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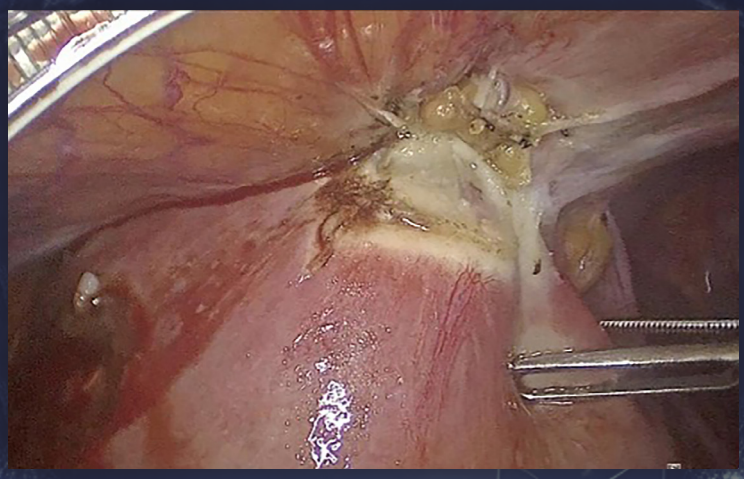

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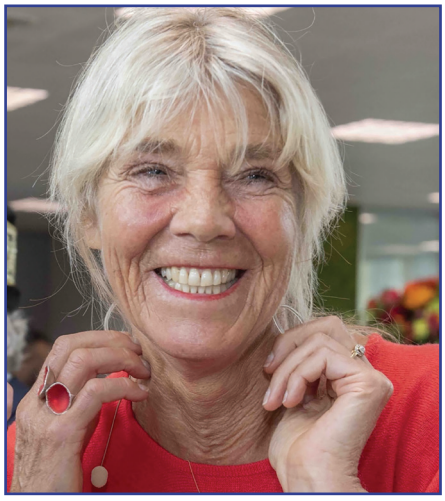
Marlies Bongers (11-03-1957 – 26-10-2025)



Marlies Bongers studied medicine in Groningen and trained as a gynaecologist at the Free University and the Onze Lieve Vrouwe Gasthuis both in Amsterdam. In 1990, she became the first female consultant to join the gynecology partnership at St. Joseph Hospital, the later Máxima Medical Center in the Eindhoven area. From there, she obtained her PhD on the subject of heavy menstrual bleeding. Marlies was highly driven to take menstrual complaints out of the taboo. She succeeded in persuading employers to create more space in the workplace for women suffering from menstrual symptoms. At the same time, she wrote together with Corien van Zweden the book "Biography of the Uterus", with which they sought to reach all women experiencing menstrual problems. Marlies listened to these women and was creative in designing research to find solutions, always grounded in her clinical experience. She was an excellent clinician and minimally invasive surgeon and attached the greatest importance to a scientific approach to demonstrate the effectiveness and safety of procedures. She was a pioneer in the field of women's health, also training her residents in this domain. Until then, the field of benign gynecology was not at the forefront of clinical scientific research, largely due to lack of funding. This did not stop her from initiating research trajectories with many PhD candidates. To finance this work, she established a foundation. In the Netherlands, she introduced the NovaSure technique and conducted research into various methods of global ablation. She was the driving force behind ambulatory hysteroscopy in the Netherlands, including the introduction of the vaginoscopic hysteroscopy and NovaSure under sedation and later using only so-called fundal anesthesia. Her efforts were recognized when she was appointed Professor of Benign Gynecology. In 2015, she delivered her inaugural lecture entitled "The End of the Period".

With her boundless energy and optimism, Marlies inspired many colleagues to collaborate with her and to engage in research. She had her group of "Murder Women"—a group of young researchers who regularly met at her home and, after a meal, discussed their research activities. The name "Murder Women" refers to a Dutch cartoon with the text "Menstruation kills". She was also greatly beloved abroad for her expertise, generous laugh, and inexhaustible energy. She served as a board member of the European Society for Gynaecological Endoscopy (ESGE) and editor of the European Journal of Obstetrics and Gynecology and the journal Facts, Views and Vision in ObGyn. With her research team, she delivered numerous presentations over the past 30 years at the annual meetings of ESGE and American Association of Gynecologic Laparoscopists. From 2013 to 2017, she was a section editor of the Nederlands Tijdschrift voor Geneeskunde. She was rewarded the Els Borst Lifetime Achievement Award in 2022 and decoration a year later she was appointed an Officer of the Order Orange-Nassau by Royal Decree as a "crowning achievement" of her work. Marlies is deeply missed by her PhD students and colleagues, many of whom also developed a close friendship with her. The prospect of a long and vital—cycling—life after her retirement was abruptly ended by a tragic accident. We express our deepest sympathy to her husband, children, grandchildren, and all who loved her.

Sebastiaan Veersema
Andreas Thurkow

EDITORIAL

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Facts Views Vis Obgyn 2025;17(4):303-305

From calculators to artificial intelligence: moving beyond rejection to responsible adoption

Sergio Haimovich

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Keywords: Academia, accountability, artificial intelligence, authorship, evidence-based care

Every technology that changes the rules tends to follow the same arc: suspicion, rejection, tolerance, and eventual integration. Academia -rightly cautious about quickly embracing new technology- repeats this cycle with each new wave. The 1970s and 1980s saw the debate about banning the calculator from the classroom, when the worry was that the ability of students to conduct mental mathematics would be lost. Today, calculators are even allowed in the examination room, because they enable teaching mathematical thinking and problem-solving. We traded some mental arithmetic for abstraction, modelling, and analysis.[1]

Artificial intelligence (AI) is constantly improving its quality and becoming popular among us. Journal editors warn against its abuse; universities put out sensible guidelines; AI detectors sprout up, as do "humanisers" designed to slip under the detectors' radar. We will soon reach the point where it will be impractical to prove whether AI supported a manuscript. Is this inherently detrimental to the quality of publications? The response varies depending on how and why we use AI.

To perhaps make this point clear, a recent experience of mine illustrates this point. In the context of the Spanish Fertility Society Benign Pathology Special Interest Group (SIG), I was involved in a meta-analysis to investigate the association between chronic endometritis and endometriosis. The methodology is precise. On this occasion, I directed the workflow with AI assistance, keeping my role in design, critical oversight, and verification. A job that takes days of our most precious resource, time, was done in four hours without giving up rigour. Among other things, AI did not "invent" the question, replace clinical judgment, or make methodological decisions for me; rather, it sped up time-consuming tasks, helped me to synthesise disparate data, and write stronger drafts for critique, which aligns with evidence that AI can accelerate aspects of systematic review.[2] What is wrong with that? Nothing, if the outcome is clearer, more reproducible, and more useful for patients.

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Independent "clinically meaningful" research questions are not driven by AI, at least for now. Conceptual originality, ethical design, and accountability remain human if and when Artificial General Intelligence, a general-purpose system with human-level or greater competence across domains, able to learn, reason, plan, transfer knowledge across tasks, and act autonomously, arrives, we will need to revisit boundaries. That future debate should not paralyse today's progress.

In the meantime, the stance of academia should switch from "ban or detect" to the affirmative "govern and leverage with safeguards". We can be guided by a set of basic principles for adopting in a responsible way:[3]

• Transparency: Reveal AI use (what tools, when, with what controls).

• Authorship and Responsibility: Humans are solely responsible; AI is not a co-author.

• Data Integrity: No artificial data without specifying it as such, no reinvention of data inside images/figures; control over the images/figures.

• Traceability: Version of the document, prompts, methodological choices and substantial changes; allow for reproducibility.

• Privacy and Security: Protect sensitive information; maintain strong de-identification.

• Training: Teach authors, reviewers, and editors about what they can and can't do with AI.

• Critical Assessment: All AI outputs should be tested against methodological and clinical benchmarks; AI is a helper, not a judge.

• Red Lines: Plagiarism, made-up references, or unverifiable hallucinations; apply appropriate sanctions.

Our goal as surgeons and medical scientists is to promote quality care and improve patient outcomes based on the best available evidence. If these principles, of transparency, traceability, integrity of data, verification and privacy, are respected, then the primary question is not whether AI "participated", but whether the knowledge that came after is valid, useful and applicable to improve practices. The authors have the intellectual authorship and the clinical judgment; AI is the instrument we use to improve and fine-tune. Priorities should centre on aligning decisions with high-quality evidence, with critical appraisal of bias and benefit–harm, rather than ritual scrutiny of the tool used to reach the result.

Some academic societies are already making progressing in this direction. The European Society for Gynaecological Endoscopy, which is one of the surgical societies at the forefront of minimally invasive gynaecologic surgery, created a SIG on AI. The American Association of Gynecologic Laparoscopists formed an AI Task Force. The goals of these academic societies include education, project development, as well as ethical and medico-legal discussion about institutional and professional use. This, I think, is the right route to take: not rejection, but acceptance with discernment, adjustment, and improvement.

What about the near future? Early prototypes of more autonomous surgical robots are emerging.[4] They remain imperfectly implemented and must still operate under strict human supervision, but they are there. In the beginning, the majority of patients are likely to trust and give preference to their surgeon, but subsequent generations, who have grown up with this technology, will see nothing unusual in it. Adoption is inevitable, and responsibility lies in arriving prepared using standards, audits, and a culture of safety.

AI is not a shortcut to think less, just as calculators were not a shortcut to understand less mathematics. It is a tool that allows us to spend more human intellect to what matters, like spending more time with our patients or improving our surgical skills. If our shared goal is to improve practice and deliver the best evidence-based care, the question is not whether we allow AI, but how we incorporate it so that it raises quality, saves time, and expands equity, whilst yielding nothing on ethics, rigour, and accountability. Let's adapt before we fall behind.

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EDITORIAL

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Facts Views Vis Obgyn 2025;17(4):306-309

Bowel surgery for endometriosis-associated infertility: navigating amidst the certainty of the uncertainty

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Keywords: Endometriosis, bowel endometriosis, infertility, surgery, pelvic pain, assisted reproductive technology

Of Methodology, Bias, and Confounding: The Helter-skelter of the Available Evidence

The Authors of the review in this issue of Facts Views Vis Obgyn have done an excellent job of synthesising the published data on colorectal surgery for bowel endometriosis as a fertility-enhancing procedure.[1] They have also provided a comprehensive, objective, and balanced approach to this common and challenging clinical situation.[1] Indeed, even when prognostic factors such as radicality/residual disease, coexisting adenomyosis, age, and ovarian reserve are considered, quantifying the benefits of colorectal surgery based on largely inconsistent estimates is arduous.

Several confounding factors may here preclude a precise definition of the magnitude of the effect. Firstly, when assessing the impact on postoperative fertility, only preoperatively infertile patients should have been enrolled. However, in published studies available, it is not always easy to distinguish between infertile patients and those with an unknown fertility status who only sought to conceive after the procedure. Moreover, postoperative reproductive performance is often a secondary study outcome. This means that conclusions about the effect of surgery on fertility may be based on data from a population not selected to evaluate this outcome specifically. Secondly, since bowel lesions usually coexist with other endometriosis forms and infertility factors, how can the specific effect of intestinal endometriosis on the likelihood of conceiving after surgery be determined? Thirdly, colorectal endometriosis could be considered an indicator of advanced and progressive disease.[2] If this is true, the effect on fertility cannot be attributed exclusively to bowel lesions themselves, but rather to the extensive anatomical distortion, adhesions, and abdominopelvic inflammation associated with aggressive lesions. Fourthly, postoperative conceptions achieved after natural attempts or *in vitro* fertilization/intracytoplasmic sperm injection (IVF/ICSI) were often grouped. This prevents the quantification of the additional benefit of colorectal procedures, as it is impossible to know what would have happened if IVF/ICSI had been resorted to upfront without prior surgery.[3] Fifthly, resection of bowel endometriosis is generally performed by highly skilled surgeons. How can we distinguish how much of the effect on fertility is due to the removal of colorectal lesions "per se" and

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how much is due to the technical capability of radically removing "all" endometriotic lesions with limited tissue trauma, excising adhesions, and correcting additional coexisting anomalies according to precise reconstructive surgery criteria? Sixthly, non-comparative, observational studies generally overestimate the effect of any medical intervention for several reasons, including selecting the most favourable participants in terms of age and co-occurring infertility factors in addition to endometriosis, and excluding patients lost to follow-up (i.e., those with the worst prognosis). Seventhly, publication bias is highly likely, as no surgeon would reasonably be willing to report suboptimal post-surgical reproductive outcomes and complication rates.

The Role of Adenomyosis and Age

Adenomyosis and endometriosis are strongly associated "sister entities", particularly in cases of severe, infiltrating lesions such as colorectal endometriosis.[4] Several studies included in the present review clearly demonstrated the detrimental impact of adenomyosis on the reproductive performance of infertile patients, whether conception was sought naturally or via IVF/ICSI.[1] This is expected and can be explained by the reduction in implantation likelihood associated with adenomyosis.[4] Therefore, the removal of bowel endometriosis, along with all coexisting extraintestinal lesions, may reduce local inflammation, theoretically favouring gamete interactions and thus fecundation (i.e., the pelvic phase of reproduction). However, as adenomyosis is generally left untreated, it is unclear how colorectal surgery might influence implantation, i.e., the intrauterine phase, which is the limiting step in the conception process.

Thus, adenomyosis and age are independent factors that reduce the likelihood of a live birth, regardless of the presence of bowel endometriosis or any type of colorectal procedure performed.[4] This is important to consider when counselling individual patients, as the reported mean postoperative pregnancy rates should be contextualised. Appropriately, the Authors suggest that IVF/ICSI should be considered without prior surgery for women over 35 years of age, especially if adenomyosis is present.[1]

Risk of Progression of Unoperated Bowel Lesions and Obstetric Complications with and without Colorectal Surgery

A potential drawback of upfront IVF/ICSI is the risk of colorectal endometriosis progression and bowel occlusion or perforation during ovarian stimulation or pregnancy. Although anecdotal reports have been published,[5] the overall risk of occlusion seems low, unless the degree of lumen stenosis is ≥60% or subocclusive symptoms are reported at baseline evaluation. Indeed, these patients should undergo surgery anyway, regardless of their desire for conception.

An important issue to discuss when deciding whether to resort to surgery is how it may modify the risk of major obstetrical complications. Placenta praevia is the condition more consistently and robustly associated with severe endometriosis.[6,7] However, this adverse outcome is most likely due to coexisting adenomyosis,[4] rather than bowel endometriosis. As expected, resorting to excisional colorectal procedures does not seem to reduce the risk.[6,7] Spontaneous haemoperitoneum in pregnancy is another rare but life-threatening complication affecting patients with severely infiltrating endometriosis. In theory, pseudo-normalisation of the pelvic anatomy could reduce this risk; however, the rarity of the event makes it difficult to assess the effect of bowel surgery, if any.

Balancing Trade-Offs, Communicating Uncertainties, and Setting Thresholds

In addition to the above factors impacting the assessment of the potential benefits of colorectal surgery for bowel endometriosis, factors influencing the potential harms should also be evaluated.[8,9] Above all, a surgeon's expertise in dealing with difficult procedures for extensive and infiltrating disease forms influences the risk of major complications. According to a large French survey of 56 hospital facilities, 82 out of 1,135 patients (7.6%) with colorectal endometriosis who underwent surgery in 2015 developed Clavien-Dindo grade III-V complications (rectovaginal fistula, 2.7%; anastomotic leakage, 0.8%; pelvic abscess, 3.4%; ureteral fistula, 0.7%). The proportion was highest for segmental resection, lowest for shaving, and intermediate for disc excision. Importantly, an inverse relationship was observed between the number of procedures performed per year, both at the institutional and individual levels, and the probability of complications.[10] Therefore, the type of referral centre and the experience and technical capabilities of the surgeon affect the risk of severe complications.

This has methodological and practical implications. On the one hand, the reported complication rate reflects the best possible clinical scenario and is not generalisable. Indeed, the likelihood of potential harm may be higher

when colorectal procedures are performed by surgeons with average experience and capability. In this regard, choosing shaving instead of disc excision or segmental resection to limit surgical risk is often not feasible because, as the authors correctly highlight, "the decision to perform one technique over another is largely based on the characteristics of the endometriotic bowel lesions".[1]

On the other hand, these aspects contribute to shaping the overall therapeutic balance that each patient should ponder based on comprehensive, detailed, and balanced information, including the disclosure of personal and institutional volumes and performance.[8] Moreover, in a framework of truly shared medical decision-making, it must be disclosed whether both surgery and ART can be provided with the same level of expertise. In other words, offering one of the two options simply because it is more readily available at one's hospital without disclosing this does not seem ethically appropriate, as it infringes the fiduciary pact of trust between a patient and doctor.

The probability of major complications that is acceptable for a given magnitude of the expected additional benefit of bowel surgery over expectant management or upfront IVF/ICSI is a matter of patient choice, not healthcare provider choice. The issue is complicated by the fact that, while potential harms can now be quantified with an adequate degree of precision,[10] quantifying the potential benefits in different conditions is difficult, as the quality of the evidence is low and the clinical variables are many.[1] Thus, another ethically crucial aspect of counselling is open communication about uncertainties.[8,9] Uncertainty is part of everyday medical practice and is particularly important here. If an individual patient is aware of the uncertainty surrounding the communicated estimates of the potential benefits of surgery, she may be more inclined to opt for upfront IVF/ICSI. Otherwise, she may choose to undergo a colorectal procedure even in the absence of severe bowel symptoms.

Counselling involves weighing up the quantified benefits and harms of the two options. Even when based on robust evidence, weights have a relative impact on the final decision, as different patients may attribute different weights to the same estimate.[8,9]

Actually, as offering precise estimates of the potential benefits of colorectal surgery for endometriosis as a fertility-enhancing procedure in different clinical conditions is complicated, when in doubt, the less invasive option, i.e., upfront IVF/ICSI, can be suggested,[3] unless i) the patient reports subocclusive complaints; ii) examinations demonstrate a degree of bowel lumen stenosis ≥60% regardless of symptoms; iii) the woman has severe abdominopelvic pain and/or is willing to conceive through natural attempts only; iv) repeated IVF/ICSI cycles have failed.

Interestingly, the Authors have also provided an update on ongoing randomised, controlled trials investigating the effect of colorectal surgery for bowel endometriosis in diverse infertile populations.[1] Considering the methodological limitations of the available observational evidence,[1] women with endometriosis and healthcare providers are eagerly awaiting the results of these high-quality trials.

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ORIGINAL ARTICLE

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The impact of laparoscopic deep endometriosis surgery on sexual functioning and distress

Rozemarijn de Koning[1,2], Jeroen Metzemaekers[2], Sharon Keetels[2], Sabine Kleinjans[2], Frank Willem Jansen[2], Andries Twijnstra[2], Stephanie Both[3,4]*, Mathijs Blikkendaal[1]*

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ABSTRACT

Background: Sexual functioning is a complex phenomenon driven by multiple physical, psychological and social factors, necessitating comprehensive evaluation.

Objectives: To assess the impact of laparoscopic deep endometriosis (DE) surgery on sexual functioning and distress in comparison to healthy controls.

Methods: Retrospective cohort study including 125 sexually active women who underwent DE surgery and who completed patient-reported outcome measurements (PROMs) pre- and postoperatively. Postoperative data were compared to prospectively collected data from 134 healthy controls.

Main Outcome Measures: Postoperative female sexual function index (FSFI-9), including the FSFI-9 total score (percentage of best possible FSFI-9 score), and the Female Sexual Distress Scale-Revised score. Secondary outcomes included pain scores, depressive symptoms, quality of life (QoL), relational satisfaction and positive affect.

Results: Sexual functioning significantly improved across all domains (desire, arousal, lubrication, orgasm, satisfaction, pain, distress) after DE surgery. The FSFI-9 total score increased from 65% pre-operatively [mean 29.3 (27.2, 31.23)] to 75% at 3 months [mean 33.6 (32.3, 34.9), $P<0.001$)] and 74% at 6 months [mean 33.1 (31.0-35.0), $P<0.001$] after DE surgery, compared to 85% in healthy controls [mean 38.08 (37.21-38.87)]. In addition, an improvement in QoL, pain scores, depressive symptoms and positive affect was observed. Bowel surgery or reoperations did not affect postoperative sexual functioning. Compared to healthy controls, DE patients reported similar sexual functioning 3 months post-surgery, except for significantly lower sexual arousal, lubrication and pain. At 6 months, these differences persisted, with DE patients also reporting significantly lower sexual satisfaction, higher pain scores and poorer QoL across multiple domains compared to controls.

Conclusions: DE surgery (including bowel surgery) does significantly improve sexual functioning and distress. However, sexual functioning and distress remain inferior compared to healthy peers.

What is New? This study provides comprehensive pre- and postoperative PROMs to assess the impact of DE surgery on sexual functioning and to evaluate other key influencing factors.

Keywords: Sexual quality of life, laparoscopy, deep endometriosis, quality of life

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***Shared last author. These authors contributed equally to this work.**

Introduction

Decreased sexual functioning is often observed in women with endometriosis.[1] Dyspareunia may be caused by endometriosis lesions located in the posterior vaginal fornix, the pouch of Douglas, the uterosacral ligaments or the rectum due to traction of scarred, inelastic and immobilised pelvic structures or pressure exerted on lesions within the fibrotic tissue.[2] Also, it is well-known that endometriosis is associated with pain symptoms, a reduced quality of life (QoL), social participation and mental health, which all may affect sexual functioning.[3-5]

While multiple studies demonstrate a positive effect of laparoscopic (deep) endometriosis resection on dyspareunia and sexual functioning, none provide a comprehensive view of the sexual and psychosocial functioning of either patients or healthy controls.[6-16] However, sexual functioning is a complex phenomenon driven by multiple physical, psychological and social factors which require holistic evaluation.[1,17] Hence, the methodology of the available studies, which often relied solely on the presentation of a single questionnaire to conclude on the sexual QoL, was identified earlier as an important weakness in the review on this topic.[17] This study aimed to examine the impact of deep endometriosis (DE) surgery, including bowel surgery, on sexual functioning and distress as primary outcomes, and on QoL, pain scores, relational satisfaction, depression and positive affect as secondary outcomes, in comparison to healthy controls.

