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Conventional Hemorrhoidectomy Versus Recent Advances in Energy-Based Devices: A Comparative Narrative Review

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ABSTRACT: Excisional hemorrhoidectomy by the open Milligan–Morgan or closed Ferguson technique remains the most durable treatment for advanced hemorrhoidal disease, but the wide wounds it creates in the sensitive anoderm are associated with substantial postoperative pain, bleeding, urinary retention and prolonged convalescence. Over the past two decades several energy-based devices have been introduced to reduce this morbidity while preserving efficacy. This narrative review compares conventional hemorrhoidectomy with three contemporary modalities — laser hemorrhoidoplasty, radiofrequency excision and the LigaSure bipolar vessel-sealing system — and additionally compares LigaSure with the ultrasonic Harmonic device. Across randomised trials and a recent meta-analysis, laser hemorrhoidoplasty offered shorter operative times, lower intraoperative blood loss, less early postoperative pain and a lower risk of postoperative haemorrhage, at the cost of higher equipment expense, operator dependence and a theoretical risk of recurrence when redundant mucosa is preserved rather than excised. Radiofrequency excision reduced severe postoperative pain and improved wound healing with complication rates comparable to conventional diathermy, although an earlier return to daily activity was not consistently demonstrated. LigaSure has the most robust evidence base, with multiple randomised trials showing reduced operative time, blood loss and pain, faster healing and earlier return to activity, while complication and recurrence rates remained broadly similar to conventional surgery. Head-to-head, LigaSure and Harmonic produced comparable outcomes. Energy devices reduce perioperative morbidity without clearly increasing complications; device selection should be guided by hemorrhoid grade, available expertise, cost and patient priorities.

1. INTRODUCTION

Hemorrhoidal disease is among the most common anorectal conditions encountered in surgical practice; in the United States alone it accounts for more than 2.2 million outpatient evaluations each year [1]. Internal hemorrhoids are conventionally graded by the Goligher classification: grade I, no prolapse; grade II, prolapse on straining with spontaneous reduction; grade III, prolapse requiring manual reduction; and grade IV, irreducible prolapse [1]. For symptomatic disease, dietary and behavioural modification together with office-based procedures such as rubber band ligation form the first line of treatment, while surgery is generally reserved for higher-grade (III–IV) and refractory disease [1].

Conventional excisional hemorrhoidectomy — whether performed as the open Milligan–Morgan operation or the closed Ferguson technique — remains effective and durable and is widely regarded as the reference standard for advanced disease. Its

principal drawback is significant postoperative pain, arising from the wide external wounds created in the richly innervated perianal skin and anoderm [2]. This pain, along with bleeding, urinary retention, delayed wound healing and a prolonged absence from work, has motivated the search for techniques that lessen perioperative morbidity without sacrificing the durability of excision [2].

Energy-based platforms have emerged as the principal response to this need. Diode and Nd:YAG lasers deliver controlled photothermal energy to shrink hemorrhoidal tissue; radiofrequency devices coagulate tissue at comparatively low temperatures; bipolar vessel-sealing systems such as LigaSure fuse vessel walls with minimal collateral injury; and ultrasonic devices such as the Harmonic scalpel cut and coagulate through mechanical vibration. The aim of this narrative review is to compare conventional hemorrhoidectomy with laser hemorrhoidoplasty, radiofrequency excision and LigaSure hemorrhoidectomy, and to place LigaSure alongside the Harmonic device, focusing on perioperative outcomes, postoperative pain, wound healing, complications, recurrence and resource considerations.

2. SEARCH STRATEGY AND SELECTION CRITERIA

This is a narrative, not a systematic, review. PubMed was searched for English-language randomised controlled trials, meta-analyses and comparative clinical studies evaluating energy-based devices against conventional excisional hemorrhoidectomy, using combinations of the terms “hemorrhoidectomy”, “laser hemorrhoidoplasty”, “radiofrequency”, “LigaSure”, “vessel sealing” and “Harmonic scalpel”. Priority was given to randomised trials and to recent meta-analyses. Because the review is narrative in design, no formal risk-of-bias appraisal or quantitative pooling of data was undertaken, and the synthesis that follows is qualitative.

