recurrence of bleeding, prolapse, postoperative pain, or operative time.[40] These findings support the use of finger-guided hemorrhoidal artery ligation as a viable, cost-effective alternative to Doppler-guided hemorrhoidal artery ligation.

Conventional hemorrhoidectomy (Milligan-Morgan or Ferguson) remains the gold standard for durable treatment of hemorrhoids, with the lowest long-term recurrence rates.[4] However, finger-guided hemorrhoidal artery ligation offers several advantages including significantly less postoperative pain, shorter hospital stay, and faster return to normal activities.[36] A multicenter prospective study by Gachabayov et al. comparing transanal hemorrhoidal dearterialization with mucopexy to Ferguson hemorrhoidectomy found that transanal hemorrhoidal dearterialization patients had

lower pain scores at all postoperative time points, with non-significantly different recurrence rates at median 3.1-year follow-up.[41]

Stapled hemorrhoidopexy (Longo procedure) uses a circular stapler to resect a circumferential cuff of mucosa above the hemorrhoidal tissue, thereby interrupting the blood supply and lifting the prolapsed tissue.[18] Comparative studies between hemorrhoidal artery ligation techniques and stapled hemorrhoidopexy have shown comparable short-term outcomes, with hemorrhoidal artery ligation associated with lower postoperative pain and greater patient satisfaction.[42] A prospective randomized study by Avital et al. directly comparing stapled hemorrhoidopexy with Doppler-guided hemorrhoidal artery ligation for grade III hemorrhoids found comparable outcomes between the two techniques, further supporting the minimally invasive approach.[30] Stapled hemorrhoidopexy has been associated with serious complications including pelvic sepsis, rectovaginal fistula, and staple-line complications, which has led to decreased enthusiasm for the procedure.[19]

Laser hemorrhoidoplasty uses diode laser energy to coagulate the hemorrhoidal arterial flow feeding the hemorrhoidal plexus. When combined with finger-guided hemorrhoidal artery ligation, laser treatment addresses the non-vascular components in the anal cushions while finger-guided hemorrhoidal artery ligation achieves dearterialization.[6] Studies using this combination have reported excellent outcomes with 90% success rates and minimal postoperative discomfort.[20] However, the addition of laser increases the cost of the procedure, potentially offsetting some of the cost advantages of finger-guided hemorrhoidal artery ligation alone.

comparative analysis of surgical modalities

Table 1: Comparison of surgical modalities for hemorrhoidal disease.

Parameter	FGHAL	DG-HAL	Conventional Hemorrhoidectomy	Stapled Hemorrhoidopexy
Postoperative Pain	Minimal (VAS 1-3)	Minimal (VAS 1-3)	Significant (VAS 6-9)	Moderate (VAS 3-5)
Return to Activities	3-7 days	3-7 days	2-3 weeks	1-2 weeks
Recurrence Rate	8-18%	5-20%	2-5%	5-15%
Equipment Cost	Low	High (Doppler)	Low	Moderate (Stapler)
Ideal Grade	II-III	II-III	II-IV	III-IV with prolapse

complications and their management

Finger-guided hemorrhoidal artery ligation is generally well-tolerated with a low complication rate. The complications that do occur are typically minor and self-limiting.[34] Minor bleeding is reported in 2-8% of patients and usually resolves spontaneously or with conservative management.[37] Significant bleeding requiring intervention is rare. Transient urinary retention occurs in 3-15% of patients, more commonly in male patients and those who received spinal anesthesia.[36] Mild to moderate pain or sensation of incomplete evacuation (tenesmus) is reported by 10-35% of patients, typically resolving within 1-2 weeks.[34] Hemorrhoidal thrombosis occurs in 2-8% of patients and may require conservative management or thrombectomy.[37]

Rare complications include rectal perforation from full-thickness suture placement, which is minimized by ensuring that sutures incorporate only mucosa and submucosa.[24] Infectious complications including perianal abscess and pelvic sepsis are extremely rare but potentially life-threatening.[19] Temporary fecal urgency is reported in 2-5% of patients, likely due to the proximity of sutures to the sensory receptors in the anal transitional zone. Permanent incontinence is rare.[32]

Most minor complications are managed conservatively with analgesics, stool softeners, and reassurance. Postoperative bleeding typically responds to local pressure and hemostatic agents. Urinary retention may require temporary catheterization. Severe or persistent complications should prompt thorough evaluation to rule out technical errors or underlying pathology.[27]

factors affecting clinical outcomes

Several factors influence the success of finger-guided hemorrhoidal artery ligation and should be considered during patient selection and counseling. Grade II and III hemorrhoids are associated with the best outcomes following finger-guided hemorrhoidal artery ligation. Grade IV hemorrhoids with large, circumferential prolapse or significant external component have higher recurrence rates and are less suitable for this approach.[25] Studies have consistently shown that higher-grade hemorrhoids are independently associated with increased recurrence, with grade IV disease having odds ratios of 3-4 for recurrence compared to grade II-III.[38]

The learning curve for finger-guided hemorrhoidal artery ligation is estimated to be 15-20 cases.[38] Recurrence rates tend to be higher during the initial experience, improving as the surgeon develops proficiency in identifying arterial branches through palpation and optimizing suture placement.[37] The addition of mucopexy to artery ligation significantly improves outcomes in patients with prolapse.[33] For patients with significant external hemorrhoids or skin tags, combining finger-guided hemorrhoidal artery ligation with excision

of the external component (hybrid procedures) may optimize results.[25]

CONCLUSION

Finger-guided hemorrhoidal artery ligation represents an important advancement in the surgical management of hemorrhoidal disease. By targeting the pathophysiological basis of hemorrhoids through dearterialization, finger-guided hemorrhoidal artery ligation offers effective symptom relief with minimal invasiveness. The elimination of expensive Doppler equipment makes this technique particularly valuable in resource-limited settings without compromising clinical outcomes.[21][39]

The mechanism of dearterialization addresses the arterial hyperperfusion that contributes to hemorrhoidal disease, while mucopexy corrects the associated mucosal prolapse. Available evidence demonstrates that finger-guided hemorrhoidal artery ligation achieves comparable results to Doppler-guided hemorrhoidal artery ligation in terms of bleeding resolution, prolapse control, postoperative pain, and recurrence rates.[39][40] The advantages of reduced pain, rapid recovery, preservation of continence, and day-case suitability make finger-guided hemorrhoidal artery ligation an attractive option for appropriately selected patients with grade II and III hemorrhoids.[34]

However, the higher recurrence rates compared to excisional hemorrhoidectomy, particularly for grade IV disease, and the learning curve associated with accurate identification of arterial branches by palpation remain important considerations.[37][38] Patient selection is crucial, and finger-guided hemorrhoidal artery ligation should be reserved for patients with grade II-III internal hemorrhoids without significant external disease.[25]

In conclusion, finger-guided hemorrhoidal artery ligation is a safe, effective, and cost-efficient minimally invasive technique for the management of hemorrhoidal disease. As healthcare systems worldwide seek to optimize outcomes while controlling costs, finger-guided hemorrhoidal artery ligation offers a pragmatic solution that bridges the gap between expensive technology-dependent procedures and morbid excisional surgery. Further research with long-term comparative data will help refine patient selection criteria and establish the definitive place of finger-guided hemorrhoidal artery ligation in the treatment algorithm for hemorrhoidal disease.

ACKNOWLEDGEMENTS

The authors would like to thank the Department of Shalya Tantra, Jammu Institute of Ayurveda and Research for their support in conducting this review. No external funding was received for this study.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this article.

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