Methods

This retrospective cohort study was conducted in a specialised endometriosis expertise centre in the Netherlands. All information for this study was obtained as part of standard clinical care and used for this research when informed consent was provided. Ethical approval was obtained from the Medical Ethics Committee Leiden Den Haag Delft (protocol number: P20.088, date: 30.05.2022).

Deep Endometriosis Patients

All women who 1) underwent DE surgery between January 2019 and December 2021, 2) completed the Female Sexual Functioning index-9 (FSFI-9) both before and after surgery, and 3) who consented to use of their patient-reported outcome measurements (PROMs) for research purposes, were selected. Inclusion criteria were: surgical confirmation of DE and being sexually active at the time of completing the FSFI-9 questionnaire before and after surgery. Exclusion criteria were: pregnancy and/or lactation, post-menopausal status, age <18 years, same-sex relationship, or cases where solely adenomyosis was diagnosed.

PROMs were sent (Questmanager, Philips) as part of the standard clinical care at the endometriosis expertise centre. All patients received questionnaires, an informed consent letter and explanatory information via email before their intake appointment. Patients were informed that questionnaires would be digitally sent at fixed intervals throughout their treatment trajectory and that the outcomes of the questionnaires would primarily be used for clinical purposes and secondarily for scientific research if the patient provided consent. Socio-demographic characteristics and clinical data were extracted from medical records, including surgical reports.

Healthy Controls

Healthy controls were recruited (December 2022-April 2023) through a database maintained by the department of sexology at the Leiden University Medical Centre, consisting of women (not patients) who expressed interest in participating in future medical research. They were sent an email with study information. In addition, participants were recruited through advertisement of the study (including a link to all study information) on social media platforms (the Instagram account of the Dutch Endometriosis Society and two sexologists). Responders were sent a digital link to an informed consent form, an inclusion and exclusion questionnaire and the PROMs using Castor EDC. The intake questionnaire was used to determine whether the healthy controls met the inclusion criteria: age 18-45, sexual activity in the preceding 4 weeks at time of completing the FSFI-9, no (prior) diagnosis of endometriosis, absence of (chronic) pain condition(s), a relationship with a heterosexual partner (for a minimum duration of three months) and understanding of the Dutch language. Exclusion criteria included pregnancy and/or lactation, post-menopausal status, malignancies and chronic diseases affecting the QoL. All women who met the inclusion criteria and who completed all questionnaires were offered a compensation of 10 euros.

Deep Endometriosis Surgery

Surgery was performed by experienced gynaecologists, abdominal surgeons and urologists, with more than 10 years of expertise. Laparoscopic DE resection was

performed according to the guidelines of the working group of the European Society for Gynaecological Endoscopy, European Society of Human Reproduction and Embryology and the World Endometriosis Society.[18] The goal of the surgery was to excise all (deep) endometriosis lesions, except for the uterus in cases of adenomyosis and a (future) wish to conceive, or when this was not deemed feasible (e.g., as determined by the surgeon), or when the patient did not consent to complete excision (e.g., in case of colorectal endometriosis). Whether complete resection of (deep) endometriosis was performed during the index surgery was documented and is presented in the results section. Bowel surgery was performed together with a specialised abdominal surgeon. Serosal shaving or superficial resection of endometriosis lesions from the bowel was performed in case the endometriosis was solely present within or on the serosa, without infiltrating the muscularis layer.[18] In case of infiltration of the muscularis, a more radical approach such as full thickness resection (discoid resection) or segmental bowel resection was necessary, depending on lesion(s) size, multifocality and the degree of infiltration.[18] During surgery, DE lesions were classified according to the #Enzian classification and the revised American Society for Reproductive Medicine.[19,20] Adenomyosis was diagnosed preoperatively through vaginal ultrasound based on the "Morphological Uterus Sonographic Assessment" criteria.[21] Postoperative complications were documented in accordance with the Clavien-Dindo (CD) classification, with CD IIIa-V considered as major complications.[22] The onset of a complication had to be within 6 weeks after surgery with the exception of lower anterior resection syndrome, which was also included as a post-operative complication, considering its impact on the patients' QoL.

Questionnaires

Please see the Supplementary for a detailed description of all included PROMs.

Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics version 29. Data distribution was assessed using histograms. Normally distributed data were presented as mean and standard deviation (SD), whereas non-normally distributed data were presented as median and interquartile range. In case of skewed PROMs outcomes, logarithmic transformation was performed to achieve a more normal distribution and to enable parametric testing. The geometric mean and 95%-confidence intervals obtained from the transformed data (which were converted back to the original scale) were provided.

A paired t-test was performed to compare pre- and post-surgical PROMs outcomes within the DE cohort. The post-surgical outcomes of the DE patients were compared to the healthy controls using univariate and multiple regression analysis. Multiple regression was performed to adjust for observed significance differences in baseline variables between the DE patients and healthy controls. Both non-adjusted and adjusted *P*-values were provided. Univariate regression analysis was also performed to assess the effect of bowel surgery and major post-surgical complications on sexual functioning. Pre- and post-surgical binary outcomes within the DE cohort were compared using the McNemar test. A Fisher's exact test was used to compare binary outcomes between the DE cohort and healthy controls. A *P*-value of <0.05 was considered statistically significant.

We did not perform a priori sample size calculation due to lack of access to effect size estimates based on the FSFI-9, which would have been necessary to demonstrate within-individual differences in sexual functioning pre- and post-surgery. However, we did perform a post-hoc power analysis. With our sample size of 125 pairs, we had 77% power to detect a mean of paired differences of 2.7 (corresponding to a 10% increase from median starting value of 27 on the original scale), applying the observed SD of paired differences on the original scale of 11.15 and with a significance level (alpha) of 0.05 using a two-sided paired t-test.

Results

Population

Between January 2019 and December 2021, a total of 125 women underwent DE surgery, completed a FSFI-9 questionnaire both prior to and after surgery and consented to use their completed PROMs for research. Women were excluded for multiple reasons, including lack of informed consent, absence of DE, same-sex relationship or non-sexually active status. The selection process for the DE patients is illustrated by Supplementary Figure 1. Among the healthy controls, 177 women responded to the e-mail or advertisement and were sent a link to the online questionnaires. Of these, 142 provided consent and completed the questionnaires. Subsequently, 8 women were excluded because they reported a chronic illness, completed the questionnaires twice or reported

not to be sexually active during the last 4 weeks at the time of questionnaire completion. Supplementary Figure 2 outlines the selection process for the control group.

Socio-demographic characteristics, comorbidities, abdominal surgical history and information on hormone or analgesic usage among the DE patients are presented in Table 1. Compared to the healthy controls, DE patients were significantly older (33.0 vs. 30.5 years, *P*=0.02), more often in a longer relationship (9 vs. 5 years, *P*<0.001) and living together with their partner (86% vs. 77%, *P*=0.02). Additionally, fewer DE patients reported being employed (75% vs. 87%, *P*=0.04), and the level of education was significantly lower among DE patients compared to the control group (tertiary education 42% vs. 88%, *P*<0.001). The majority of DE patients expressed a desire for future pregnancy (62%), of whom 30% had experienced subfertility in the preceding year. In addition, 46% of these patients had undergone previous endometriosis surgery, 61% were using hormones, and 93% used analgesics prior to surgery.

With regard to the (surgical) DE classification, most patients were diagnosed with endometriosis affecting the ligaments (#Enzian B, left 69% and right 67%) and adenomyosis (63%) (Table 2). In addition, bowel endometriosis was present in the majority of patients (#Enzian C 50%, #Enzian FI 29%).

Table 1. Baseline characteristics.

	DE patients n=125	**Healthy controls n=134**	***P*-value**
Age[a] (years), median (IQR)	33.0 (29.0-38.5)	30.5 (28.0-36.0)	0.02
BMI (kg/m²), median (IQR)	23.8 (21.7-27.2)		
Male partner, n (%)	114 (91.2%)	134 (100%)	
Unknown[b], n (%)	11 (8.8%)	0 (0%)	
Living together with a partner, n (%)	107 (85.6%)	103 (76.9%)	0.02
Unknown[b], n (%)	4 (3.2%)	0 (0%)	
Duration of relationship (years), median (IQR)	9.0 (4.5-14.0)	5.0 (2.0-10.0)	<0.001
Unknown[b], n (%)	36 (28.8%)	1 (0.8%)	
Nulliparous, n (%)	87 (69.6%)	86 (64.2%)	0.36
Active or future pregnancy wish, n (%)	77 (61.6%)	71 (53.0%)	0.18
Unknown[b], n (%)	1 (0.8%)	0 (0%)	
Subfertility in the year prior to surgery, n (%)	37 (29.6%)		
Unknown[b], n (%)	1 (0.8%)		
Working, n (%)	94 (75.2%)	116 (86.6%)	0.04
Unknown[b], n (%)	2 (1.6%)	0 (0%)	
Highest education, n (%)			
Primary education[c]	0 (0%)	0 (0%)	
Secondary education[c]	54 (43.2%)	16 (11.9%)	<0.001
Tertiary education[c]	53 (42.4%)	118 (88.1%)	<0.001
Unknown[b], n (%)	18 (14.4%)	0 (0%)	
Comorbidities, n (%)			
Pain syndromes[1]	9 (7.2%)		
Rheumatoid arthritis	1 (0.8%)		
Gastro-intestinal[2]	24 (19.2%)		
Psychiatric[3]	25 (20%)		
Gynaecological[4]	2 (1.6%)		
Prior abdominal surgery (excluding endometriosis surgery), n (%)			
None	86 (68.8%)		

Table 1. Continued

	DE patients n=125	Healthy controls n=134	*P*-value
Laparoscopic surgery	30 (24.0%)		
1	28 (22.4%)		
2	2 (1.6%)		
Laparotomic surgery	17 (13.6%)		
1	15 (12.0)		
≥2	2 (1.6%)		
Prior endometriosis surgery, n (%)			
None	68 (54.4%)		
Laparoscopic surgery	56 (44.8%)		
1	40 (32.0%)		
≥2	16 (12.8%)		
Laparotomic surgery	2 (1.6%)		
1	2 (1.6%)		
Use of hormones prior to surgery, n (%)	76 (60.8%)		
Progestogen-only	11 (8.8%)		
COC	41 (32.8%)		
IUD[5]	7 (5.6%)		
GnRH analogue	18 (14.4%)		
Other[6]	2 (1.6%)		
Use of analgetic medication prior to surgery, n (%)	116 (92.8%)		
Paracetamol	99 (79.2%)		
NSAIDs	86 (68.8%)		
Opioids	14 (11.2%)		
Other[7]	5 (4.0%)		
Unknown[b], n (%)	3 (2.4%)		

[a]Age at the moment of filling in the FSFI-9 questionnaire prior to surgery. [b]Based on the electronic patient file. [c]Education levels are defined following the International Standard Classification of Education (ISCED), primary education is defined as ISCED level 1, secondary education as ISCED level 2-4 and Tertiary education as ISCED level 5-7. [1]Fibromyalgia (n=4), sciatica lumbago (n=4), hip dysplasia treated with a Ganz osteotomy surgery (n=1), chronic pain syndrome (n=1). [2]Irritable bowel syndrome (n=20), Crohn's disease (2), colostomy due to endometriosis (n=1), colostomy due to fistula formation (n=1), ileostomy due to ileus (n=1). [3]History of depression (n=10), anxiety and/or panic disorder (n=5), post-traumatic stress disorder (n=2), bipolar disorder (n=1), suicide attempt (n=1), burn-out (n=3), anorexia (n=2), under treatment of a psychiatrist or psychologist due to mood disorders (n=3). [4]Lichen sclerosis (n=1), pre-menstrual syndrome (n=1). [5]Levonorgestel-releasing IUD (n=6), copper IUD (n=1). [6]Clomid (n=1), etonogestrel/ethinyl estradiol vaginal ring (n=1). [7]Nerve block (n=1), cannabis (n=4).
BMI: Body mass index, COC: Combined oral contraceptive, GnRH: Gonadotropin-releasing hormone, FSFI: Female Sexual Functioning index, IQR: Interquartile range, IUD: Intrauterine device, NSAID: Non-steroidal anti-inflammatory drug, DED: deep endometriosis.

Surgical Characteristics

Complete resection of all DE lesions was performed in 94% of surgeries (Table 2). Incomplete resection was performed due to the following reasons: the patient did not consent to the resection of bowel endometriosis (3.2%), and the need to remove diaphragm endometriosis and DE in two separate surgeries (2.4%). In addition, among patients who underwent bowel surgery (56%), segmental resection was performed in 69% of cases. A hysterectomy was performed in 28% of DE patients. In 36% of patients, an adenomyotic uterus was left *in situ* due to a (future) desire for children. Following surgery, 42% used hormonal medication. In total, 21 women (17%) experienced post-surgical complication(s), with 9 women (7%) who had a major post-surgical complication requiring re-operation (CD IIIb) (Supplementary Table 1).

Table 2. Characteristics of deep endometriosis (surgery).	
	n=125
Indication surgery, n (%)	
Pain	95 (76.0%)
Combination pain and subfertility	28 (22.4%)
Subfertility	1 (0.8%)
Stenotic ureter lesion	1 (0.8%)
#Enzian classification surgical, n (%)	
A (vagina)[a]	41 (32.8%)
<1 cm	3 (2.4%)
1-3 cm	12 (9.6%)
>3 cm	26 (20.8%)
B (ligaments) left[a]	86 (68.8%)
<1 cm	2 (1.6%)
1-3 cm	51 (40.8%)
> 3 cm	33 (26.4%)
B (ligaments) right[a]	84 (67.2%)
<1 cm	2 (1.6%)
1-3 cm	50 (4.0%)
>3 cm	32 (25.6%)
C (rectum)[a]	62 (49.6%)
<1 cm	5 (4.0%)
1-3 cm	18 (14.4%)
>3 cm	39 (31.2%)
Pre-operative FA (adenomyosis) according to MUSA criteria	79 (63.2%)
FB (bladder)	31 (24.8%)
FI (intestinal)	36 (28.8%)
FU (ureter)	26 (20.8%)
FO (diaphragm)	6 (4.8%)
FO (sciatic nerve)	1 (0.8%)
Presence of endometrioma(s), n (%)	47 (37.6%)
Pathological confirmation of endometriosis*, n (%)	123 (98.4%)
rASRM classification surgical[b]**,** n (%)	
1	18 (14.4%)
2	24 (19.2%)
3	28 (22.4%)
4	53 (42.4%)
Opening of the vagina during surgery, n (%)	53 (42.4%)
Women who underwent hysterectomy	35 (28.0%)
Bowel surgery, n (%)	70 (56.0%)
Shave	20 (16.0%)
Disc resection	2 (1.6%)
Segment resection	48 (38.4%)
Complete resection during surgery, n (%)	118 (94.4%)
Underwent additional endometriosis surgery in follow-up period after surgery, n (%)	23 (18.4%)
Median follow-up period in months, median (IQR)	17.0 (7.0-32.0)
Hormonal therapy after surgery, n (%)	53 (42.4%)
Unknown[d]	7 (5.6%)

[a]Not available (n=3). [b]Not available (n=2). [c]Separate video-assisted thoracoscopic surgery to remove endometriosis from diaphragm (n=2), to prevent fistula formation, a lower anterior resection and resection of endometriosis lesions in the vagina and bladder were performed in 2 separate surgeries (n=1). [d]Based on the electronic patient file. *Only coagulation was performed during the index surgery (n=1); no endometriosis was found in the provided tissue (n=1).
rASRM: Revised American Society for Reproductive Medicine, MUSA: Morphological Uterus Sonographic Assessment, IQR: Interquartile range.

The Impact of Deep Endometriosis Surgery on Sexual Functioning and Distress

Figure 1 and Supplementary Table 2 illustrate the FSFI-9 and sexual distress scores both before and after DE surgery at 3 (n=125) and 6 (n=65) months of follow-up in comparison to healthy controls.

Three Month Follow-up

Patients reported significant improvements in sexual functioning across all domains of the FSFI-9. At 3 months post-surgery, significantly fewer DE patients were classified as having low sexual functioning or having high sexual distress. While DE patients had similar post-surgical scores for sexual desire, orgasm, satisfaction and distress compared to healthy controls, healthy controls reported a significantly higher total FSFI-9 score, along with significantly better scores for sexual arousal, lubrication and pain. Furthermore, fewer women in the healthy control group were classified as having low sexual functioning compared to DE patients (Figure 1 and Supplementary Table 2).

Six Month Follow-up

At the 6-month follow-up, 53% of DE patients completed the FSFI-9 questionnaire. Significant improvements in sexual functioning were observed across all domains of the FSFI-9 compared to baseline. However, the significant improvement in low sexual functioning or having high sexual distress, compared to the pre-surgical situation

and 3-month follow-up, was no longer observed. In comparison to the healthy controls, DE patients reported similar scores for sexual desire, orgasm and distress 6 months following DE surgery. However, DE patients reported significantly lower FSFI-9 total scores, as well as significantly worse scores for sexual arousal, lubrication, satisfaction and pain compared to healthy controls. In addition, the number of women reporting high sexual distress and classified as having low sexual functioning was significantly higher 6 months following DE surgery compared to controls.

The FSFI-9 total score of 65% pre-surgically [mean 29.3 (27.2, 31.23)], increased to 75% at 3 months [mean 33.6 (32.3, 34.9)] and 74% at 6 months [mean 33.1 (31.0-35.0)] after DE surgery. In comparison, healthy controls reported a percentage of 85% on the FSFI-9 total score [mean 38.08 (37.21-38.87)].

The Impact of Deep Endometriosis Surgery on Pain Scores, Quality of Life, Relational Satisfaction, Depression and Positive Affect

Figure 2 and Supplementary Table 3 illustrate the pain scores, QoL scores, scores for relational satisfaction, depression and positive affect at 3 and 6-month follow-up in comparison to healthy controls.

DE patients reported significantly lower scores for dysmenorrhea, dyspareunia, chronic pelvic pain, dyschezia, dysuria and depression 3 and 6 months post-surgery (Figure 2 and Supplementary Table 3). In addition, three months post-surgery, QoL had significantly improved across all domains of the Endometriosis Health Profile (EHP)-30. However, at 6-month follow-up, the significant improvements in the social support and self-image domains of the EHP-30 were no longer observed.

Among those who remained in a relationship during the treatment trajectory, relational satisfaction remained stable. In some cases, the relationship was ended post-

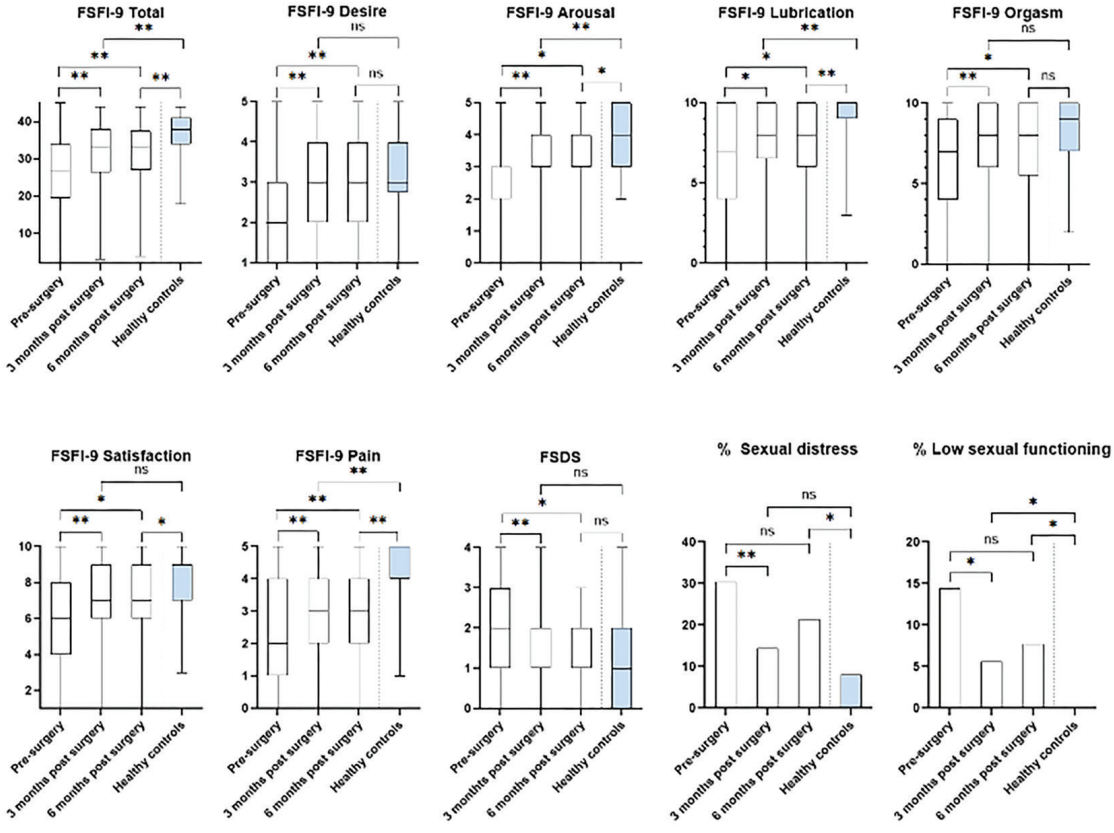

Figure 1. Sexual functioning and distress pre- and post-deep endometriosis surgery in comparison to healthy controls. Boxplots are illustrated. The adjusted *p*-values from the statistical analysis comparing deep endometriosis (DE) patients and controls are presented (see Supplementary Table 1). *P*-value controls vs. DE patients 3 and 6 months post-surgery were adjusted for age, living together (yes or no), duration of relationship, nulliparous (yes or no), future wish to conceive (yes or no), working (yes or no), and secondary education (yes or no) using multiple regression analysis.

FSFI-9: Female Sexual Functioning index-9, FSDS: Female Sexual Distress scale.

surgery (Supplementary Table 3). Furthermore, following surgery, DE patients experienced a significant increase in positive affect at 3 months post-surgery. However, this improvement was no longer observed at 6 months post-surgery. Despite all these improvements in PROMs among DE patients, most scores remained significantly lower in comparison to the control group, except for emotional well-being 3 and 6 months post-surgery, self-image 3 months post-surgery, depression 3 and 6 months post-surgery and positive affect 6 months post-surgery (Figure 2 and Supplementary Table 3). Relational satisfaction was significantly higher among DE patients 3 months post-DE surgery, but at 6 months, both groups reported similar scores for relational satisfaction.