3. CONVENTIONAL EXCISIONAL HEMORRHOIDECTOMY: THE REFERENCE STANDARD

Conventional hemorrhoidectomy aims to excise the symptomatic hemorrhoidal cushions together with their feeding vessels. In the open Milligan–Morgan procedure the resulting wounds are left to heal by secondary intention, whereas in the closed Ferguson technique the mucosal and anodermal defects are primarily approximated [2]. Both achieve excellent long-term control of grade III–IV disease and carry the lowest recurrence rates of any treatment, but both also generate the greatest postoperative pain because of the extent of the perianal wounds in innervated tissue [2]. It is against this benchmark of durability and morbidity that the newer energy devices are measured.

4. LASER HEMORRHOIDOPLASTY VERSUS CONVENTIONAL HEMORRHOIDECTOMY

Laser hemorrhoidoplasty is performed with a diode (commonly 980 or 1470 nm) or Nd:YAG laser, the energy of which is delivered through a fine radial fibre introduced into the hemorrhoidal pile. The laser produces controlled submucosal photocoagulation that shrinks the hemorrhoidal tissue and induces fibrosis, sealing the feeding vessels without excising the overlying mucosa. Because no wide external wound is created and the sphincter is spared, the technique is minimally invasive in character.

In a 2024 meta-analysis comparing diode laser hemorrhoidoplasty with conventional Milligan–Morgan and Ferguson hemorrhoidectomy, the laser technique was associated with a shorter operative time and lower intraoperative blood loss, less postoperative pain on the day after surgery, and a lower risk of postoperative haemorrhage [3]. These advantages make it an attractive, sphincter-sparing option for grade II and III hemorrhoids.

The benefits are not without trade-offs. Because redundant mucosa is preserved rather than removed, a theoretical concern remains regarding higher long-term recurrence, particularly in higher-grade disease, and the available comparative data are weighted towards short-term outcomes. The capital cost of the laser platform and a degree of operator dependence further limit its applicability, especially in resource-constrained settings.

5. RADIOFREQUENCY VERSUS CONVENTIONAL HEMORRHOIDECTOMY

Radiofrequency excision uses a high-frequency alternating current to induce localised resistive heating and tissue coagulation at temperatures lower than those of conventional monopolar diathermy, thereby limiting collateral thermal damage and lateral spread. In principle this yields more precise coagulative necrosis, with faster wound healing and a lower nociceptive burden.

In a prospective randomised study of 210 patients, Franceschilli and colleagues compared radiofrequency (delivered with a vessel-sealing device) against conventional diathermy Milligan–Morgan hemorrhoidectomy [4]. Radiofrequency was followed

by a significant reduction in severe postoperative pain and by better wound healing, while early and late complications — including recurrence — were similar between the two techniques. Notably, the reduction in pain and the improvement in healing did not translate into an earlier return to daily activities in that series [4]. The principal practical limitations of radiofrequency are the higher cost of the equipment and its consequently limited availability, rather than any excess of complications such as wound infection, urinary retention or anal stenosis, the rates of which were comparable between groups.

6. LigaSure (bipolar vessel sealing) versus conventional hemorrhoidectomy

The LigaSure system is a bipolar electrothermal device that seals blood vessels up to 7 mm in diameter by denaturing the collagen and elastin within the vessel wall to form a permanent fused seal. By delivering energy in a feedback-controlled manner it minimises lateral thermal injury and substantially reduces the need for suture ligation, which in turn lessens the postoperative nociceptive input associated with sutures and tissue handling.

A consistent body of randomised evidence supports its perioperative advantages. The multicentre trial of Altomare and colleagues [5], together with randomised trials by Muzi et al. [6], Bessa [7], Palazzo et al. [8], Pattana-Arun et al. [9] and Milito et al. [10], reported that LigaSure hemorrhoidectomy significantly reduced operative time, intraoperative blood loss and postoperative pain, and was associated with faster wound healing and an earlier return to normal daily activity when compared with conventional diathermy or scalpel excision [5–10]. Importantly, these gains did not come at the expense of safety: the rates of urinary retention, anal stenosis and recurrence remained broadly similar between the LigaSure and conventional groups across these trials [5–10]. Because the technique is excisional, its long-term durability is comparable to that of conventional surgery, distinguishing it from non-excisional approaches.