Furthermore, post-operative sexual functioning was not negatively affected by bowel surgery, nor was it affected by the occurrence of major post-operative complications when compared to their peer DE patients (Supplementary Table 4).

Discussion

Our results demonstrate a significant improvement in sexual functioning 3 and 6 months after DE surgery. This was accompanied by improvement in pain scores, QoL, depressive symptoms, positive affect and stable relational satisfaction. In comparison to healthy controls, post-surgical DE patients reported similar scores in several domains of sexual functioning (desire, orgasm,

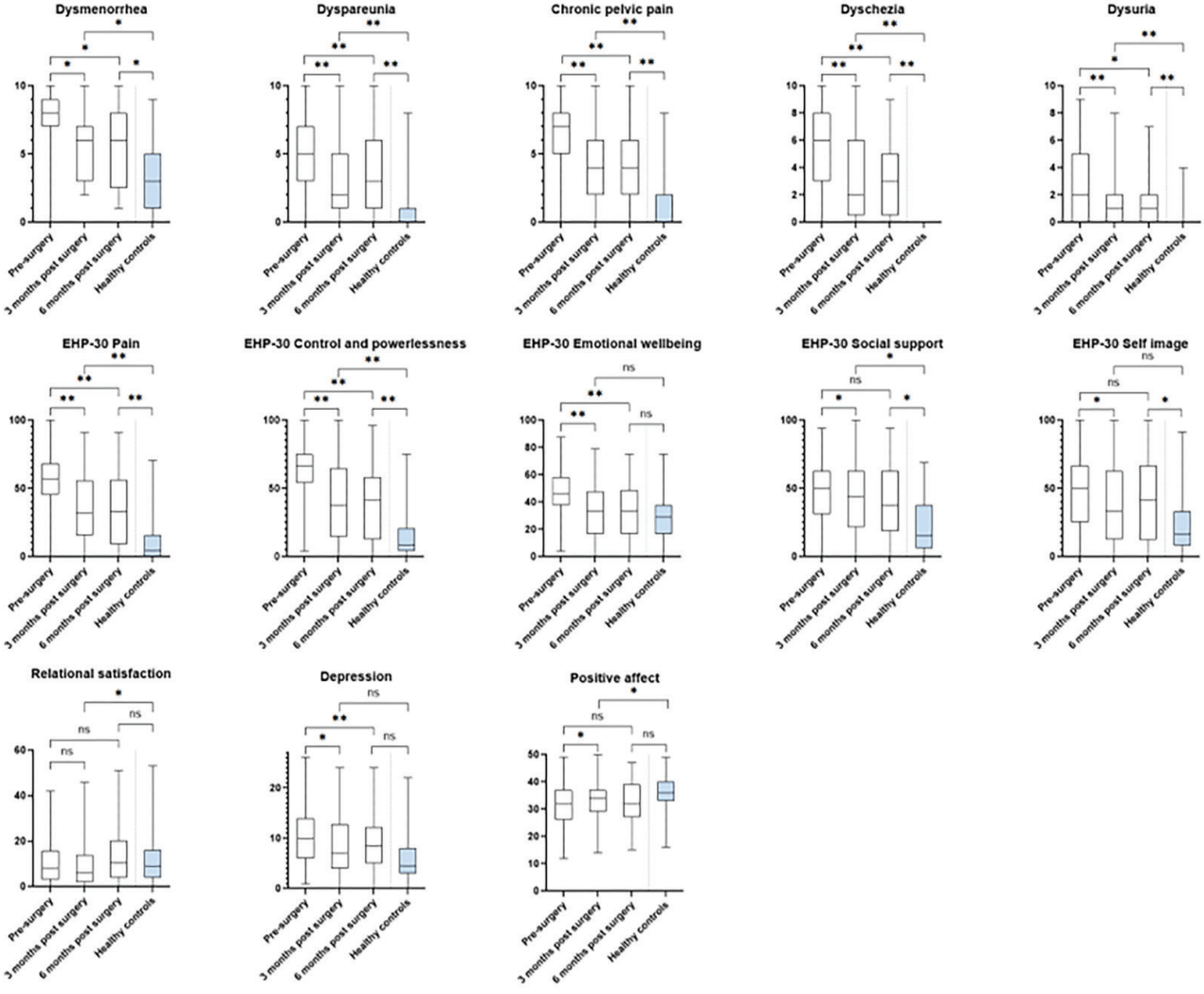

Figure 2. Numeric rating scale pain scores, quality of life (EHP-30), relational satisfaction, depression and positive affect pre- and post-deep endometriosis surgery in comparison to healthy controls. Boxplots are illustrated. The adjusted *P*-values from the statistical analysis comparing deep endometriosis (DE) patients and controls are presented (see Supplementary Table 2). *P*-value controls vs. DE patients 3 and 6 months post-surgery were adjusted for age, living together (yes or no), duration of relationship, nulliparous (yes or no), future wish to conceive (yes or no), working (yes or no), and secondary education (yes or no) using multiple regression analysis. EHP: Endometriosis Health Profile.

distress) 3 and 6 months after surgery. However, in other domains (arousal, lubrication, pain), DE patients scored significantly lower.

Sexual functioning is of importance for overall well-being and should therefore always be addressed when counselling patients (and their partners) for DE surgery.[1] Consistent with our findings, multiple studies demonstrate improvements in sexual functioning following (deep) endometriosis surgery.[9,14,15,23,24] However, these studies often lack data on relational satisfaction and psychosocial well-being and comparison against healthy controls, which may compromise the reliability of their results.

Whilst we observed a significant improvement in sexual functioning and distress following surgery, scores of DE patients remained significantly worse across several domains of sexual functioning compared to healthy controls. In contrast to our study, Martínez-Zamora et al.[6] demonstrated similar sexual and health-related QoL in DE patients compared to controls 6 months following surgery. This difference could be explained by more disease progression in our cohort compared to the study of Martínez-Zamora et al.,[6] as indicated by the relatively high percentage of patients who underwent bowel resection surgery in the current cohort (38%) compared to the cohort of Martínez-Zamora et al.[6] (9%). In addition, they excluded patients undergoing hysterectomy, which may also indicate less disease progression (no adenomyosis). However, direct comparison of classified disease severity is not possible as no endometriosis classification system was provided. Another explanation could be that their control group reported worse outcomes compared to those in our cohort.

Strengths and Limitations

Strengths of the current study are the use of a large number of PROMs in order to provide a holistic perspective on the overall well-being of the patients and controls, which is important to evaluate when assessing sexual functioning.[1] Furthermore, to our knowledge, no studies on this topic use the #Enzian criteria for surgical classification of DE.[6-17,19] This lack of standardisation makes clinical interpretation of the data challenging and hampers comparison between study cohorts.

Our study has several limitations that should be taken into account when interpreting the results. First, there is missing data in the endometriosis group (Supplementary Table 3). The burden of questionnaire completion may have been too high for some patients. This could explain why only 53% of DE patients completed the FSFI-9 questionnaire 6 months following surgery. Consequently, we cannot demonstrate whether the effect of DE surgery remains stable at 6 months follow-up, and it is questionable whether these results are representative of the entire cohort, as patients experiencing more severe symptoms may be more motivated to complete questionnaires. In addition, women who were not sexually active pre-surgically due to severe pain symptoms were not included in this study (no FSFI score available), while the effect of DE surgery would have been particularly interesting in this patient population. Considering the aforementioned limitations, had these patients been included and the follow-up completed, the effect of DE surgery would likely have been even more pronounced. Therefore, the results presented in this study might underestimate the true effect of DE surgery on sexual functioning and distress. This applies also to women in whom the adenomyosis was left *in situ*, given their future desire to conceive. Second, although our follow-up time is comparable to previous studies,[12,14] we recognise that it is relatively short and that a longer follow-up would be preferable. Third, information on other types of menstrual disorders beyond dysmenorrhea and on medications (e.g., antidepressants) affecting sexual function would have been of added value, as both may negatively impact sexual outcomes.[25,26] Nevertheless, these conditions are not primarily influenced by surgery. Finally, some of the observed postoperative sexual dysfunction may reflect non-endometriosis-related problems that were already present at baseline.

Conclusion

DE surgery significantly improves sexual functioning (FSFI-9 total from 65% to 75%, compared to 85% in healthy controls) and distress, independent of the occurrence of major post-operative complications and/or bowel surgery in the first six months after surgery.

Despite the significant improvement, sexual functioning in post-surgical DE patients does not reach the level observed in healthy controls. Future research is necessary to determine whether a holistic approach can optimise post-surgical sexual QoL of DE patients even further, aiming to achieve scores comparable to those of healthy controls. Surgery addresses the physical aspects affecting the sexual functioning of DE patients as demonstrated in our results. An additional holistic approach also focusing on psychological and social factors may further enhance overall outcomes, e.g., through consultation with a pelvic

floor physiotherapist and/or sexologist. Our findings are important to use during the counselling process in order to inform the patient on outcomes and expectations regarding sexual functioning and overall health following DE surgery.

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Data sharing: The data supporting this study will be made available upon reasonable request to the corresponding author.

Transparency: Hereby, I affirm (as corresponding author) that this manuscript is an honest, accurate, and transparent account of the study being reported. No important aspects of the study have been omitted. Discrepancies from the study as planned have been explained.

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Supplementary Data

Included Questionnaires

Sexual functioning was assessed using the Female Sexual Function index (FSFI-9), including six domains (desire, arousal, lubrication, orgasm, satisfaction and pain).[27] One more question was added to determine whether patients were sexually active around the time of completion. The total FSFI-9 score ranges from 2 to 45, with a higher score indicating better sexual functioning. Low sexual functioning was defined as a total score <15.[27] To make findings applicable to usage in clinical practice, we calculated the FSFI-9 total score pre- and post-surgery as a percentage of the maximum possible score (45.0). To assess sexual distress, one item based on the Female Sexual Distress Scale-Revised (FSDS-R) was used: "How many times have you felt stressed or unhappy about your sex life in the past 4 weeks?". This was answered on a 5-point Likert scale from 0 (never) to 4 (always).[28] Sexual distress was defined as an FSDS-R score ≥3.

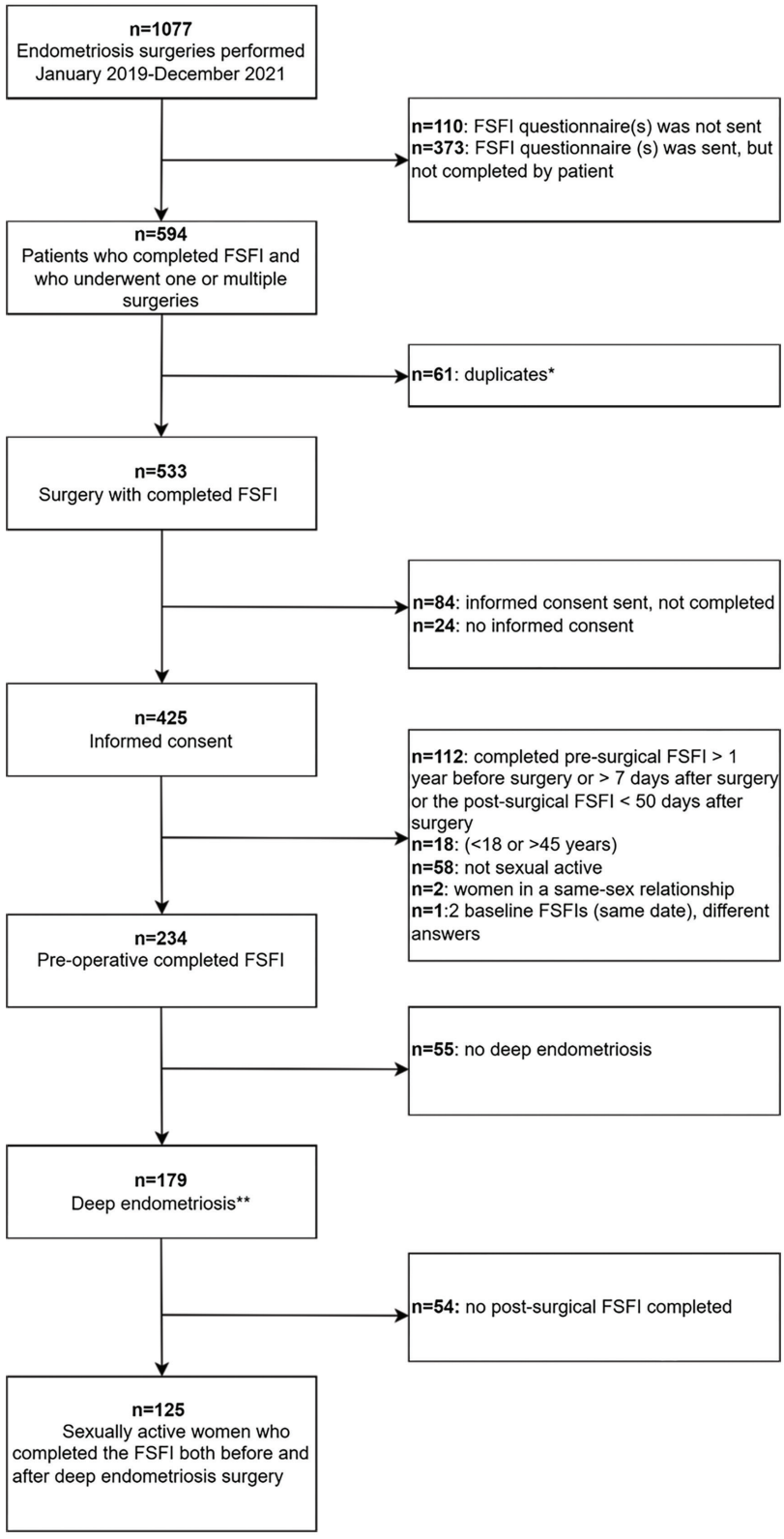
Endometriosis-associated quality of life (QoL) was examined using the Endometriosis Health Profile-30 questionnaire, containing 5 domains: pain (11 items), control and powerlessness (6 items), emotional well-being (6 items), social support (4 items) and self-image (3 items), with the outcome ranging on a scale of 0 to100, with lower scores representing better QoL. For the healthy controls, the standard question "Because of your endometriosis, how often did you ..." was adjusted into "How often did you ...," as suggested by van de Burgt et al.[29]

Pain symptoms were assessed using the numeric rating scale scores for dysmenorrhea, dyspareunia, dyschezia, dysuria and chronic pelvic pain. The scale ranges from 0 (no pain) to 10 (worst pain imaginable).

Depressive symptoms were measured using the Patient Health Questionnaire-9. The total score ranges from 0 to 27 and can be classified in the following categories: no depression (0-4 points), mild depression (5-9 points), moderate depression (10-14 points), moderate to severe depression (15-19 points) and severe depression (20-27 points).[30]

Relational satisfaction was measured using the Maudsley Marital Questionnaire vsubscale, including 10 questions, with each item rated on a scale ranging from 0 (satisfied) to 8 (dissatisfied).[31]

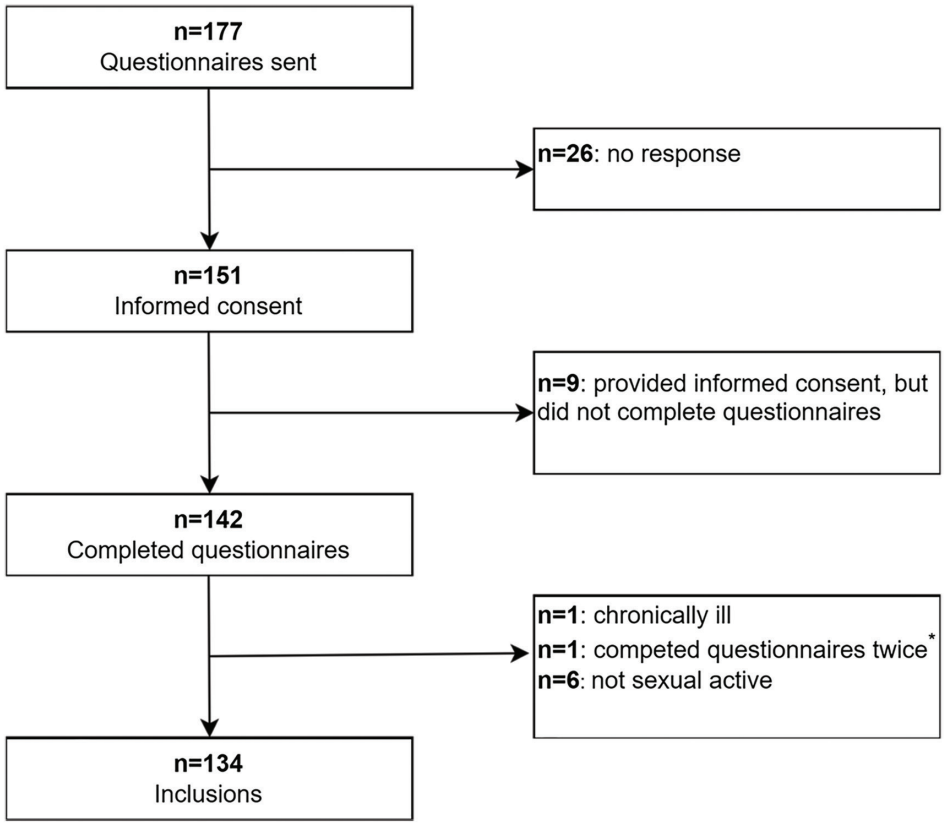
Positive affect was measured using the 10 items on positive affect which are part of Positive and Negative Affect Schedule.[32] Total scores range from 10 to 50, with higher scores representing more positive affect.



Supplementary Figure 1. Flow selection deep endometriosis patients.

*The same patient underwent multiple surgeries and completed the FSFI questionnaire before one single surgery (55 patients: 2 surgeries, 3 patients: 3 surgeries). **Deep endometriosis was confirmed during surgery.

FSFI: Female sexual functioning index.



Supplementary Figure 2. Flow selection healthy controls.

*The most recently filled in questionnaires were used in the analysis.

Supplementary Table 1. Intra- and postoperative complications.		
	Total n=125	
Intraoperative complications, n (%)	**n=3 (2.4%)**	
Visceral	n=2 (1.6%)	
Other	n=1 (0.8%)	
Postoperative complications, n (%)	**n=21 patients (16.8%)** **n=29 post-operative complications**	**Clavien-Dindo classification***
Vaginal cuff dehiscence	n=2 (6.9%)	Grade IIIb
Urinary infection	n=4 (13.8%)	Grade II
Pyelonephritis	n=2 (6.9%)	Grade II
Pelvic abscess	n=1 (3.4%)	Grade II
Lower anterior resection syndrome	n=3 (10.3%)	Grade I
Infection of unknown cause treated with antibiotics	n=2 (6.9%)	Grade II
Pneumonia	n=1 (3.4%)	Grade II
Postdural puncture headache	n=2 (6.9%)	Grade II
Hydronephrosis	n=2 (6.9%)	Grade IIIb
Postoperative acute kidney injury	n=2 (6.9%)	Grade I
Ureterovaginal fistula	n=1 (3.4%)	Grade IIIb
Rectovaginal fistula	n=1 (3.4%)	Grade IIIb
Bowel injury	n=1 (3.4%)	Grade IIIb
Bladder injury	n=1 (3.4%)	Grade I
Hypotonic bladder	n=1 (3.4%)	Grade I
Acute endometritis**	n=1 (3.4%)	Grade IIIb
Infected hematoma	n=1 (3.4%)	Grade IIIb
Thrombophlebitis	n=1 (3.4%)	Grade II
*Complications were classified according to the Clavien-Dindo classification as described elsewhere.[22] **Laparoscopic surgery was done to rule out bowel injury.		

Supplementary Table 2. Sexual functioning and distress pre- and post-deep endometriosis surgery in comparison to healthy controls.

	Min-Max score	DE patients' prior surgery (n=125)	3 months post-surgery (n=125)	*P*-value	6 months post-surgery (n=65)	*P*-value	Healthy controls (n=134)	Non-adjusted *P*-value HC vs. DE 3 months post-surgery	Adjusted *P*-value HC vs. DE 3 months post-surgery	Non-adjusted *P*-value HC vs. DE 6 months post-surgery	Adjusted *P*-value HC vs. DE 6 months post-surgery
Days before or after surgery, median (IQR)		11.0 (6.0-13.0) 0.4 months	81.0 (71.0-185.0) 2.7 months		193.0 (171.5-357.5) 6.3 months						
FSFI-9, geometric mean (95% CI)											
Total score	2-45	29.31 [27.15,31.23]	33.62 [32.16,34.94]	<0.001[a]	33.13 [31.02,34.95]	<0.001[b]	38.08 [37.21,38.87]	<0.001[c]	<0.001[d]	<0.001[e]	<0.001[f]
Desire	1-5	2.46 [2.25,2.66]	3.02 [2.82,3.21]	<0.001[a]	3.05 [2.81,3.29]	<0.001[b]	3.21 [3.05,3.36]	0.12[c]	0.39[d]	0.27[e]	0.66[f]
Arousal	0-5	2.87 [2.62,3.11]	3.39 [3.20,3.57]	<0.001[a]	3.31 [3.03,3.57]	0.002[b]	3.98 [3.83,4.13]	<0.001[c]	<0.001[d]	<0.001[e]	0.001[f]
Lubrication	0-10	7.55 [7.02,8.01]	8.18 [7.81,8.51]	0.007[a]	8.19 [7.60,8.69]	0.02[b]	9.32 [9.15,9.49]	<0.001[c]	<0.001[d]	<0.001[e]	<0.001[f]
Orgasm	0-10	7.13 [6.56,7.64]	8.10 [7.69,8.48]	<0.001[a]	8.02 [7.40,8.56]	0.009[b]	8.52 [8.20-8.82]	0.096[c]	0.21[d]	0.11[e]	0.25[f]
Satisfaction	1-10	6.44 [5.93,6.91]	7.53 [7.14,7.90]	<0.001[a]	7.42 [6.87,7.92]	0.002[b]	8.52 [8.26,8.76]	<0.001[c]	0.11[d]	<0.001[e]	0.046[f]
Pain	0-5	2.80 [2.47,3.10]	3.45 [3.19,3.69]	<0.001[a]	3.28 [2.90,3.62]	<0.001[b]	4.58 [4.46,4.70]	<0.001[c]	<0.001[d]	<0.001[e]	<0.001[f]
FSDS-R, geometric mean (95% CI)	0-4	1.72 [1.94,1.52]	1.28 [1.47,1.10]	<0.001[a]	1.40 [1.69,1.14]	0.02[b]	1.0 [1.17,0.85]	0.03[c]	0.25[d]	0.01[e]	0.16[f]
								***P*-value**		***P*-value**	
Low sexual function[a], n (%)		n=18 (14.4%)	n=7 (5.6%)	0.01[g]	n=5 (7.7%)	0.07[h]	n=0 (0%)	0.01[i]		0.003[j]	
High sexual distress[b], n (%)		n=38 (30.4%)	n=18 (14.4%)	<0.001[g]	n=14 (21.5%)	0.06[h]	n=11 (8.2%)	0.120[i]		0.01[j]	

[a]Paired t-test 3 months post-surgery vs. baseline. [b]Paired t-test 6 months post-surgery vs. baseline. [c]Unadjusted *P*-value controls vs. DE patients 3 months post-surgery, univariable regression analysis. [d]*P*-value controls vs. DE patients 3 months post-surgery, adjusted for age, living together (yes or no), duration relationship, nulliparous (yes or no), future wish to conceive (yes or no), working (yes or no), secondary education (yes or no), multiple regression analysis. [e]Unadjusted *P*-value controls vs. DE patients 6 months post-surgery, univariable regression analysis. [f]*P*-value controls vs. DE patients 6 months post-surgery adjusted for age, living together (yes or no), duration relationship, nulliparous (yes or no), future wish to conceive (yes or no), working (yes or no), secondary education (yes or no), multiple regression analysis. [g]McNemar test 3 months post-surgery vs. baseline. [h]McNemar test 6 months post-surgery vs. baseline. [i]Fisher's exact test controls vs. DE patients 3 months post-surgery. [j]Fisher's exact test controls vs. DE patients 6 months post-surgery. HC: Healthy controls, DE: Deep endometriosis, FSDS: Female Sexual Distress scale, IQR: Interquartile range, CI: Confidence interval. Min: Minimum, Max: Maximum.

Supplementary Table 3. PROM outcomes pre- and post-deep endometriosis surgery in comparison to healthy controls.

	DE patients' prior surgery (n=125)	**3 months post-surgery**	***P*-value**	**6 months post-surgery**	***P*-value**	**Healthy controls (n=134)**	***P*-value HC vs. DE 3 months post-surgery**	**Adjusted P-value HC vs. DE 3 months post-surgery**	***P*-value HC vs. DE 6 months post-surgery**	**Adjusted *P*-value HC vs. DE 6 months post-surgery**
NRS pain scores	n=117	n=105		n=65						
Days before or after surgery, median (IQR)	10.0 (6.0-13.0)	81.0 (72.0-184.5)		193.0 (173.5-357.5)		NA				
	Min score: 0 (positive)	Max. score: 10 (negative)								
Dysmenorrhea, geometric mean [95% CI]	6.55 [5.75,7.43]	5.10 [4.40,5.89]	0.004[a]	4.91 [3.75,6.36]	0.003[b]	2.27 [1.91,2.67]	<0.001[c]	0.002[d]	<0.001[e]	0.008[f]
Dyspareunia	3.84 [3.22,4.54]	2.03 [1.61,2.51]	<0.001[a]	2.64 [2.01,3.40]	<0.001[b]	0.63 [0.46,0.82]	<0.001[c]	<0.001[d]	<0.001[e]	<0.001[f]
Chronic pelvic pain	5.80 [5.16,6.50]	3.28 [2.77,3.88]	<0.001[a]	3.74 [3.07,4.53]	<0.001[b]	0.72 [0.54,0.93]	<0.001[c]	<0.001[d]	<0.001[e]	<0.001[f]
Dyschezia	4.08 [3.43,4.82]	2.09 [1.63,2.62]	<0.001[a]	2.05 [1.50,2.72]	<0.001[b]	0.55 [0.40,0.71]	<0.001[c]	<0.001[d]	<0.001[e]	<0.001[f]
Dysuria	1.53 [1.17,1.94]	0.98 [0.72,1.28]	<0.001[a]	0.96 [0.66,1.31]	0.001[b]	0.07 [0.02,0.12]	<0.001[c]	<0.001[d]	<0.001[e]	<0.001[f]
EHP-30 core questionnaire	n=107	n=109		n=64						
Days before or after surgery, median (IQR)	127.0 (24.0-220.0)	81.0 (72.0-181.0),		182.5 (172.3-357.3)		NA				
	Min score: 0 (positive)	**Max score: 100 (negative)**								
EHP-30 Pain, geometric mean [95% CI]	51.02 [45.68,56.98]	22.87 [17.85,29.23]	<0.001[a]	18.59 [13.02,26.35]	<0.001[b]	3.58 [2.58,4.86]	<0.001[c]	<0.001[d]	<0.001[e]	<0.001[f]
EHP-30 control and powerlessness	60.25 [55.51,65.40]	26.66 [21.29,33.34]	<0.001[a]	25.26 [18.45,34.46]	<0.001[b]	7.91 [6.33,9.83]	<0.001[c]	<0.001[d]	<0.001[e]	<0.001[f]
EHP-30 emotional well-being	47.94 [44.84,51.03]	34.21 [30.12,38.31]	<0.001[a]	32.68 [27.61,37.75]	<0.001[b]	27.39 [24.75, 30.04]	0.50[c]	0.98[d]	0.91[e]	0.37[f]
EHP-30 social support	38.52 [32.19,46.07]	26.91 [21.17,34.13]	0.03[a]	24.46 [17.19,34.63]	0.13[b]	10.65 [8.11,13.90]	<0.001[c]	0.02[d]	<0.001[e]	0.007[f]
EHP-30 self-image	28.48 [22.04,36.71]	18.82 [13.88,25.40]	0.003[a]	21.21 [14.14,31.57]	0.122[b]	10.66 [8.18,13.80]	0.005[c]	0.20[d]	0.004[e]	0.02[f]
MMQ	n=112	n=119		n=68						
Days before or after surgery, median (IQR)	11.0 (6.0-13.0)	81.0 (71.0-182.0)		181.0 (172.0-356.5)		NA				

Supplementary Table 3. Continued

	DE patients' prior surgery (n=125)	3 months post-surgery	*P*-value	6 months post-surgery	*P*-value	Healthy controls (n=134)	*P*-value HC vs. DE 3 months post-surgery	Adjusted P-value HC vs. DE 3 months post-surgery	*P*-value HC vs. DE 6 months post-surgery	Adjusted *P*-value HC vs. DE 6 months post-surgery
	Min score: 0 (positive)	**Max. score: 80 (negative)**								
Relational satisfaction, geometric mean [95% CI] No relation	6.65 [5.34,8.22] n=0	5.88 [4.63,7.41] n=12	0.25[a]	8.36 [6.16,11.24] n=6	0.24[b]	7.77 [6.46,9.32]	0.06[c]	0.003[d]	0.67[e]	0.86[f]
PAS, median (IQR)	n=115	n=110		n=64						
Days before or after surgery, median (IQR)	10.0 (6.0-13.0)	81.0 (72.0-182.3)		216.5 (175.0-357.8)		NA				
	Min. score: 10 (negative)	**Max. score: 50 (positive)**								
Total score, mean [95% CI]	31.26 [29.90,32.62]	32.63 [31.25,34.00]	0.02[a]	32.36 [30.49,34.23]	0.10[b]	35.95 [34.94,36.96]	<0.001[c]	0.02[d]	<0.001[e]	0.07[f]
PHQ-9, median (IQR)	n=64	n=64		n=46						
Days before or after surgery, median (IQR)	11.0 (6.0-13.0)	78.0 (72.0-130.8)		178.0 (171.8-323.8)		NA				
	Min. score: 0 (positive)	**Max. score: 27 (negative)**								
Total score, geometric mean [95% CI] No depression, n (%) Mild depression, n (%) Moderate depression, n (%) Moderate severe depression, n (%) Severe depression, n (%)	9.25 [7.83,10.90] n=7 (10.9%) n=23 (35.9%) n=20 (31.3%) n=5 (7.8%) n=9 (14.1%)	6.76 [5.51,8.25] n=18 (28.1%) n=20 (31.3%) n=17 (26.6%) n=7 (10.9%) n=2 (3.1%)	0.001[a]	7.23 [5.65,9.18] n=9 (19.6%) n=17 (37.0%) n=14 (30.4%) n=3 (6.5%) n=3 (6.5%)	<0.001[b]	4.66 [4.07,5.31] n=67 (50.0%) n=46 (34.3%) n=14 (10.4%) n=4 (3.0%) n=3 (2.2%)	0.002[c]	0.11[d]	0.001[e]	0.053[f]

[a]Paired t-test 3 months post-surgery vs. baseline. [b]Paired t-test 6 months post-surgery vs. baseline. [c]Unadjusted *P*-value controls vs. DE patients 3 months post-surgery, univariable regression analysis. [d]*P*-value controls vs. DE patients 3 months post-surgery adjusted for age, living together (yes or no), duration relationship, nulliparous (yes or no), future wish to conceive (yes or no), working (yes or no), secondary education (yes or no), multiple regression analysis. [e]Unadjusted *P*-value controls vs. DE patients 6 months post-surgery, univariable regression analysis. [f]*P*-value controls vs. DE patients 6 months post-surgery adjusted for age, living together (yes or no), duration relationship, nulliparous (yes or no), future wish to conceive (yes or no), working (yes or no), secondary education (yes or no), multiple regression analysis. HC: Healthy controls, DE: Deep endometriosis, IQR: Interquartile range, CI: Confidence interval, EHP: Endometriosis health profile, Min: Minimum, Maximum, NRS: Numerical rating scale, MMQ: Maudsley Marital Questionnaire, PAS: Perceived anxiety scale, PHQ-9: Patient health questionnaire-9, NA: Not applicable.

Supplementary Table 4. The impact of major postoperative complication(s) and bowel surgery on sexual functioning.

Surgical variable		n	FSFI-9 total score, 3 months post-surgery Geometric mean [95% CI]	*P*-value	n	FSFI-9 total score, 6 months post-surgery Geometric mean [95%CI]	*P*-value
Major postoperative complication(s) (CD 3B)	No Yes	116 9	33.89 [32.39, 35.24] 29.68 [21.61, 35.19]	0.17[a]	60 5	33.34 [31.12, 35.24] 30.35 [19.60, 36.88]	0.46[a]
Bowel endometriosis surgery	No Yes	55 70	33.52 [31.27, 35.45] 33.70 [31.65, 35.49]	0.90[a]	26 39	32.97 [29.16, 35.96] 33.23 [30.48, 35.52]	0.90[a]

[a]Univariate regression analysis. CD: Clavien-Dindo, FSFI-9: Female sexual function index-9, CI: Confidence interval.

ORIGINAL ARTICLE

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Robotic-assisted hysterectomy using DEXTER®: the first prospective multicentre study

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ABSTRACT

Background: Minimally invasive hysterectomy is increasingly performed robotically as new systems expand options and address limitations of traditional platforms, including financial, infrastructure, and workflow demands. The DEXTER® Robotic Surgery System was designed to address some of these challenges.

Objectives: To confirm perioperative and early postoperative safety, and evaluate the clinical performance of DEXTER in hysterectomy.

Methods: This prospective multicentre study included 34 patients who underwent robotic-assisted hysterectomy for benign or low-risk malignant diseases between November 2022 and November 2023. DEXTER was integrated into the surgical workflows of the four participating centres, which used their existing laparoscopic towers.

Main Outcome Measures: Primary outcomes were procedural conversions and Clavien-Dindo grade III-V events up to 30 days post-surgery.

Results: Median patient age was 45.5 years; median body mass index was 26.0 kg/m^2. There were no conversions to laparotomy, intraoperative complications or transfusions, with a median estimated blood loss of 100 mL. Median skin-to-skin operative time was 125.5 min, including a median docking time of 5 minutes. Median length of hospitalisation was 2 days. Two Clavien-Dindo grade IIIb adverse events were recorded, neither of which was device-related. In 3 cases, the surgeons decided to finish the procedure laparoscopically.

Conclusions: Hysterectomy assisted with DEXTER can be safely performed even in the early learning phase. DEXTER facilitated an adaptable OR workflow allowing greater flexibility in procedural approaches. Further investigation with a larger cohort and a longer follow-up is required to evaluate long-term outcomes.

What is New? First prospective multicentre study to confirm robotic-assisted hysterectomy using DEXTER is a feasible and safe approach for treating benign and low-risk malignant conditions.

Keywords: Hysterectomy, intraoperative complications, laparoscopic, prospective, robotic-assisted, robotic surgery

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Introduction

Hysterectomy is the most common gynaecological surgery, with variable incidence rates among countries.[1,2] Approximately 10% of hysterectomies are performed for malignant conditions, whereas the majority address benign indications such as myomas, abnormal uterine bleeding, prolapse, and endometriosis.[1]

Robotics is increasingly adopted in gynaecology surgery,[3,4] combining the established benefits of minimally invasive surgery, such as reduced blood loss, faster recovery, and shorter hospital stays,[5-7] with robot-specific advantages, including improved ergonomics, natural movements, and enhanced dexterity through articulated instruments and elimination of the "fulcrum effect".[8-10] Additionally, robotics may be gaining popularity simply because it is perceived by surgeons as easier and more comfortable to use.[11]

Robotic hysterectomy is considered non-inferior to conventional laparoscopic hysterectomy in terms of peri- and postoperative complication rates, though further studies are needed to determine clear advantages in clinical outcomes.[12,13] Most comparative studies to date have been retrospective, prone to underreporting of adverse events, or limited to the learning phase, which may not capture a comprehensive assessment of the robotic approach.[6,14]

Conventional robotic systems also introduce challenges, including increased costs compared to other surgical approaches,[15] limited availability when shared with other surgical departments, and operative room (OR) setups that physically separate surgeons from their teams. This separation can hinder situational awareness and decision-making,[16] disrupt communication through the closed console (noise, missing non-verbal cues), and increase reliance on surgical assistants during emergencies while the non-sterile console surgeons scrub in.[17] Furthermore, the large footprint of existing systems around the operating table often impedes patient access.[18]

The DEXTER® Robotic Surgery System (Distalmotion SA, Epalinges, Switzerland) is CE marked for use in gynaecology, urology, and general surgery, and has been routinely utilised in clinical practice since 2022.[19-23] It was designed with an open-architecture and small, mobile footprint, so it could integrate into diverse laparoscopic workflows without dedicated room or installation requirements, while offering the full articulation, precision, and ergonomic benefits of a robotic system.[24]

One of the design features of DEXTER is its compact, modular layout, which provides unobstructed access to the surgical table, allowing both the table assistant and the uterine manipulator assistant to work alongside the robotic arms without interference. DEXTER furthermore allows scrubbed surgeons to alternate easily between conventional laparoscopy and robotic surgery as desired within seconds.[25]

Evidence on the use of DEXTER in real-world gynaecology surgery remains limited.[19,26] This study analysed the safety and performance of hysterectomy with DEXTER in a prospective, multicentre setting during the initial learning phase of participating surgeons.

Methods

Study Design and Population

This was a prospective, single-arm study, approved by the Ethics Committees according to local and national regulations of the participating countries (Switzerland: protocol number: 2021-00079, date: 14.09.2022; Germany: protocol number D525/22, date: 23.08.2022; France: not required for observational studies). All patients provided informed consent. The study was conducted in line with the Declaration of Helsinki and ISO 14155:2020 standards and was registered in the ClinicalTrials.gov database (NCT05537727). The study was completed in the context of the post-market clinical follow-up evaluation, which included 3 surgical procedures: hysterectomy, partial nephrectomy, and right colectomy. This article reports the results from the hysterectomy cohort only.

All enrolled patients were adult women scheduled to undergo minimally invasive hysterectomy with DEXTER according to its intended use. The study methodology aimed to reflect a real-world surgical environment, capturing a range of typical indications encountered in every gynaecology practice, including myomas, abnormal uterine bleeding, endometriosis, as well as confined uterine malignancies with minimal risk of metastasis. Patients requiring additional procedures such as salpingo-oophorectomy, lymphadenectomy, or excision of endometriosis were also included if these interventions were part of the planned treatment. All patients were followed for 30 days postoperatively.

Exclusion criteria included morbid obesity [body mass index (BMI) ≥40], contraindications for endoscopic surgery, bleeding diathesis, presence of pacemakers or internal defibrillators, pregnancy, or concurrent participation in

another interventional clinical trial. Procedure-specific exclusion criteria included a history of major abdominal or pelvic surgery (defined as abdominal incisions >10 cm or extensive organ resections significantly altering anatomy), malignancies with intraabdominal spread, and uterine fibroids >8 cm.

The primary safety endpoint was the occurrence of Clavien-Dindo grade III-V adverse events during the perioperative period and up to 30 days postoperatively. The primary clinical performance endpoint was a successful completion of the procedure without conversion to open or fully laparoscopic surgery due to any robotic system deficiency. This endpoint reflects the intended application of DEXTER as an assistive robotic system, deployed at the surgeon's discretion for selected procedural steps. Secondary safety endpoints included perioperative and early postoperative outcomes such as intra- and postoperative complications, estimated blood loss, length of hospital stay, procedure-related rehospitalisation, and mortality. Secondary performance endpoints included docking time and total operative time. Total (skin-to-skin) operative time was measured from the first skin incision to the final suture, including any concomitant procedures. Docking time was measured from the moment the patient carts approached the operating table until the final docking step was completed, defined as either the removal of the last incision pointer or the secure placement of the endoscope in the docking arm, whichever occurred later.

Procedures were performed by six laparoscopic surgeons with a minimum of ten years of surgical experience, stratified by robotic surgery proficiency: two novice users (no prior robotic experience before training on DEXTER), two intermediate users (limited robotic experience either with DEXTER or another robotic platform, defined as <2 years of robotic practice), and two expert users (≥3-5 years of routine robotic use for both simple and complex procedures across one or more robotic platforms). All centres completed the mandatory manufacturer training prior to the first surgeries. The training curriculum included an online didactic course focusing on the DEXTER hardware, preparation and procedural steps, as well as multiple hands-on sessions in dry-lab and wet-lab environments, and optional simulator exercises. Additionally, all centres had treated three roll-in patients using DEXTER prior to enrolling in the study.

DEXTER® Robotic Surgery System

The DEXTER system consists of four modular components: two patient carts with robotic instrument arms, an endoscope cart with a robotic endoscope arm, and an open surgeon console with height-adjustable ergonomic armrests. The console includes two pedals for clutching and endoscope control.

Docking is facilitated by so-called "incision pointers", which help align the instrument arms' remote centre of motion with the trocars (Figure 1a). The system is fully draped, allowing the surgeon to remain sterile when working at the console and immediately access the patient when necessary. The robotic instrument arms can be retracted into laparoscopic mode within seconds, allowing ample space and trocar access to perform certain steps laparoscopically (Figure 1c), even with two assistants and a scrub nurse present. This enables seamless transitions between robotics and conventional laparoscopy.

Dexter integrates with existing OR infrastructure, including electrosurgical and endoscopic equipment. The surgeon continues using the existing electrosurgery pedals from the laparoscopic tower. At the console, DEXTER integrates with the full visualisation system, including two-dimensional and three-dimensional (3D) imaging as well as indocyanine green (ICG) fluorescence. The system supports five single-use, fully articulated 8-mm robotic instruments: a monopolar hook, monopolar scissors, a bipolar Maryland dissector, a bipolar Johann grasper, and a needle driver. Each instrument offers seven degrees of freedom and a micro-clutching function on wrist rotation for precise, natural control, even at extreme angles.

Surgical Technique

Patients were placed in the supine position with a 15-20° Trendelenburg tilt. A uterine manipulator was used to facilitate adequate exposure of the uterus, optimise visualisation of anatomical planes and enable colpotomy. Three translucent laparoscopic 10-12 mm trocars were used: one for the 3D endoscope (positioned medially, at the umbilical level) and two for the robotic instruments (placed 8-9 cm lateral to the linea alba on both sides and at least 5 cm below the umbilical level) (Figure 2). An additional 5- or 10-mm trocar was typically placed for the assistant, either in a suprapubic position or in the right hypochondrium, more than 10 cm superior to the anterior superior iliac spine. The trocar placement closely followed the usual laparoscopic setup.

After abdominal inspection, in the presence of endometriosis or adhesions, the surgeon decided whether to perform endometriosis resection or adhesiolysis laparoscopically or robotically, depending on the diagnosis and personal preference. For docking, the two patient carts were positioned on either side of the operating table, with the endoscope arm placed at the cephalic level (Figure 1b). The endoscope arm was docked to the optical trocar, and the robotic instruments were inserted under direct visualisation.

The hysterectomy began with the division of the round ligaments and the mobilisation of the uterus. Salpingectomy or salpingo-oophorectomy was performed as indicated. Colpotomy and coagulation of the uterine artery followed, after which the uterus was retrieved either transvaginally or via morcellation within an endobag, according to the site's routine practice. The vaginal closure was subsequently performed using a 3-0 barbed suture. Additional procedures, such as endometriosis resection or sentinel lymph node dissection, were carried out before or after the hysterectomy as planned. The procedure concluded with haemostasis, inspection, trocar removal, and wound closure.