7. LIGASURE VERSUS THE HARMONIC SCALPEL

The Harmonic scalpel achieves simultaneous cutting and coagulation through ultrasonic mechanical vibration, and like LigaSure it limits lateral thermal spread relative to conventional diathermy. Two randomised comparisons are informative here. Talha and colleagues compared LigaSure and Harmonic with conventional diathermy in excisional hemorrhoidectomy [11], and Kwok and colleagues performed a double-blind randomised trial directly comparing LigaSure with the Harmonic scalpel [12]. Taken together, these studies indicate that both energy devices deliver better postoperative outcomes than conventional diathermy, but that when compared head-to-head LigaSure and Harmonic produce broadly equivalent results in terms of postoperative pain, blood loss and wound healing [11,12].

8. COMPARATIVE SYNTHESIS

Laser, radiofrequency and LigaSure share the common advantages of reduced thermal spread and precise haemostasis relative to conventional excision. Their distinguishing features, however, suggest different niches. Laser hemorrhoidoplasty produces the least wound formation and the best cosmetic and sphincter-sparing outcomes and is well suited to grade II–III disease, but carries a recurrence concern in higher grades and demands significant capital outlay and operator skill. Radiofrequency offers controlled coagulation with faster healing and reduced severe pain, with cost and availability being its main constraints. LigaSure is supported by the most extensive and reproducible randomised evidence and, being excisional, combines reduced perioperative morbidity with durability comparable to conventional surgery, making it a cost-effective and reproducible choice in adequately resourced settings. The optimal device is therefore best chosen according to hemorrhoid grade, the equipment and expertise available, cost, and whether the individual patient prioritises early comfort and cosmesis or long-term durability.

Table 1. Comparative summary of conventional and energy-based hemorrhoidectomy techniques.

Modality	Mechanism	Key advantages vs conventional	Limitations / considerations
Conventional (Milligan–Morgan / Ferguson)	Surgical excision of hemorrhoidal cushions; open or closed wounds	Reference standard; most durable; lowest recurrence	Greatest postoperative pain; slower healing; longer convalescence
Laser hemorrhoidoplasty	Diode / Nd:YAG submucosal	Shorter operative time; less blood loss; less early pain;	Higher cost; operator-dependent; recurrence

Modality	Mechanism	Key advantages vs conventional	Limitations / considerations
	photocoagulation and shrinkage	lower haemorrhage risk; sphincter-sparing	concern in higher grades; best for grade II–III
Radiofrequency	High-frequency current; low-temperature coagulation	Reduced severe pain; better wound healing; complications similar	Higher equipment cost; limited availability; earlier return to activity not consistent
LigaSure (vessel sealing)	Bipolar sealing of vessels up to 7 mm by collagen/elastin denaturation	Reduced operative time, blood loss and pain; faster healing; earlier return to activity; excisional durability	Equipment cost; complication and recurrence rates similar to conventional
Harmonic scalpel	Ultrasonic mechanical cutting and coagulation	Better outcomes than conventional diathermy; comparable to LigaSure head-to-head	Equipment cost; no clear advantage over LigaSure

9. LIMITATIONS

Several caveats temper the conclusions of this review. It is narrative rather than systematic, and no formal quality appraisal or quantitative synthesis was performed. The underlying literature is heterogeneous in the devices used, the grades of hemorrhoidal disease treated, the anaesthetic and analgesic protocols applied, and the duration of follow-up. Many of the individual trials are small or single-centre. Terminology also overlaps — some “radiofrequency” trials in fact employed bipolar vessel-sealing instruments — which complicates direct comparison. Finally, robust long-term recurrence data are limited, particularly for laser hemorrhoidoplasty, where preservation of mucosa raises questions that short-term studies cannot answer.

10. CONCLUSION

Energy-based devices reduce the perioperative morbidity of hemorrhoid surgery relative to conventional excision without a clear increase in complications, while conventional Milligan–Morgan and Ferguson hemorrhoidectomy remain the benchmark for durability in advanced disease. Among the alternatives, LigaSure is supported by the most robust randomised evidence and offers an excisional, reproducible and cost-effective option in high-resource settings; laser hemorrhoidoplasty provides the gentlest recovery and best cosmesis for grade II–III disease; and radiofrequency is an effective alternative where the equipment is available. Larger, adequately powered randomised trials with long-term follow-up are needed to define the durability of these techniques and to guide device selection more precisely.

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