Data Acquisition and Analysis

Based on a comprehensive literature review on other robotic platforms, the expected rate of Clavien-Dindo grade III-V complications ranged from 2.7% (weighted mean) to a non-inferiority threshold of <9.8%, reflecting

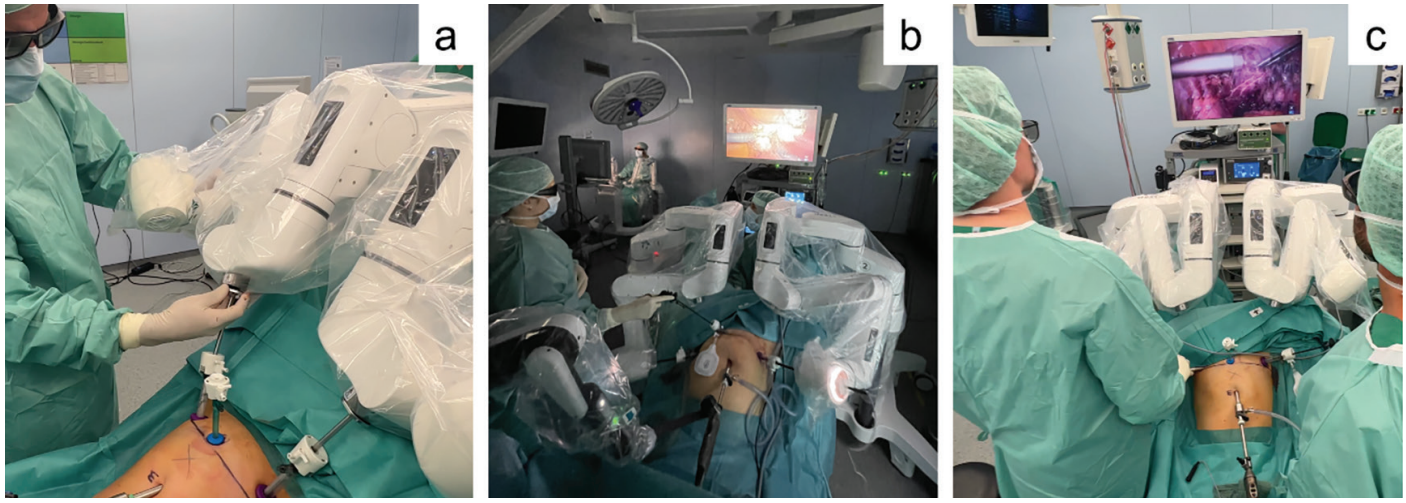

Figure 1. Docking DEXTER using incision pointers to align the remote centre of motion of the instrument arms with the trocars **(a)**, OR hysterectomy setup **(b)**, DEXTER instrument arms folded in laparoscopic mode **(c)**.

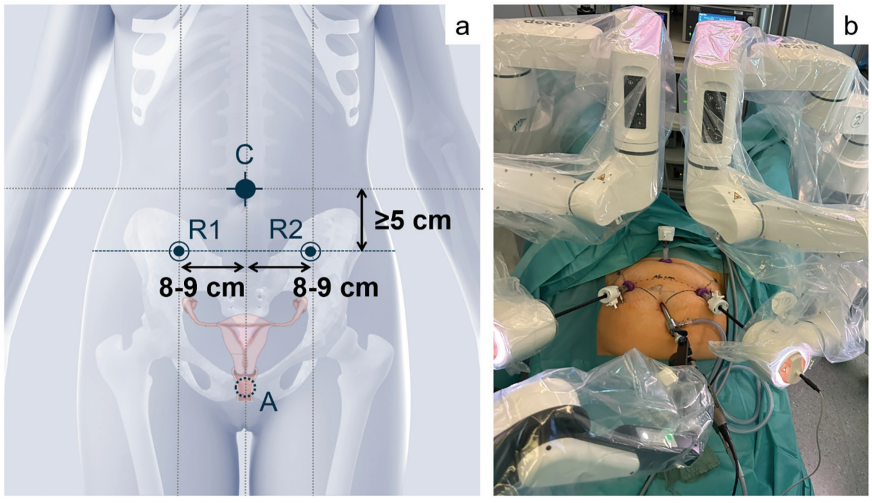

Figure 2. Port placement for hysterectomy as outlined in the procedure guide **(a)** and in actual surgery **(b)**. The setup includes one port C for the endoscope camera (medially, at the umbilical level), 2 ports, R1 and R2, for robotic instruments (8-9 cm lateral to the linea alba on both sides, at least 5 cm below the umbilical level), and 1 assistant laparoscopic port A (suprapubic).

the variability in published data.[12,27] A sample size of 30 patients in the hysterectomy group was chosen, as it allows the calculation of a one-sided 95% confidence interval for observed complication rates, with upper bounds of 14.9% for a 3.3% rate (one event) and 23.9% for a 10% rate (three events), ensuring an acceptable level of precision.

Adverse events were reviewed and adjudicated by an independent Clinical Event Committee. Descriptive statistics were used in this study; median values with interquartile range (IQR) were used to present the data. Data were analysed using StataCorp (2023. Stata Statistical Software: Release 18. College Station, TX: StataCorp LLC).

Results

Between November 2022 and November 2023, 34 patients were enrolled, with a median age of 45.5 years (IQR: 42.0-52.0) and a median BMI of 26.0 kg/m^2 (IQR: 22.8-28.2). Each participating centre enrolled at least five patients. Detailed patient characteristics and indications for surgery are presented in Table 1.

No device-related adverse events or intraoperative complications were reported. Median blood loss was 100 mL (IQR: 50-200), and no blood transfusions were required (Table 2). There were no conversions to open surgery. In three cases, however, one surgeon converted to laparoscopy towards the end of the procedure due to multiple instrument arm collisions caused by suboptimal trocar placement and docking. In one of these cases, the surgeon did not keep both robotic instruments visible on the screen, which contributed to the collision. None of these incidents was associated with adverse events.

Transvaginal specimen extraction was reported in 17 (50%) patients, while the abdominal specimen extraction route was reported in 8 (23.5%) patients. In the remaining 9 (26.5%) cases, the specimen extraction route was not documented in the operative report.

Median operative time was 125.5 minutes (IQR: 107.0-159.0). Concomitant procedures such as lymph node dissection and endometriosis resection were performed either laparoscopically or robotically, depending on the surgeon's clinical judgement, robotic experience and the specific demands of each case. For instance, lymph node dissection was performed robotically with ICG-3D near-infrared visualisation (Figure 3). In another case, a patient with stage IV deep infiltrating endometriosis required a concomitant rectosigmoid resection, which was performed laparoscopically by an assisting colorectal surgeon. For this step, the robot was switched to its laparoscopic mode, as the colorectal surgeon was not trained on DEXTER.

Median length of hospitalisation was 2.0 days (IQR: 1.0-3.0). During the 30-day follow-up period, Clavien-Dindo grade III-V adverse events occurred in two patients (5.9%), both

Table 1. Patient characteristics.

Parameter (n=34)	Value
Age (years), median (IQR)	45.5 (42.0-52.0)
BMI (kg/m^2), median (IQR)	26.0 (22.8-28.2)
ASA score, n (%)	
I	7 (20.6)
II	26 (76.5)
III	1 (2.9)
Indications for surgery, n(%)	
Uterine fibroids	13 (38.2)
Heavy uterine bleeding	8 (23.5)
Endometriosis	5 (14.7)
Low-risk endometrial cancer	3 (8.8)
Symptomatic adenomyosis	2 (5.8)
Endometrial intraepithelial neoplasia	1 (2.9)
Borderline tumour of the ovary	1 (2.9)
Endometrial hyperplasia	1 (2.9)

IQR: Interquartile range; BMI: Body mass index; ASA: American Society of Anaesthesiologists.

Table 2. Perioperative results.

Parameter (n=34)	Value
Conversion to open, n	0
Conversion to laparoscopy, n	3
Operative time (skin-to-skin) (min), median (IQR)	125.5 (107.0-159.0)
Docking time (min), median (IQR)	5.0 (5.0-7.0)
Estimated blood loss (mL), median (IQR)	100 (50-200)
Blood transfusions, n	0
Length of hospital stay (days), median (IQR)	2.0 (1.0-3.0)
Concomitant procedures, n (%)	
Salpingectomy	26 (76.5)
Salpingo-oophorectomy	5 (14.7)
Adhesiolysis	8 (23.5)
Endometriosis	7 (20.6)
Lymphadenectomy	3 (8.8)

IQR: Interquartile range.

classified as grade IIIb. One patient, who had five previous pregnancies, was readmitted six days after the hysterectomy with radical lymphadenectomy and reoperated for an umbilical trocar-site hernia at the 12-mm endoscope port. The hernia occurred despite fascial closure with Endo Close™ (Medtronic, Macquarie Park, NSW, Australia) and resolved without further sequelae. Another patient was readmitted on postoperative day six with suspected anastomotic leakage following the rectosigmoid resection. The leak was not confirmed intraoperatively, and the patient did not require a stoma. Both patients who had Clavien-Dindo III events were released with antibiotics without further complications. The remaining adverse events, as detailed in Table 3, were classified as Clavien-Dindo grade I (6 patients) and grade II (5 patients). These included two further readmissions for wound infection and faecaloma with abdominal pain. All grade I-II adverse events were managed conservatively, with patients recovering fully and without long-term sequelae.

Discussion

Main Findings

This study represents the first prospective multicentre investigation of robotic-assisted hysterectomy using DEXTER, providing early clinical experience with this system, and reflecting real-world utilisation across four different hospitals in three European countries. Importantly, despite the early experience with DEXTER and varying levels of robotic experience of the participating surgeons, all procedures were performed without conversion to open surgery or intraoperative complications. This finding is significant, as conversions to open surgery is a recognised risk early in the learning curve.[28]

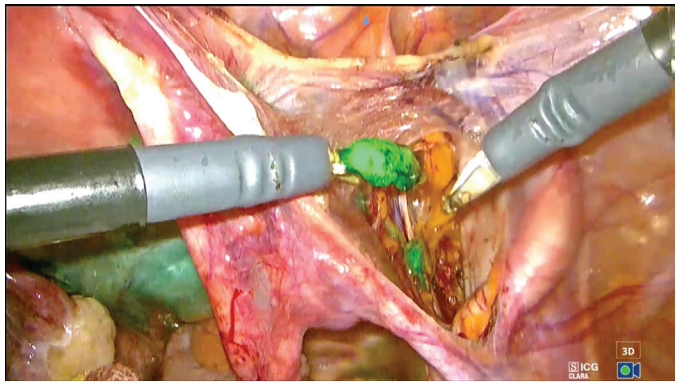

Figure 3. ICG fluorescence was used with DEXTER for sentinel lymph node removal performed concomitantly with hysterectomy.

ICG: Indocyanine green.

There were no device-related complications. Most postoperative adverse events were minor and consistent with those commonly observed in hysterectomy patients regardless of the surgical technique, such as urinary incontinence and pelvic pain in endometriosis patients.[29,30] The patient who developed an umbilical trocar-site hernia had five previous pregnancies, which may have contributed to the abdominal wall weakness despite appropriate fascial closure. The second Clavien-Dindo grade III event involved a suspected anastomotic leak following a concomitant laparoscopic rectosigmoid resection for deep infiltrating endometriosis, which is a known concern after intestinal resection in such cases,[31] and must be ruled out by laparoscopy.[32]

The three procedures which could not be completed robotically were performed by a surgeon with previous robotic experience on another robotic platform**,** but during their initial learning phase with DEXTER. The main reasons for conversion were suboptimal patient positioning and suboptimal trocar placement, which limited access within the surgical workspace. These early learning cases were subsequently reviewed and analysed with the surgical team to highlight the importance of careful planning during initial implementation of the robotic system. We believe that with increased experience using DEXTER, such conversions can be avoided. During a conversion to laparoscopy with DEXTER, the operating sterile surgeon has direct and immediate access to the patient, enabling a rapid transition without the need for additional trocar placement. This flexibility may be of use to be able to perform different steps of the procedure

Table 3. Postoperative results.

Parameter (n=34)	**Value**
Patients with Clavien-Dindo events, n	
I	6
Minor bleeding, abdominal/pelvic pain, urinary incontinence, tachycardia, delayed wound healing, scar dehiscence in the flank	
II	5
Herpes genitalis, minor wound infection, low haemoglobin level, urinary tract infection, faecaloma	
III	2
Trocar-site hernia, suspected anastomotic leak	
IV-V	0
Rehospitalisation, n	4
Reoperation, n	2
Mortality, n	0

at the surgeon's preferred method, which is a unique feature of DEXTER.

Comparison with Other Studies

The rate of Clavien-Dindo III-V events in our study aligns with those previously reported in other studies for robotic-assisted hysterectomy.[12,27] Similarly, our observed conversion rate to laparoscopy is consistent with findings on other modular platforms, with a reported conversion rate of 4.2-6.25%.[28,33]

Literature on hysterectomy performed with robotic assistance reports mean operative times ranging from 70 to 298 minutes,[12,34] suggesting that integration of DEXTER into clinical workflows does not compromise efficiency, even during early experience with the system. Moreover, additional procedures like excision of endometriosis, lysis of adhesions, and lymph node dissection contributed to our total operative time. For reference, median operative times reported for other modular platforms were in the range of 127-158 minutes,[35,36] which is comparable to our findings. Estimated blood loss in our cohort was also comparable to, and in some cases lower than, that reported for other systems.[35,37-39] Similarly, the length of hospital stay was equal to or shorter than observed with other platforms.[35,38]

Strengths and Limitations

The study has several notable strengths. It provides real-world data collected during the implementation of the DEXTER system, offering valuable insights into outcomes that can be expected with broader adoption. The feasibility of various types of gynaecologic surgeries using DEXTER is described in detail. Its prospective, multicentre design ensured systematic and thorough documentation of adverse events, supported by independent adjudication through a Clinical Events Committee, delivering a level of rigour superior to many retrospective studies.

Despite these strengths, the study had limitations. The sample size was modest, limiting definitive conclusions on safety. Furthermore, while the patient population was heterogeneous, reflecting real-world case mix and clinical practice, this diversity simultaneously limited direct comparability with the available literature on other modular platforms. All surgeons were still in their learning curve with Dexter (having performed fewer than 40 hysterectomies each), with prior experience on the system varying from 3 to 20 cases before study recruitment. Three surgeons had prior experience with other robotic systems. The BMI distribution in this study reflects European demographics and may not extrapolate to higher BMI populations. The exclusion of patients with morbid obesity (BMI≥40) reflected a precaution in the system's instructions for use during its early clinical implementation, rather than suggesting that higher BMI is inoperable with DEXTER because of any technical limitations. The absence of a control group limited direct comparisons, requiring outcomes to be interpreted in the context of existing literature. Additionally, because the study focused on short-term safety and performance in routine use, it did not include uterine weight or oncologic outcomes for low-risk malignancies treated in this cohort. Potential selection bias and the relatively short follow-up period must also be acknowledged.

Clinical Implications

The DEXTER robotic arms setup preserves standard laparoscopic trocar placement, and the 'LAP' function allows the robotic instrument arms to be retracted within seconds. In addition, the draped surgeon console enables the sterile surgeon to rapidly access the patient when necessary, and to switch between robotics and laparoscopy without placing new trocars. This was particularly useful in more complex cases (e.g., adhesions outside the pelvis, deep endometriosis excision or dense adhesiolysis),[25] in combined procedures with other specialities (such as rectosigmoid resection performed by a colorectal surgeon), or when assistants were less experienced. It also facilitated the learning phase, as laparoscopically experienced surgeons could perform certain steps laparoscopically if preferred, while developing their robotic skills. This adaptability should not be seen as a system limitation, but as an intended design feature that allows intraoperative flexibility and adjustment of the surgical approach to case-specific requirements. However, this adaptability makes direct comparisons with other systems challenging. DEXTER is an open system**,** allowing surgeons to work with standard laparoscopic visualisation systems, including ICG 3D near-infrared imaging, which was successfully used for robotic-assisted lymphadenectomy in the study. This compatibility allows the surgeon to maintain familiar imaging protocols, improving safety for tasks such as vascular control or ureter identification, and has the potential to enhance surgical precision while facilitating integration into existing workflows.

Unanswered Questions and Future Research

Unanswered questions and long-term outcomes remain to be evaluated in future prospective studies. The dataset was not powered to enable robust learning curve analyses, but this should be an important focus for future research. Future studies with larger cohorts and more surgeries per surgeon would be beneficial to confirm these initial findings and further explore the long-term functional and oncological outcomes.

Conclusion

This multicentre prospective study is the first to describe robotic-assisted hysterectomy using the DEXTER system, demonstrating its feasibility and safety. Its open-architecture design enables surgeons to adapt the surgical approach in real time, making it well-suited to the diverse demands of gynaecological procedures in real-world clinical practice. Moreover, its compatibility with existing laparoscopic infrastructure supports its accessibility. Further studies with larger cohorts and extended follow-up are warranted to confirm these findings.

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Ethical approval: Clinical Trial Registration: NCT05537727 (ClinicalTrials.gov). This study was approved by the Ethics Committee according to local and national regulations of the participating countries: Switzerland (reference 2021-00079), Germany (reference D 525/22). In France, observational studies that do not require any additional procedures over and above standard-of-care patient management are not subject to approval. The data protection requirements (GDPR) were followed for all patient data collection.

Data sharing: The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Transparency: The lead author affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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ORIGINAL ARTICLE

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Light at the end of the tunnel: design, implementation and outcomes of a pelvic pain management programme

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ABSTRACT

Background: Chronic pelvic pain (CPP) is a complex, prevalent condition that significantly impacts quality of life, work, relationships, and healthcare resources. Management remains challenging, with variation in practice and no national consensus. Evidence supports a multidisciplinary approach to treatment.

Objectives: To describe the design, implementation, and outcomes of a multidisciplinary Pelvic Pain Management Programme (PPMP), reporting results from four programme cycles.

Methods: The PPMP was developed using behaviour-change principles and delivered over 12 weekly sessions. Participants completed validated psychometric questionnaires at baseline, programme completion, and 3-month follow-up. Change was analysed using repeated-measures ANOVA and clinical significance assessed using the Minimal Clinically Important Difference or the Reliable Change Index.

Main Outcome Measures: Psychometric questionnaires assessed the following outcome measures: pain intensity, pain self-efficacy, kinesiophobia, anxiety, depression, patient activation, health-related quality of life, pain acceptance, and catastrophising.

Results: Thirty-three participants completed the programme, with 19 full datasets. A statistically significant improvement was recorded across all measures, except for anxiety. At the 3-month follow-up, 79% of participants reported a clinically significant improvement in several areas. Notably, 82% of participants showed clinically significant improvement in pain self-efficacy, 74% in depression, and 81% in pain catastrophising at programme completion.

Conclusions: A PPMP is feasible, acceptable, and associated with significant and sustained improvements across biopsychosocial outcomes. Tailored PMPs may address gaps in CPP care and support long-term recovery.

What is New? This represents the largest published dataset evaluating a PPMP. These results highlight the potential of PPMPs to achieve pain reduction and sustainable improvement in quality of life for individuals with CPP.

Keywords: Multi-disciplinary working, pain, pain management, pain programme, pelvic pain

Introduction

Chronic pelvic pain (CPP) is common, with an estimated prevalence of 24% in the United Kingdom (UK) communities.[1] However, wide-ranging estimates are reported, partly due to ambiguity in defining CPP, which reflects the complexity of the condition. CPP impacts quality of life, affecting work, relationships, sexual interactions, and mental health.[1] It contributes to higher rates of absenteeism from work and education, and imposes an economic burden on healthcare, with estimated National Health Service costs exceeding £326 million annually.[2,3]

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Effective management of CPP remains challenging, 45% of UK gynaecologists express concerns about current practices.[4] There are UK-wide variations in the management, with no standard consensus. Ineffective and disjointed treatment can lead to ongoing disability and risk of iatrogenic harm. To address the complexities of CPP, the Royal College of Obstetricians and Gynaecologists and the British Pain Society (BPS) advocate for a multidisciplinary approach from the outset.[5,6] Evidence demonstrates that a multidisciplinary approach to pain management, compared to unimodal or standard care, results in significantly greater improvements in pain scores and objective measurements, such as increased likelihood of returning to work.[7]

Pain Management Programmes (PMPs) address the multifaceted and complex nature of CPP utilising integrated, multidisciplinary management. This paper aims to describe the design, implementation, and outcomes of a PMP tailored to assist individuals in managing pelvic pain. It reports on the outcomes from four cycles and feedback from focus groups.

Creating an Inclusive Community

We aimed to be inclusive and accessible to individuals experiencing CPP in bodies categorised as female at birth, regardless of gender identity. Feedback from focus groups highlighted the difficulties participants encountered discussing personal subjects in programmes with mixed-sex groups. It is vital that participants feel comfortable sharing experiences, the sex of other participants contributes towards this perception of comfort and should be carefully considered.[7] Additionally, we recognise the unique challenges those born female encounter in accessing healthcare, such as underfunded and under-researched medical conditions and difficulties obtaining accurate, timely diagnoses. Whilst acknowledging these aspects, we aim to be inclusive and accessible to all gender identities, creating an environment in which everyone feels acknowledged, supported, and able to benefit from the care and community we offer.

Pain Management Programmes: A Multidisciplinary Approach to Care

To effectively address the wide-ranging impact of CPP on an individual's quality of life, optimal therapeutic strategies encompass all biopsychosocial aspects of health. This requires a collaborative multidisciplinary team (MDT) with the patient as the central focus. PMPs offer evidence-based and cost-effective methods for amalgamating knowledge and experience from a range of specialties.[8] PMPs are designed to enhance the well-being of individuals living with conditions such as back pain and fibromyalgia.

The BPS recommend that teams are composed of healthcare professionals from relevant backgrounds, including a pain specialist, clinical psychologist, physiotherapist, dietitian, occupational therapist (OT), and specialist nurses.[8] Wilkinson and Whiteman[9] outlined the basic structure and content of PMPs.

The overarching goal of PMPs is to empower participants to improve their functional capacity and achieve personally meaningful objectives. This is achieved by generating behaviour change to enhance both physical and mental health and improve quality of life. Behaviour changes groups go beyond providing peer support and education, although both are key components. To achieve this, PMPs should be delivered by professionals trained in behaviour change approaches. We adhered to NICE recommendations by designing our programme to promote awareness of consequences, encourage positive attitudes towards change, support goal setting and planning, and address social and contextual factors influencing behaviour.[10]

PMPs are usually delivered in a group format of 8–12 participants. This group setting fosters normalisation of experiences, mutual sharing and learning, and encourages social interactions. Complementing the group sessions, targeted individual therapy can also be provided when specific needs are identified. The BPS recommends 36 hours of content to be delivered over 12 half days.

Reimagining Pain Management Programmes: Tailoring to the Unique Needs of People with Pelvic Pain

Identifying the Unmet Need

In our hospital, people with CPP were historically referred to generic PMPs, but anecdotal feedback suggested these fell short of expectations. To better understand their experiences, we interviewed people with CPP about their experience of generic PMPs. A key issue was the mixed-sex group composition, participants felt that this hindered open discussion of sensitive topics. Additionally, generic programmes did not approach subjects like sex and intimacy with sufficient space or context. They also lacked content relevant to those assigned female at birth, such as hormone-related issues and pelvic floor health.

"I felt as if I was the only one there with my problem. The majority seemed to have back issues. I understand that pain is pain to a degree, but I was hoping it would be more specialised to the problems I was having."

"The range of people and problems meant it was not specific enough for me to take anything from. Listening to someone who has chronic joint pain did not give me anything to work with, and they wouldn't have needed to hear about my pelvic pain. I am not sure I got anything out of it."

There is limited access to PMPs tailored for pelvic pain in the UK, with only a handful of centres offering such programmes. Recognising this gap, we aimed to establish the first Pelvic Pain Management Programme (PPMP) in the Southwest UK.

Bringing Together the Team and Programme

We began by establishing our MDT, initially led by a Clinical Psychologist and Pelvic Health Physiotherapist. Recent ACOG guidance supported having a physiotherapist lead, as multimodal physical therapy reduces pain intensity compared to inert or non-conservative treatments.[11] As the programme evolved, we added an OT as a core team member to deliver content on work and employment support. The Endometriosis and Pelvic Pain Clinical Nurse Specialist, trained in facilitator skills and now acts as participant liaison and liaison with gynaecology services. Additional contributions come from a gynaecologist, nutritionist, and psychosexual medicine-trained doctor. To provide comprehensive, specialised care, the pathway also includes a consultant pain specialist, psychiatrist, and expert patient input.

The pelvic pain MDT collaboratively curated the content, aligning with BPS guidelines while customising for pelvic pain. Core elements included pain mechanisms, chronic pain impact, goal setting, confidence-building, self-compassion, sleep, flare-up strategies and exercise. In addition, the team integrated pelvic pain-specific tailored topics, see Table 1 for details of topics covered in each session.

Sessions covered different topics and included time for goal-setting and action-planning, feedback, monitoring, and social support, in line with NICE guidance.[10] The programme is delivered by professionals experienced in behaviour change approaches, with competencies aligned to the Health Behaviour Change Competency.[12] Borek and Abraham's[13] conceptual review, describes the processes by which small groups promote behaviour change. The key domains are group development, dynamic group processes, social change processes, personal change processes and group design and operating parameters. Group development progresses through stages: forming,

Table 1. Pelvic pain management programme session topics and structure.

Session	Intro	Topic 1		Topic 2	End
1	Welcome and short relaxation exercise	Psychometrics Ground rules Ice breaker	Break	Consequences of pelvic pain Programme aims Attendee hopes	Group hopes
2		Warm-up activity Pain mechanisms and the nervous system		Exploring values SMART goal setting	Small group goal setting
3		Pelvic anatomy and pelvic floor Relaxation exercise		Activity management Pacing	
4		Exercise		Stress	
5		Bladders and bowels		The CBT model	
6		Hormones and cycles		Medication	
7		Flare-ups		Sleep	
8		Intimacy and sex		Self-compassion Mindfulness	
9		Mood and emotions		Employment	
10		Nutrition		Relationships and communication	
11		Posture		Problem solving	
12		Pulling together and reflections Troubleshooting exercise		Setting long-term intentions Psychometrics	

CBT: Cognitive behavioural therapy.

storming, norming, performing, and adjourning, during which members build relationships, define roles, and work toward shared goals. Dynamic group processes such as identification, cohesion, norms, roles, and group climate shape interactions and motivation. Social change processes, including comparison, facilitation, modelling, influence, and support, drive behavioural alignment within the group. Personal change occurs through cognitive shifts, skill development, and feedback in a supportive environment. Finally, group design, including its purpose, composition, size, leadership, facilitation, and interaction management, determines how effectively it promotes and sustains behaviour change. Facilitation techniques and group exercises are included throughout the PPMP supporting these processes.

The programme ran over 12 weeks, one afternoon per week. To support group sessions, one-to-one appointments with lead facilitators were scheduled at key points: a pre-programme review to assess readiness and suitability, a mid-point review to monitor progress and address concerns privately, and a final review to consolidate learning and plan next steps. A follow-up group session was held three months post-programme to assess ongoing progress. Participants also had access to individual sessions with a pelvic health physiotherapist for pelvic floor assessment and tailored bladder and bowel advice. Dedicated sessions were offered to involve and support partners and carers.

Patient Selection and Screening: Who is Invited to the Programme?

Individuals assigned female at birth with CPP causing significant disability or reduced quality of life despite conventional treatments were identified as potential candidates for the PPMP. Referrals came from outpatient clinics, the pelvic pain MDT, or acute hospital presentations. Interested patients received an information leaflet (Figure 1) and were referred for a screening assessment with a lead facilitator to evaluate suitability and readiness. Additional interventions, such as a medication review with a Consultant Pain Physician, individual physiotherapy, or psychiatric input, were offered based on need (see screening algorithm, Figure 2).

Attendance was tracked, and reasons for withdrawal were noted where available. Non-engagement after confirmation was often due to life events such as bereavement, employment changes, health issues, treatment adjustments, or social anxiety. Where appropriate, patients were signposted to community wellbeing teams for anxiety support and deferred to future cohorts.

Given the programme's progressive structure, participants were encouraged to attend all sessions. Missing more than two sessions, especially early on, triggered a review to determine whether deferral or withdrawal was appropriate.

Common reasons for non-completion included personal or family illness, bereavement, work changes, physical difficulties attending, or deciding the timing or content was unsuitable.

Psychometric Questionnaires: Evaluating the Impact of the PPMP

Participants completed a range of psychometric questionnaires at the start of the programme, upon completion, and again at three months post-programme. Statistical significance of change was analysed using repeated measures ANOVA. For each outcome measure, clinical impact was assessed using either the Minimal Clinically Important Difference (MCID) or, where unavailable, the Reliable Change Index (RCI). The MCID represents the smallest change in an outcome that is considered meaningful and important to patients. The RCI determines whether a change in a participant's score over time is statistically significant, exceeding the expected variability due to measurement error, and is calculated using the standard error of measurement. Each outcome variable is described in the sections below, alongside the corresponding MCID or RCI. Where possible, we used values referenced for pain cohorts.

Pain Intensity

Participants' average pain intensity is measured using a Numeric Pain Rating Scale (0–10).

A reduction by 2 points indicates the MCID.[14]

Pain Self-efficacy

We assess the participants' confidence in activity despite pain using the Pain Self-Efficacy Questionnaire (PSEQ). Low scores on the PSEQ (<20) are a predictor of long-term disability and depression. A study of people with chronic lower back pain observed an MCID of 5.5 for the PSEQ.[15]

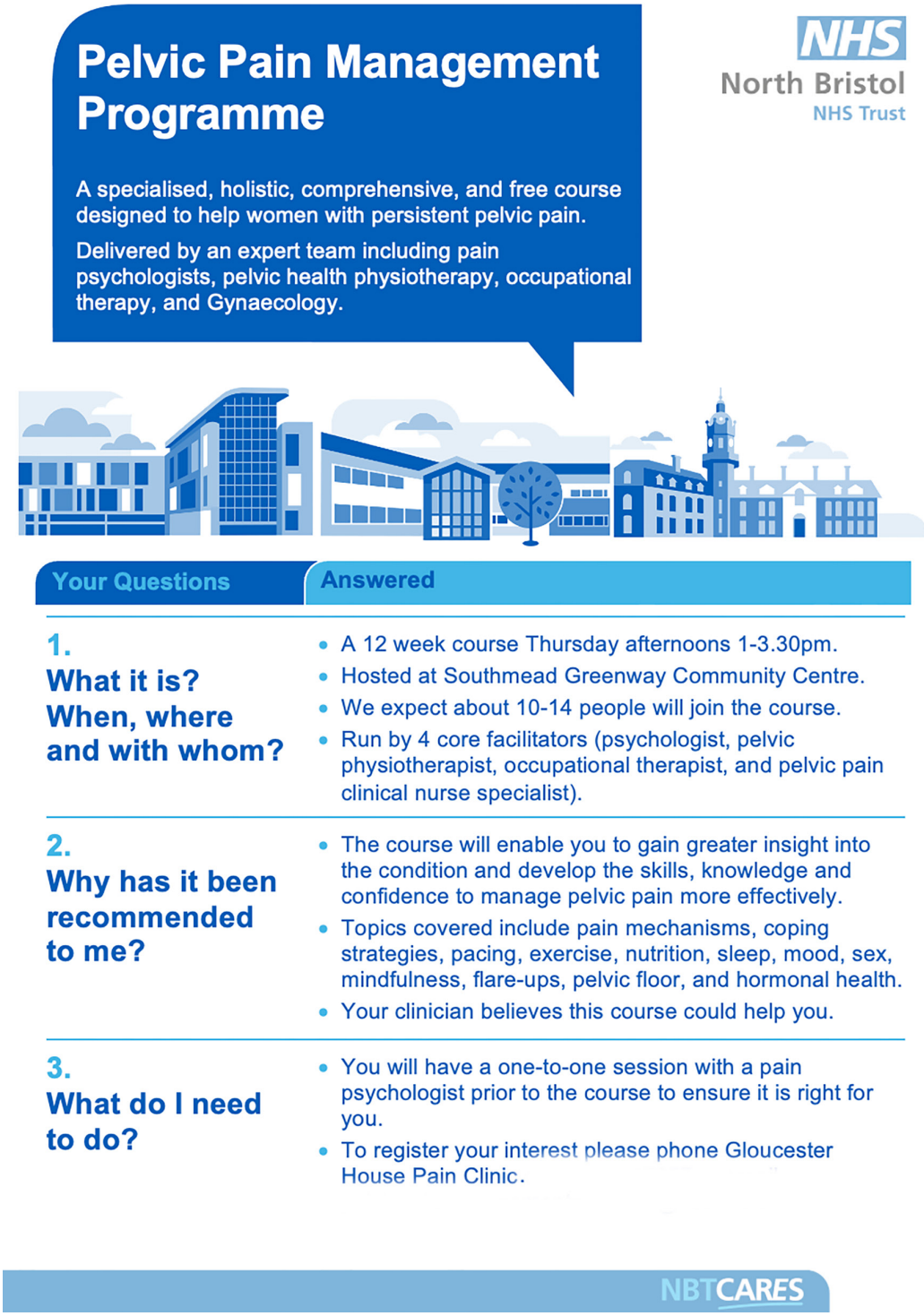

Figure 1. North Bristol Trust pelvic pain management programme patient leaflet.

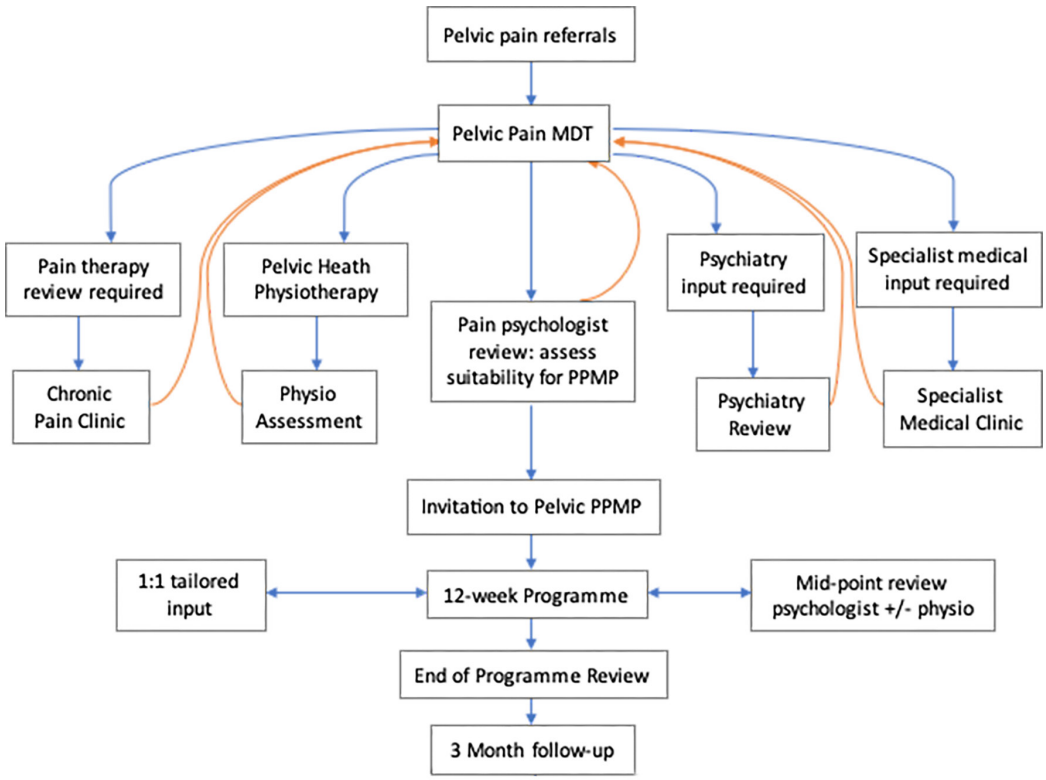

Figure 2. Algorithm of screening, assessment and interventions.
MDT: Multidisciplinary team, PPMP: Pelvic Pain Management Programme.

Fear of Movement

The Tampa Scale of Kinesiophobia (TSK) is used to assess fear of movement. A reduction of 6 points has been shown to be the MCID for the TSK.[16]

Anxiety

Participants' anxiety was measured by the Hospital Anxiety and Depression Scale (HADS). A reduction of 1.32 is evidenced to be the MCID for the HADS anxiety subscale.

Depression

The HADS is also used to measure depression. On the depression subscale, a reduction of 1.40 has been indicated as the MCID.[17]

Patient Activation

The Patient Activation Measure (PAM) measures participants' knowledge, skills and confidence in managing their own wellbeing. Patient activation is a significant predictor of future health care costs and health outcomes.[18] An increase of 4 has been shown to be the MCID for the PAM.[19]

Health Related Quality of Life

Participants' health-related quality of life is measured by the EuroQol-five Dimensions, five-level (EQ-5D-5L). The Visual Analogue Scale (VAS) included in the EQ-5D-5L measured participants' perceived health. An improvement of 15 on the EQ-5D-5L VAS is the proposed MCID.[20]

Acceptance of Pain

The Chronic Pain Acceptance Questionnaire measured participants' acceptance of pain. As there is no MCID reported in the existing literature for this measure, the RCI was calculated to determine change over and above measurement error.[21]

Pain Catastrophising

Participants' catastrophic beliefs about pain were measured using the catastrophising subscale of the Coping Strategies Questionnaire. As there is no MCID reported in the existing literature for this subscale, the RCI was calculated to determine change over and above measurement error.

Outcomes

Since establishing the PPMP, we have conducted four cycles with a total of 33 participants completing the full 12 weeks. The participants ranged in age from 21 to 59 years with an average age of 37 years. Diagnoses include endometriosis, adenomyosis, bladder pain syndrome, vulvodynia and vaginismus. Some attendees suffered co-morbid persistent pain conditions, such as osteoarthritis and fibromyalgia.

Of the 33 participants who completed the programme, nineteen participants provided full datasets at all three time points (18 for the Numerical Pain Rating Scale). Table 2 demonstrates the mean scores for each psychometric questionnaire (pre-programme, immediately post-programme and 3-months post-programme) and F scores and *P*-values obtained from repeated-measures ANOVA. Post-hoc two-tailed pairwise t-tests, adjusted using the Holm-Bonferroni correction, determined between which time points significant differences occurred.

All questionnaires, excluding that one measuring anxiety, showed statistically significant change across time. Post-hoc analysis demonstrated that pain intensity, pain self-efficacy, fear of movement, depression, patient activation, perceived health and pain catastrophising all significantly improved between week one of the programme and week 12. This change was maintained at the three-month follow-up for all but depression. Whilst pain acceptance showed significant change overall in repeated measures ANOVA, post-hoc pair-wise analyses were not significant when adjusted with the Holm-Bonferroni correction.

For evaluating how this statistical significance translated into clinically meaningful change in the lives of programme attendees, 27 sets of pre- and post-programme psychometric questionnaires and 22 sets at 3-month follow-up were compared to MCID or RCI figures for each measure. Table 3 shows the proportion of participants who achieved MCID or RCI at each time point compared with pre-programme scores (Week 1).

At the post-programme assessment, every measured variable showed that at least 44% (12/27) of participants had made a significant clinical improvement. The variables demonstrating the biggest positive impact at the initial post-programme assessment were pain catastrophising (81%, 22/27), pain self-efficacy (74%, 20/27), depression (70%, 19/27) and pain acceptance (70%, 19/27). The outcome demonstrating the smallest positive change was fear of movement, with 44% (12/27) demonstrating an improvement meeting the MCID criteria.

Table 2. Mean scores and F and *P*-values for repeated measures ANOVA.

		Mean score for psychometric questionnaires (SD)			Repeated measures ANOVA	
Variable	**Measure (n)**	**Pre***	**Post****	**Follow-up*****	**F (df)**	***P*-value**
Average pain intensity	NPRS (18)	5.78[a] (1.22)	4.06[b] (1.21)	3.89[b] (2.27)	13.05 (2)	<0.001
Pain self efficacy	PSEQ (19)	24.42[a] (14.72)	35.68[b] (12.02)	36.05[b] (11.23)	11.73 (2)	<0.001
Fear of movement	TSK (19)	28.21[a] (8.11)	23.74[b] (5.32)	23.37[b] (6.17)	9.17 (2)	<0.001
Anxiety	HADS-A (19)	10.16 (3.56)	10.37 (3.27)	11.21 (3.01)	0.55 (2)	0.58
Depression	HADS-D (19)	11.26[a] (3.75)	6.89[b] (4.20)	9.11[ab] (4.82)	5.98 (2)	<0.01
Patient activation	PAM (19)	51.72[a] (15.11)	64.22[b] (15.15)	63.32[b] (14.04)	8.50 (2)	<0.001
Perceived health	EQ-5D-5L: VAS (19)	50.79[a] (20.50)	63.68[b] (18.02)	64[b] (19.74)	7.37 (2)	<0.01
Pain acceptance	CPAQ (19)	53.85[a] (17.75)	62.79[a] (15.26)	63.68[a] (15.12)	4.92 (2)	<0.05
Pain catastrophising	CSQ-CAT (19)	20.63[a] (6.30)	13.68[b] (6.91)	13.47[b] (7.61)	4.92 (2)	<0.05

[a,b,c]: Means not sharing a common superscript letter in a row are significantly different at $P<0.05$ determined by post-hoc two-tailed pairwise t-tests, adjusted using the Holm-Bonferroni correction. Pre*: Pre-programme assessment prior to commencing the programme (Week 1), Post**: Post-programme assessment on immediate completion of the programme (Week 12), Follow-up***: Post-programme assessments completed at the 3-month follow-up (approximately Week 25).
SD: Standard deviation, NPRS: Numerical Pain Rating Scale, PSEQ: Pain Self-Efficacy Questionnaire, TSK: Tampa Scale of Kinesiophobia, HADS-A: Hospital Anxiety and Depression Scale-Anxiety subscale, HADS-D: Hospital Anxiety and Depression Scale-Depression subscale, PAM: Patient Activation Measure, EQ-5D-5L: VAS: European Quality of Life 5 Dimensions 5 Level, Visual Analogue Scale, CPAQ: Chronic Pain Acceptance Questionnaire, CSQ-CAT subscale: Coping Strategies Questionnaire-Catastrophising subscale.

Table 3. Percentage achieving clinically meaningful change comparing pre-programme scores to post-programme and at 3 months follow-up (measured using Minimal Clinically Important Difference or Relative Change Index).

		Clinically meaningful change achieved (%)	
Variable	**Measure**	**Post* (/27)**	**Follow up**(/22)**
Average pain intensity	NPRS	56% (15)	41% (9)
Pain self efficacy	PSEQ	74% (20)	82% (18)
Fear of movement	TSK	44% (12)	41% (9)
Anxiety	HADS-A	56% (15)	41% (9)
Depression	HADS-D	70% (19)	45% (10)
Patient activation	PAM	63% (17)	73% (16)
Perceived health	EQ-5D-5L: VAS	48% (13)	45% (10)
Pain acceptance	CPAQ	70% (19)	64% (14)
Pain catastrophising	CSQ-CAT	81% (22)	73% (16)

Post*: Comparing scores before (Week 1) and immediately after the programme (Week 12). Follow-up**: Comparing scores before (Week 1) and 3 months after the end of the programme (approximately Week 25). NPRS: Numerical Pain Rating Scale, PSEQ: Pain Self-Efficacy Questionnaire, TSK: Tampa Scale of Kinesiophobia, HADS-A: Hospital Anxiety and Depression Scale-Anxiety subscale, HADS-D: Hospital Anxiety and Depression Scale-Depression subscale, PAM: Patient Activation Measure, EQ-5D-5L: VAS: European Quality of Life 5 Dimensions 5 Level, Visual Analogue Scale, CPAQ: Chronic Pain Acceptance Questionnaire, CSQ-CAT subscale: Coping Strategies Questionnaire-Catastrophising subscale.

The clinical impact was sustained (within 5%) and, in some cases, improved for four of the measured variables (pain self-efficacy, patient activation, perceived health and fear of movement) at the 3-month follow-up. Pain self-efficacy showed the biggest impact at 3 months, with 82% (18/22) of respondents demonstrating MCID.

Most demonstrated a continued clinically important improvement in pain self-efficacy (82%), patient activation (73%), pain acceptance (64%) and pain catastrophising (73%) at 3 months. Variables with a drop in the proportion of participants demonstrating MCID or RCI at 3 months were pain acceptance (6% decline), pain catastrophising (8% decline), average pain intensity (15% decline), anxiety (15% decline) and depression (25% decline). The biggest drop in the number reporting MCID or RCI at 3 months compared to the initial post-programme scores was for depression, with 70% of participants reporting MCID at completion of the programme and 45% at 3 months.

Focus Groups and Interviews

We conducted focus groups and interviews with participants from the first programme cycle. Findings highlighted several positive outcomes, including feeling less isolated and more validated, suggesting that group activities fostered a sense of community. Many reported improved personal relationships, likely due to increased social interaction and shared experiences. Participants described feeling motivated, learning from others, and experiencing personal growth. Importantly, they felt empowered, gaining a sense of agency through active participation. Overall, group activities had a positive impact across emotional, relational, and developmental domains.

Discussion

Main Findings

Our results demonstrate that tailored pelvic PMPs can deliver measurable clinical improvements and meet the expectations of people with CPP. CPP is a complex entity with evidence to support a combination of organic, psychological and environmental variables driving the severity and impact of pain.[22,23] Therefore, using a simple medical model of pain results in oversimplification and emphasis on the identification and treatment of organic pathology. Our programme recognises the complex drivers of pain, resulting in clinically significant improvements in a range of domains, including pain intensity, for over half the participants.

In the context of our study, the 3-month results hold considerable significance, shedding light on the sustainability of the observed improvements in most outcome measurements. Of note, at least 79% of responding participants continued to report a clinical improvement in several areas, namely pain self-efficacy, patient activation, pain acceptance, and pain

catastrophising. These findings highlight the robust and enduring impact of our intervention.

A significant strength is the sustained enhancement of pain self-efficacy at the 3-month assessment (82% reporting the MCID). Higher levels of pain self-efficacy correlate with a reduction in functional impairment, affective distress, and severe pain hence, therapy that successfully improves levels of self-efficacy is crucial in the management of chronic pain.[24]

Improved patient activation has been highlighted as important on an individual and healthcare service level. For the individual, it leads to improvements in self-management behaviours and a better quality of life.[25] On a service level, it results in reduced service use, hospital admissions and healthcare costs, and improved experiences with care.[26]

Our findings related to pain acceptance indicate that participants sustained a greater degree of acceptance toward their pain at the 3-month review. This shifting mindset was paralleled in our focus groups with one particularly notable quote: "The PPMP gives different strategies on how to live with pain rather than necessarily curing your pain. It is about living with the pain and accepting it.

The maintained improvement in pain catastrophising signifies a decrease in the tendency to magnify and dwell on pain-related thoughts and concerns. Pain catastrophising is linked to poor mental health and has a negative correlation with pain-related outcomes, for example, developing long-term pain, worsening physical disability, higher healthcare costs and increased pain sensitivity.[27]

Strengths and Limitations

The sample of 33 participants limits the statistical power and generalisability of the findings. Although our results are encouraging and reflect the largest published dataset for a pelvic pain-specific PMP in the UK, a larger sample would increase the robustness of our outcomes. People referred to the PPMP tended to experience a greater impact of pain compared to the average patient with CPP. Therefore, the results may not be generalisable to people experiencing less severely impactful pain. The follow-up period of 3 months provides initial insight into sustained effects but does not capture longer-term outcomes. We are exploring the feasibility of 6- and 12-month follow-ups to evaluate the durability of effects. Further information about the outcomes of those who did not attend the full programme or complete questionnaires at each time point could also be valuable. Participants were primarily referred from specialist outpatient settings, which may lead to selection bias. The findings may not be generalisable to individuals with limited access to specialised care.

Clinical and Policy Implications

Our results build on existing evidence supporting the importance of a biopsychosocial approach to pelvic pain. Peters et al.[28] conducted an RCT comparing a traditional approach (exclusion of organic causes and routine laparoscopy before considering non-organic factors) to an integrated approach (equal attention to somatic, psychological, dietary, environmental, and physiotherapeutic factors) from the outset of management.The integrated approach showed greater improvement in pain scores, a greater reduction in disturbance of daily activities, and reduced associated symptoms. Recently, Starzec-Proserpio et al.[11] published a systematic review with meta-analysis demonstrating that multimodal physical therapy is more effective in women with CPP compared with inert or non-conservative measures (e.g., surgery). It follows that the most effective strategy for managing CPP incorporates holistic management from the outset (Figure 3).

However, programmes such as PPMPs cannot feasibly be delivered to all with CPP, and not everyone needs this level of intervention. A solution is a service capable of delivering tiered levels of intervention intensity, with each level incorporating PPMP components. Examples include digitalised PPMP content with self-directed therapies, Pelvic Pain Workshops and higher intensity therapies such as the PPMP and one-to-one therapist sessions.

Unanswered Questions and Future Research

An unanticipated decline in HADS-D depression scores was observed at three-month follow-up: while 70% of participants exceeded the MCID at programme completion, this reduced to 45%. There was also no statistically significant change in HADS-A anxiety scores across the programme, although some participants showed clinically meaningful change. The bidirectional relationship between pain and mental health is well established, and while pain reduction can alleviate both anxious and depressive symptoms, mental health is complex and influenced by multiple factors.[29] The initial improvements in mood may reflect the therapeutic value of a supportive group environment, which mitigates isolation commonly associated with chronic conditions.[30]

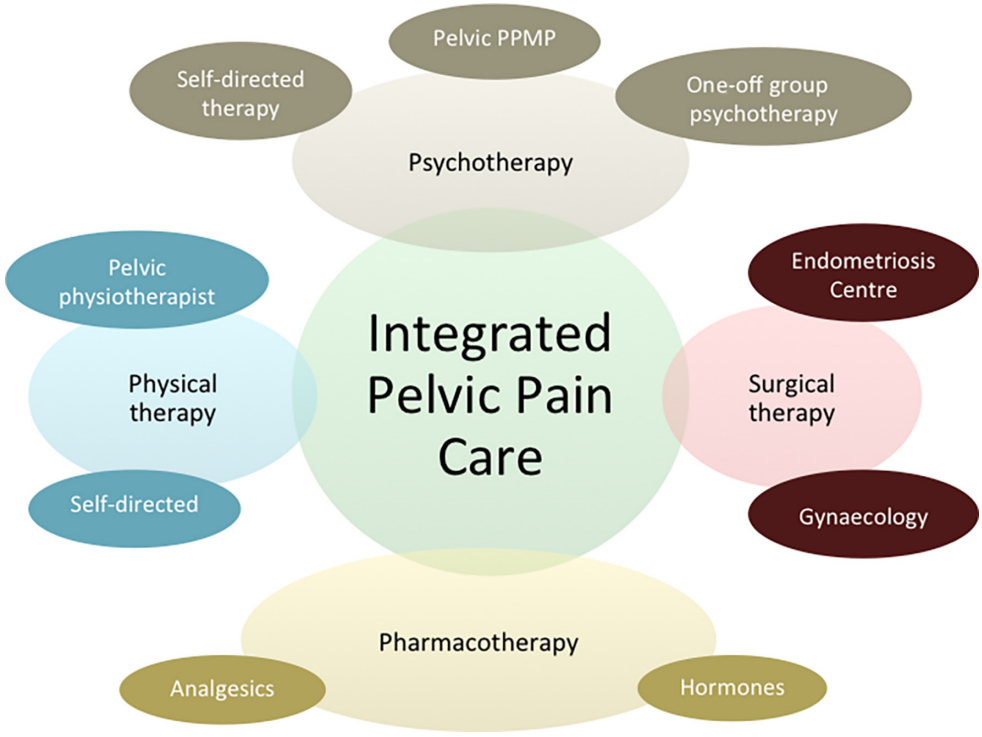

Figure 3. Holistic model of care for chronic pelvic pain.

PPMP: Pelvic Pain Management Programme.

However, these effects appeared less durable following programme cessation. Emerging evidence indicates that continued participation in peer-led support groups may help sustain behavioural changes and associated benefits in pain and psychological well-being.[31] Extending this model to pelvic-specific pain programmes may offer a means of maintaining post-programme outcomes.

Conclusion

In conclusion, people with CPP often struggle to access effective care. Those without a clear organic cause or with persistent pain despite treatment are frequently referred between specialties or returned to primary care, receiving fragmented, unidisciplinary support. Psychological, social, or environmental interventions are typically delayed by years. As a result, patients risk unnecessary procedures, disengagement, and reduced quality of life. Our findings show that pelvic pain-specific PMPs are acceptable to patients and produce clinically meaningful, lasting improvements, highlighting their potential to reduce pain and enhance long-term quality of life.

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Perceptions of endometriosis surgery on TikTok: quality and implications for patient counselling

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ABSTRACT

Background: TikTok is a popular platform for sharing health experiences, including those related to endometriosis. However, the quality and tone of the surgical information shared remain unclear.

Objectives: To characterise TikTok content regarding perceptions of surgical management for endometriosis and analyse content for information quality and differences between healthcare professionals and patients.

Methods: A cross-sectional analysis of the top 100 most-viewed TikTok videos under the search term "endometriosis surgery" was conducted on September 22, 2024. Videos were included if in English, referenced "endometriosis," and mentioned "surgery," "operation," or "laparoscopy." Two independent reviewers assessed creator identity, tone, and content. The brief DISCERN tool evaluated information quality.

Main Outcome Measures: Primary outcomes included the perceived benefits and drawbacks of surgery, tone towards surgical intervention, and thematic content. Secondary outcomes included DISCERN scores and comparison of content across creator identities.

Results: Of the included videos (2021-2024), 80% were created by patients. Most conveyed a neutral tone (41%) towards surgery. Perceived benefits included therapeutic effects (68%) and diagnostic clarity (61%). Reported drawbacks were postoperative recovery (58%) and symptom persistence (22%). Common themes among patients included barriers to surgery (35%), medical gaslighting (30%), delayed diagnosis/misdiagnosis (25%), and inadequate presurgical counselling (20%). Median DISCERN scores were significantly lower for patient videos (1.00) vs. healthcare professionals (1.96; $P<0.001$).

Conclusions: TikTok content on endometriosis surgery is largely driven by patient narratives that highlight both hope and frustration. The low quality of information underscores the need for accessible, evidence-based educational content. Our findings represent a cross-sectional snapshot subject to algorithmic ranking and platform dynamics.

What is New? This is the first study to systematically evaluate TikTok content focused on surgical management of endometriosis, demonstrating that patient-generated videos overwhelmingly drive the conversation. While patients frequently describe benefits such as diagnostic clarity and symptom relief, they also highlight barriers to surgery, postoperative challenges, recurrent symptoms, and experiences of medical gaslighting. Patient-created videos had significantly lower information quality than provider-generated content, underscoring a critical gap in evidence-based surgical education on social media and an opportunity for clinician engagement.

Keywords: Endometriosis, social media, TikTok, surgical resection, experience

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Introduction

TikTok, a short-form video-sharing platform with over 1 billion active users, is emerging as a significant medium for health communication.[1,2] In 2024, TikTok had more than 1.5 billion users across the globe.[1,2] Since 2021, there has been a 600% increase in health content, and over 3.8 million healthcare professionals are estimated to be actively generating content on this app.[1,2] Its unique algorithm and engaging formats allow for the rapid spread of user-generated information, often blending personal narratives with educational content. TikTok skews towards a younger audience, with a substantial proportion of users being women of reproductive age.[3] Endometriosis, a chronic gynaecological condition characterised by the presence of endometrial-like tissue outside the uterus, affects approximately 10% of women of reproductive age globally.[4] The condition is associated with a wide range of symptoms: chronic pelvic pain, dysmenorrhea, dyspareunia, and infertility.[5] Surgical management remains a cornerstone in definitive diagnosis and/or treatment of endometriosis.[5,6]

The diagnostic delays associated with endometriosis may drive patients to seek information and support through readily available resources such as TikTok.[7] Analysing TikTok content related to the surgical management of endometriosis may offer valuable insights into educational exposures that influence patient decision-making, treatment expectations, and satisfaction. Insights from existing content can, in turn, improve healthcare professionals' engagement with patients in digital spaces, address misconceptions, and improve shared decision-making in clinical settings.[1,3] There has yet to be an analysis on popular TikTok content around patients' perspectives on the surgical management of endometriosis. This is the first study to characterise TikTok content creator perceptions on surgical management for endometriosis and analyse content for information quality. Furthermore, we aim to assess differences in patient versus healthcare professional-created content.

Methods

Search Strategy

This study was considered IRB exempt by the Massachusetts General Brigham Institutional Review Board. The search term "endometriosis surgery" was entered into the TikTok search bar on September 22, 2024, to retrieve relevant content. The inclusion criteria for videos were: 1) in English, 2) inclusion of the word "endometriosis," and 3) mention of the terms "surgery," "operation," or "laparoscopy." Duplicate, irrelevant, or promotional videos (e.g., advertisements or unrelated medical topics) were excluded. The top 100 most-viewed videos, based on TikTok's ranking algorithm, that met the inclusion criteria were selected for analysis. The "top 100 most-viewed" reflects TikTok's engagement-weighted ranking at a single time point, prioritising popularity rather than representativeness. Although only the single most-used term was applied for uniformity, we pilot-tested related hashtags to confirm content overlap.

Data Extraction

Data were extracted from each video. User demographics focused on information about the content creator (e.g., healthcare provider, patient, or organisation). The primary outcome was the content creator's perception of surgical management of endometriosis. Content creator perspectives considered personal narratives shared in the video, including reasons for undergoing surgery, expectations, and emotional responses. User perspectives considered personal narratives shared in the video, including reasons for undergoing surgery, expectations, and emotional responses. Clinical content involved key topics such as symptoms leading to surgery, the type of surgical procedure discussed, and postoperative outcomes. Healthcare experiences were identified as descriptions of interactions with healthcare providers, challenges in accessing care, and satisfaction with surgical outcomes. The overall tone of the videos was also evaluated as a subjective assessment agreed upon by researchers and grouped into either negative, neutral, or positive. These data were assessed via reviewer judgement.

The secondary outcome focused on information quality, which was assessed using the brief DISCERN questionnaire, a reliable and valid instrument for judging the quality of consumer health information.[8] The DISCERN scale was developed by an expert panel comprised of health information providers, patients, and self-help groups. Its reliability has been assessed across multiple studies,[9,10] and the DISCERN scale has been implemented in prior social media studies examining the content quality of TikTok videos regarding various health conditions.[11-13]

Each video was rated using the Brief DISCERN instrument,[8] a six-item, five-point scale (1: very poor reliability, 5: high reliability). As DISCERN was originally

validated for written content, it was applied here as an adapted metric for video-based health information following prior TikTok studies.[11-13] To ensure accuracy and reliability, two reviewers (JP, ATL) independently analysed the demographic and content data extracted from each video. Discrepancies in video selection, tone, or categorisation were discussed between the two reviewers and subsequently resolved. As codes were finalised by consensus rather than retained as independent ratings, a kappa statistic was not calculated.

Statistical Analysis

Descriptive statistics were used to summarise the demographic and content variables. Qualitative analysis was used to identify subthemes of the major categories that had been identified prior to the data collection step. Subthemes in user perspectives and healthcare experiences were identified by both reviewers, and final themes were mutually agreed upon. Median and interquartile range (IQR) were reported for the Global DISCERN scores. Chi-squared and Wilcoxon rank sum tests were used to test differences between content creator groups. Statistical significance was defined as $P<0.05$.

Results

In total, the TikTok videos analysed within our study generated over 36.2 million views. Of the 100 TikTok videos analysed, 80% (80/100) were created by patients, while 15% (15/100) were generated by healthcare professionals or organisations. The remaining videos (5/100) were not included as they included medical procedure descriptions and were made by organisations without human portrayal. All included videos incorporated at least one of the following overlying themes: surgery benefits, surgery drawbacks, recommendations, and prior healthcare experiences (Table 1). Through our study, we evaluated patient-created versus healthcare professional-created TikTok videos and overall found significant differences. Table 2 demonstrates differences between themes derived from patient-created versus provider-created videos.

Surgical Benefits and Drawbacks

Of the 80 videos identifying specific surgical procedures, 50% (40/80) mentioned laparoscopic resection or excision, 34% referenced general laparoscopic surgery (27/80), and 9% (7/80) discussed hysterectomy. Overall, 13% (10/80) of videos noted other procedures: cystectomy, bowel resection, and salpingo-oophorectomy. The benefits of surgery, as reported in 33 videos, included symptom relief (79%, 26/33), diagnostic clarity (48%, 16/33), and improved fertility (9%, 3/33). Drawbacks were noted in 52 videos, with postoperative pain being the most cited issue (58%, 30/52), followed by postoperative bloating (29%, 15/52), surgical complications (21%, 11/52), recurrent or residual symptoms (15%, 8/52), irregular vaginal bleeding (6%, 3/52), and financial costs (6%). A total of 17% of all videos analysed in this study (17/100) mentioned alternatives to surgical management, such as hormonal suppression and alternative medicine strategies.

Healthcare Experiences

Both patients and professionals provided general recommendations for endometriosis management. Of the 30 videos with this content, 63% (19/30) emphasised preparation for postsurgical recovery, 23% (7/30) advocated for patient self-advocacy, and 17% (5/30) highlighted the importance of finding

Table 1. Thematic analysis of included TikTok videos.

Surgery benefits	**n=33**
Symptom relief	79% (26)
Diagnostic clarity	48% (16)
Improved fertility	9% (3)
Surgery drawbacks	**n=52**
Postoperative pain	58% (30)
Postoperative bloating	29% (15)
Surgical complications	21% (11)
Recurrent/residual symptoms	15% (8)
Irregular vaginal bleeding	6% (3)
Financial costs	6% (3)
Recommendations	**n=30**
Post-surgical recovery preparation	63% (19)
Patient self-advocacy	23% (7)
Identifying experienced healthcare professionals	17% (5)
Prior healthcare experiences	**n=20**
Barriers to surgery	35% (7)
Medical gaslighting	30% (6)
Delayed diagnosis/misdiagnosis	25% (5)
Inaccurate surgery counselling	20% (4)

*Remaining videos (n=5) were not included in Table 1 as they included medical procedure descriptions and were made by an organisation without human portrayal.

experienced healthcare professionals. Lastly, prior healthcare experiences were discussed in 20 videos by patients. Patient-generated videos regarding prior personal healthcare experiences frequently highlighted barriers to surgical care (35% 7/20), experiences of medical gaslighting (30%, 6/20), delayed diagnoses or misdiagnoses (25%, 5/20), and inadequate presurgical counselling (20%, 4/20). The term medical gaslighting was included if used specifically by the TikTok video creator and often referred to as manipulation by healthcare providers who minimised patients' clinical concerns. Importantly, though medical gaslighting was frequently tied to delayed diagnosis and management, it specifically referred to the act of providers invalidating symptoms and pain.

Information Quality and Engagement

Overall DISCERN scores for patient videos were low, with a median of 1 (IQR 1-1). However, healthcare professional-created videos had significantly higher DISCERN scores, suggesting better quality health information (median: 2 vs. 1; *P*<0.001) (Table 3). Engagement, measured by likes, was similar between healthcare professional- and patient-generated videos (median: 1,921 vs. 1,622; *P*=0.756) and not significantly influenced by tone or video type. Regarding tone, overall, 41% (38/93) of the videos were neutral, 32% (30/93) were positive, and 27% (25/93) were negative. Healthcare professional-created videos were predominantly neutral in tone (92.9%, 13/15). Patients were significantly more likely than healthcare professionals to have a negative tone towards surgical management (33.3%, 25/80 versus 0%, 0/15, *P*<0.001).

Table 2. Differences in themes generated by patient-generated vs. provider-generated content.

	Overall	Patient (n, %)	Provider (n, %)	*P*-value
Pros of surgery	32 (32.0)	25 (31.3)	7 (46.7)	0.246
Cons of surgery	50 (50.0)	44 (55.0)	6 (40.0)	0.286
Recommendations	29 (29.0)	23 (28.8)	6 (40.0)	0.385
Prior healthcare experiences	19 (19.0)	19 (23.8)	0 (0)	0.036

Table 3. Quality of content, tones, and types of included TikTok videos created by healthcare professionals vs. patients.

	Overall (n=100)	Healthcare professionals (n=15)	Patient (n=80)	*P*-value
Likes (median, IQR^)	1691 (438-4495)	1921 (733-2236)	1622 (336-1622)	0.756
DISCERN score (median, IQR)	1 (1-1)	2 (2-2)	1 (1-1)	*P*<0.001
Tone of video (n, %)				
Positive	30 (32.3)	1 (7.1)	28 (37.3)	
Neutral	38 (40.9)	13 (92.9)	22 (29.3)	
Negative	25 (26.9)	0 (0.0)	25 (33.3)	*P*<0.001
Type of video (n, %)				
Educational/advising (didactic content presenting information or guidance)	28 (28.0)	14 (93.3)	11 (13.8)	*P*<0.001
Preoperative experiences (anticipatory content prior to surgery)	7 (7.0)	0 (0.0)	7 (8.9)	0.592
Postoperative experiences (recovery narratives or symptom updates following surgery)	35 (35.0)	0 (0.0)	35 (43.8)	0.001
Humorous (comedic pieces based on experiences or opinion)	11 (11.0)	0 (0.0)	11 (13.8)	0.203
Personal reaction (spontaneous emotional responses or opinion pieces)	19 (19.0)	1 (6.7)	16 (20.0)	0.216

^IQR refers to interquartile range, *Remaining videos (n=5) were not included in Table 3 as they included medical procedure descriptions and were made by an organisation without human portrayal.

Discussion

Principal Findings

This study provides valuable insights into how TikTok functions as a major platform for disseminating information and sharing personal experiences related to surgical management of endometriosis. Content was overwhelmingly patient generated, reflecting a growing reliance on social media to share personal health journeys, seek validation, and bridge perceived gaps in traditional healthcare communication. Patient videos most often described postoperative pain, recovery challenges, and mixed satisfaction with surgical outcomes, while healthcare professional videos focused on procedural explanations and educational messaging. Despite clear differences in tone and content, engagement levels -measured by likes- were similar between groups, suggesting that emotionally resonant and professionally informative content can achieve comparable visibility. However, information quality was low, particularly among patient-generated videos, as indicated by markedly lower DISCERN scores compared with healthcare professionals. These findings underscore a critical disconnect between the content most visible to patients and the standards of evidence-based surgical education, raising concerns about misinformation, unmet information needs, and the influence of digital narratives on patient expectations and decision-making.

Results in Context of What is Known

The volume of patient-generated content highlights the power of relatable and emotional narratives in resonating with audiences. Personal stories of postoperative recovery, struggles with symptoms, and humour in navigating endometriosis resonate deeply with viewers, potentially offering a sense of solidarity and validation.[14,15] However, these narratives often lack the nuance and evidence-based guidance necessary for informed decision-making, underscoring a missed opportunity for healthcare professionals to engage audiences with both relatable and accurate content.[16,17] While DISCERN scores were higher for healthcare professionals' generated videos, even clinician-generated videos achieved a median DISCERN score of 2/5, underscoring that high-quality educational material remains scarce on the platform. Healthcare professionals may consider using the DISCERN criteria while making content and focusing on providing balanced information, acknowledging uncertainty, and citing sources in their captions.[7] Additionally, the predominantly neutral tone of healthcare professional videos may come across as impersonal or overly clinical, potentially reducing their appeal to TikTok users.[18] This finding suggests a need for healthcare professionals to adopt more patient-centred communication strategies, such as incorporating storytelling, addressing common fears and misconceptions, and using an empathetic tone to connect with viewers on a personal level. The variability in tone and content reflects the multifaceted -and often intertwined- challenges faced by individuals with endometriosis, including delayed diagnoses, medical gaslighting, and limited access to experienced healthcare professionals.[19,20] The popularity of videos discussing these topics indicates that social media platforms are not only sources of information but also spaces for advocacy and community building. Collaborations between patients and healthcare professionals may be an opportunity for accurate information that leverages the compelling nature of narrative and personal experiences.[21] For example, co-created content featuring patient testimonials alongside expert commentary could combine the authenticity

Table 4. Optimising TikTok content for endometriosis surgery.

Video structure	Inclusion of both patient and healthcare professional
	Empathetic tone
	Incorporate a narrative
	Ensure video objectives/aims are focused and clearly communicated
Video information	Provide accurate, unbiased, and balanced information
	Avoid absolute statements of management that do not reflect areas of uncertainty
Video themes	Include reliable references and link to cited sources, and more patient information
	Guidance to optimise care (symptom timeline, treatment timeline, seek multiple opinions, bring a support person to appointments, prepare questions to ask)
	Misconceptions and/or misinformation topics
	Preoperative and postoperative expectations/guidance

of lived experiences with the reliability of professional guidance. We offer suggestions for generating social media content that can help inform patients about the surgical management of endometriosis in Table 4.

Strengths and Limitations

This study is among the first to analyse TikTok content related to the surgical management of endometriosis, addressing an important gap in digital health communication research. The mixed-methods design, combining quantitative analysis of engagement and DISCERN scoring with qualitative thematic coding, provides both breadth and depth of insight into how surgical information is framed and perceived online. The inclusion of dual independent reviewers enhanced analytic rigour and minimised individual bias in video selection, coding, and tone classification. The use of a validated information-quality tool, adapted transparently for short-form media, allowed structured comparison between patient- and clinician-generated content. By focusing on a highly visible sample of the most-viewed videos, the study also captures the messages most likely to shape public understanding and discourse around endometriosis surgery.

Limitations include reliance on algorithm-driven, cross-sectional sampling at a single time point, restriction to English-language content, and lack of adjustment for confounders such as follower count or video length. The DISCERN tool, while validated for written health information, may not fully capture the narrative, visual, or emotional elements that influence short-form video communication. Finally, although we performed a preliminary patient versus provider analysis based on the content that met inclusion criteria for our study, this analysis is certainly limited by the discrepant sample sizes, as only 15% of videos were generated by providers compared to the 80% generated by patients. These limitations notwithstanding, the findings provide an informative snapshot of current digital discourse and a foundation for future longitudinal and multilingual studies of social-media-based gynaecological education.

Implications for Practice and Future Research

Healthcare professionals, national women's health organisations, and healthcare systems should note that common themes on TikTok reflect longstanding gaps and systemic issues in endometriosis care. Addressing these barriers through improved training, earlier diagnosis, and accessible care options could have a significant impact on patient outcomes and satisfaction. Educational campaigns led by national organisations tailored to social media that emphasise preparation for surgery, recovery tips, and dispelling myths may also help bridge the information gap.[22,23]

Future research should explore how TikTok content evolves over time, the role of platform algorithms in shaping public discourse, and the real-world impact of this content on patient decision-making, health literacy, as well as care-seeking behaviour. Future studies should also employ multi-keyword, multilingual, and longitudinal designs to assess how algorithmic changes shape the visibility of endometriosis content. Complementary tools beyond DISCERN could capture narrative accuracy, empathy, and influence on patient decision-making. Given the exploratory aim and cross-sectional design, we report unadjusted comparisons and recommend adjusted modelling in future work.

The findings from our study additionally have important implications for both patients and healthcare providers. For patients seeking information about endometriosis surgery, the dominance of low-quality, patient-generated TikTok content may shape expectations and decisions based on anecdotal, emotionally resonant -but often incomplete- information. For healthcare providers, the study underscores an urgent need to engage with social media platforms more actively and empathetically. As summarised in Table 4, effective TikTok communication around endometriosis surgery should combine authentic narrative with clinical accuracy. Recommended strategies include structuring videos with clear objectives, using empathetic and accessible language, presenting balanced and referenced information, and addressing common misconceptions or postoperative expectations. Such approaches can help healthcare professionals produce content that is both engaging and evidence-based, ultimately fostering more informed and empowered patient communities. This dual insight highlights both the power and pitfalls of digital health narratives and calls for collaborative, patient-centred communication to improve education, trust, and shared decision-making.

Conclusion

TikTok offers a unique blend of opportunities and challenges in health communication for endometriosis. Our study found that videos related to the surgical

management of endometriosis discussed surgical benefits, surgery drawbacks, recommendations, and prior healthcare experiences. While the majority of endometriosis patient-created videos are patient-generated, the healthcare professionals-created content illustrated higher, yet still low, levels of reliability and quality. Our study highlights the critical need for improved patient education. Given the utilisation of TikTok content by patients, social media content produced by healthcare professionals, particularly minimally invasive gynaecological surgeons, may be an opportunity to improve understanding of surgical approaches for endometriosis.

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SHORT COMMUNICATION

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Adenomyosis and dysmorphic uterus: is there a correlation? Analysis of reproductive outcomes after hysteroscopic metroplasty

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ABSTRACT

Hysteroscopic metroplasty improves reproductive outcomes in women with a dysmorphic uterus, but the impact of adenomyosis in these patients is uncertain. We retrospectively analysed 69 women who underwent metroplasty for a dysmorphic uterus, with histological assessment of the excised tissue. Adenomyosis was more frequently identified at histology in patients with recurrent pregnancy loss compared to those with infertility/single miscarriage (54% vs. 27%, P=0.03). Following surgery, the clinical pregnancy rate in the overall cohort reached 65%, and the live birth rate (LBR) per pregnancy increased from 0% to 62% (P<0.01). Among patients with histological evidence of adenomyosis, the LBR was 43%, compared to 71% in those without adenomyosis (P=0.07). Hysteroscopic metroplasty appears to improve reproductive outcomes overall. Larger, prospective studies are needed to better define the role of adenomyosis in this patient population.

Keywords: Adenomyosis, metroplasty, recurrent pregnancy, uterus

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Introduction

The T-shaped uterus is a rare Müllerian anomaly first described by Kaufman et al.[1] in 1977 in women exposed to diethylstilbestrol (DES). It is now classified as U1a within the broader category of dysmorphic uteri in the European Society of Human Reproduction and Embryology - European Society for Gynaecological Endoscopy (ESHRE-ESGE) system, alongside two other subtypes.[2] These anomalies are often associated with adverse reproductive outcomes, including infertility and recurrent pregnancy loss (RPL).[3] Proposed mechanisms include altered myometrial architecture, reduced uterine volume, and constriction rings that impair receptivity, implantation, and uterine expansion.[4] Although initially linked to DES exposure, cases are still reported in the post-DES era, suggesting alternative aetiologies, including acquired conditions such as adenomyosis.[3,5]

Adenomyosis has recently gained attention in the context of infertility. Mechanisms proposed include distortion of the uterine cavity, abnormal uterine peristalsis, altered sex steroid pathways, increased inflammation, impaired adhesion molecule expression, and dysfunction of implantation-related genes.[6] Junctional zone involvement has been linked to higher pregnancy loss rates.[7,8] Severe adenomyosis can even mimic the ultrasonographic appearance of a T-shaped uterus, raising questions about overlap with congenital anomalies, although data are still controversial.[5,9]

Hysteroscopic metroplasty has been shown to improve reproductive outcomes in women with dysmorphic uteri.[10] A newer technique using a bipolar 15 Fr mini-resectoscope allows reshaping of the uterine cavity while providing tissue for histological analysis, creating an opportunity to investigate coexisting uterine wall abnormalities and their contribution to reproductive dysfunction.[11]

The aim of this study was to assess the histological prevalence of adenomyosis in tissue excised during metroplasty for dysmorphic uterus in women with adverse reproductive outcomes and to evaluate obstetrical outcomes following the surgical procedure.

Methods

This retrospective observational cohort study was conducted at the Digital Hysteroscopic Clinic, Class Hysteroscopy, Fondazione Policlinico Gemelli in Rome, between January 2021 and January 2024. Eligible women had a confirmed diagnosis of dysmorphic uterus and a history of either RPL or infertility/single miscarriage. They all underwent hysteroscopic metroplasty.

Infertility was defined as no conception after ≥12 months of unprotected intercourse, and RPL as ≥2 consecutive pregnancy losses before 24 weeks.

Diagnosis of dysmorphic uterus was based on ESHRE/ESGE criteria (a narrow uterine cavity with thickened lateral walls) and fulfilment of at least two of the three CUME criteria (lateral indentation angle ≤ 130°, lateral wall thickness ≥7 mm, and T-angle ≤40°), acknowledging that discrepancies exist among current diagnostic systems for T-shaped uterus.[2,12,13] Y-shaped uteri were also included.[14]

All procedures were performed by a single experienced surgeon (U.C.) using a standardised minimally invasive technique with a bipolar 15 Fr mini-resectoscope (Karl Storz, Tuttlingen) under general anaesthesia. A Collins bipolar loop was used to incise the lateral walls and, when needed, the fundus; redundant fibromuscular tissue was then excised with a 90° angled loop.[11] Patients received one month of progestin pretreatment and underwent post-operative assessment with two-dimensional/three-dimensional ultrasound and office hysteroscopy at 30-40 days.

Adenomyosis was assessed by ultrasound (MUSA criteria) and confirmed histologically in excised tissue.[15] Other histological abnormalities were also recorded. Pre-operative and post-operative reproductive outcomes, including clinical pregnancy rate (CPR), live birth rate (LBR), and miscarriage rate (MR), were assessed. CPR was defined as any pregnancy confirmed by ultrasound for each woman. LBR was defined as the delivery of a live infant after 24 completed weeks of gestation, calculated per number of pregnancies. MR was defined as the spontaneous loss of a clinical pregnancy before 24 completed weeks of gestation, also calculated per number of pregnancies.

The study was approved by the Ethics Committee of the "Comitato Etico Territoriale Lazio Area 3" (protocol number: 0001534/24, date: 11.09.2024; ClinicalTrials.gov ID NCT06610864). All participants provided written informed consent.

Statistical Analysis

Descriptive statistics were applied; categorical variables were compared using chi-square or Fisher's exact test, and continuous variables with the Mann–Whitney U test. The agreement between ultrasound and histology for adenomyosis was assessed using Cohen's kappa.

Pre- and post-operative outcomes were compared using the McNemar test. The association between adenomyosis and LBR was evaluated using univariate logistic regression, with results reported as odds ratios (ORs) and 95% confidence intervals (CIs). Analyses were performed with NCSS v11 (Kaysville, Utah, USA). A *P*-value <0.05 was considered significant.

Results

Seventy-nine consecutive women with dysmorphic uterus were recruited; ten were excluded as they did not plan pregnancy postoperatively. Baseline and surgical characteristics are shown in Table 1. The mean age was 35.9±4.7 years; 47 women (68%) had infertility/single miscarriage, and 22 (32%) had RPL. On ultrasound, 34 patients (49%) exhibited at least one direct MUSA feature of adenomyosis, most commonly myometrial cysts. Indirect features alone were present in 21 women (31%), most frequently asymmetric wall thickening. Thirty-four uteri (49%) were classified as T-shaped and 35 (51%) as Y-shaped. Mean operative time was 24.8±9.8 minutes, with no complications. A normal, triangular uterine cavity was achieved in all cases.

Histological examination revealed adenomyosis in 25/69 patients (36%), as shown in Table 2. Prevalence was significantly higher in the RPL group (54%, 12/22) compared with infertility/single miscarriage (27%, 13/47; *P*<0.05). Leiomyomuscular hyperplasia was the most frequent additional abnormality, observed in 8/22 RPL (36%) and 24/47 infertility/single miscarriage patients (51%). Concordance between ultrasound and histology for adenomyosis was poor (Cohen's kappa 0.156).

After a median follow-up of 21 months, reproductive outcomes were assessed (Table 3). The overall CPR was 65% (45/69) and the LBR per pregnancy was 62% (28/45), a significant increase compared with preoperative rates (*P*<0.01). Seven ongoing pregnancies were recorded at the last follow-up. Overall, 53% of pregnancies occurred spontaneously and 47% through Assisted Reproductive Technology (ART). Caesarean delivery occurred in 35% of cases; no uterine rupture, placenta accreta, or cervical incompetence was reported. Two obstetrical complications (postpartum haemorrhage, placental abruption at 36 weeks) were managed without sequelae.

Among patients with histological evidence of adenomyosis, the LBR was 43%, compared to 71% in those without adenomyosis (*P*=0.07).

The LBR per pregnancy increased from 0% to 43% after metroplasty (*P*<0.05), with a LBR of 66% in women with infertility/single miscarriage and 25% in those with RPL. Although the LBR increased in women with adenomyosis, the improvement was less pronounced than in the non-adenomyosis subgroup, with 43% (6/14) vs. 71% (22/31), respectively. Similar to the adenomyosis group, the non-adenomyosis group also showed a better postsurgical LBR in women with infertility/single miscarriage compared to those with RPL (73% vs. 67%).

Logistic regression showed no significant predictors of LBR, although adenomyosis approached significance (*P*=0.07, OR: 0.31, 95% CI: 0.08-1.14).

Discussion

To our knowledge, this is the first study to specifically investigate the histological prevalence of adenomyosis in women with dysmorphic uterus undergoing metroplasty. The availability of excised endomyometrial tissue enabled systematic histological assessment, which has rarely been performed in this context. All procedures were conducted using a standardised, minimally invasive hysteroscopic technique, strengthening the consistency of the findings.

Study Limitations

The study has several limitations. Its retrospective, single-centre design reduces generalisability, and the relatively small sample size, without a formal calculation, limits statistical power. The median follow-up of 21 months, although comparable to other series, does not allow long-term outcomes to be assessed.[16-18] Histological analysis was restricted to excised redundant tissue, so adenomyosis confined to deeper myometrium may have been missed, in line with the poor concordance between ultrasound and histology (Cohen's kappa 0.156). A control group was lacking, and post-surgical management was not standardised, with patients pursuing either spontaneous conception or ART. This heterogeneity reflects clinical practice but may influence outcomes.

Despite these limitations, our data provide useful insights. The higher prevalence of adenomyosis in women with RPL is consistent with reports of an association with pregnancy loss.[19] Adenomyosis has been linked to impaired implantation through disruption of the junctional zone, aberrant peristalsis, altered hormonal pathways, increased inflammation, and reduced endometrial receptivity.[6] Involvement of the junctional zone has been

Table 1. Baseline and surgical features of the study population.

	Total (n=69)	**Histological adenomyosis (n=25)**	**Non-histological adenomyosis (n=44)**	***P*-value**
Age at surgery (years, mean±SD)	35.9±4.7	37.8±4.6	35±4.7	<0.05
BMI (kg/m², mean±SD)	22.6±3.6	22.6±3.7	22.5±3.6	0.43
Indications for surgery, n (%)				
Recurrent pregnancy loss (≥2)	22 (32)	11 (44)	11 (25)	0.11
Infertility or a single miscarriage	47 (68)	14 (56)	33 (75)	
Subtype of dysmorphic uteri, n (%)				
T-shaped	34 (49)	17 (68)	26 (59)	0.6
Y-shaped	35 (51)	8 (32)	18 (41)	
I-shaped	0 (0.0)	0 (0.0)	0 (0.0)	
Ultrasonographic features of adenomyosis (according to MUSA Consensus), n (%)				
No	14 (20)	3 (12)	11 (25)	
Yes	55 (80)	22 (88)	33 (75)	0.23
Direct features	34 (49)	15 (60)	19 (43)	
Indirect features	21 (31)	7 (28)	14 (32)	
Direct features				
Hyperechogenic islands	14 (20)	5 (20)	9 (20)	NA
Echogenic subendometrial lines/buds	2 (3)	2 (8)	0 (0)	0.30
Myometrial cysts	29 (42)	12 (48)	17 (39)	0.46
Indirect features				
Asymmetrical thickening	46 (67)	17 (68)	29 (66)	NA
Fan-shaped shadowing	22 (32)	9 (36)	13 (29)	0.60
Trans lesional vascularity	11 (16)	6 (24)	5 (11)	0.18
Irregular junctional zone	14 (20)	5 (20)	9 (20)	NA
Interrupted junctional zone	8 (12)	7 (28)	1 (2)	**<0.05**
Surgical time (min, mean±SD)	24.8±9.8	23.2±9.1	25.9±9.8	0.15
Second surgical step, n (%)				
Yes	1 (1.5)	1 (4)	0	0.34
No	54 (78)	18 (72)	36 (82)	
Fundal and/or lateral cuts (second-look hysteroscopy)	14 (20)	6 (24)	8 (18)	
Endometrial preparation, n (%)				
Yes	59 (86)	22 (88)	37 (84)	0.73
No	10 (14)	3 (12)	7 (16)	

SD: Standard deviation, BMI: Body mass index, min: Minimum, NA: Not applicable.

Table 2. Histological findings.

Histological findings (n=69)			
Histology, n (%)	**RPL (n=22)**	**Infertility/single miscarriage (n=47)**	***P*-value**
Adenomyosis	12 (54)	13 (27)	0.03
Leiomuscular hyperplasia	8 (36)	24 (51)	0.377
Vascular congestion	4 (18)	7 (15)	0.734
Vascular hyperplasia	2 (9)	3 (6)	0.925
Sclerosis	2 (9)	9 (19)	0.477
Inflammation	0 (0)	1 (2)	1.0
Fibroids/leiomyoma	1 (4.5)	0 (0)	0.318

RPL: Recurrent pregnancy loss.

Table 3. Reproductive outcomes stratified by primary surgical indication (RPL or infertility/single miscarriage) and histological presence or absence of adenomyosis.

Reproductive outcomes	**Subgroup RPL (n=22)**			**Subgroup infertility/single miscarriage (n=47)**			**Overall population (n=69)**		
	Before	**After**	***P***	**Before**	**After**	***P***	**Before**	**After**	***P***
CPR (n, %)	22/22 (100)	17/22 (77)	/	15/47 (32)	28/47 (60)	<0.01	37/69 (53)	45/69 (65)	/
LBR per pregnancy (n, %)	0/22 (0)	8/17 (47)	<0.01	0/15 (0)	20/28 (71)	<0.01	0/37 (0)	28/45 (62)	<0.01
MR per pregnancy (n, %)	22/22 (100)	5/17 (29)	<0.05	15/15 (100)	5/28 (18)	<0.01	37/37 (100)	10/45 (22)	<0.01
Ongoing per pregnancy (n, %)	-	4/17 (24)	-	-	3/28 (11)	-	-	7/45 (16)	-
Hystological adenomyosis (n=25)									
CPR (n, %)	12/12 (100)	8/12 (67)	/	4/13 (31)	6/13 (46)	0.42	15/25 (60)	14/25 (56)	/
LBR per pregnancy (n, %)	0/12 (0)	2/8 (25)	<0.05	0/4 (0)	4/6 (66)	<0.05	0/15 (0)	6/14 (43)	<0.05
MR per pregnancy (n, %)	12/12 (100)	4/8 (50)	<0.05	4/4 (100)	1/6 (17)	<0.05	15/15 (100)	5/14 (36)	<0.05
Ongoing per pregnancy (n, %)	-	2/8 (25)	-	-	1/6 (17)	-	-	3/14 (21)	-
No adenomyosis (n=44)									
CPR (n, %)	10/10 (100)	9/10 (90)	/	11/34 (32)	22/34 (65)	<0.01	22/44 (50)	31/44 (70)	/
LBR per pregnancy (n, %)	0/10 (0)	6/9 (67)	<0.05	0/11 (0)	16/22 (73)	<0.01	0/22 (0)	22/31 (71)	<0.001
MR per pregnancy (n, %)	10/10 (100)	1/9 (11)	<0.05	11/11 (100)	4/22 (18)	<0.01	22/22 (100)	5/31 (16)	<0.001
Ongoing per pregnancy (n, %)	-	2/9 (22)	-	-	2/22 (9)	-	-	4/31 (13)	-

RPL: Recurrent pregnancy loss, CPR: Clinical pregnancy rate, LBR: Live birth rate, MR: Miscarriage rate.

associated with higher MRs, underscoring its critical role in embryo implantation and placentation.[6] In our series, histological abnormalities such as leiomyomuscular hyperplasia, vascular congestion, vascular hyperplasia, sclerosis, and inflammation were also observed. Although these findings were not significantly associated with outcomes, they may interfere with uterine function. Previous reports suggest that hysteroscopic removal of superficial adenomyotic tissue can improve reproductive outcomes, beyond anatomical correction.[8,20]

The outcomes observed are consistent with existing literature, which shows improved clinical pregnancy and LBRs and reduced miscarriage after metroplasty.[10,16-18] For example, a 2022 SWOT analysis reported LBRs rising from below 2% preoperatively to over 55% after surgery, with MRs falling from over 85% to approximately 20%.[10] Our findings confirm the beneficial effect of metroplasty, particularly in women with infertility or a single miscarriage.

Conclusion

In conclusion, this study has several clinical implications. Histological assessment of tissue resected during metroplasty may reveal pathological changes not detectable by imaging. Our data confirm that patients with dysmorphic uterus benefit from metroplasty, but suggest that adenomyosis might influence outcomes, although our study was underpowered to demonstrate a significant effect. Larger, prospective studies are needed to clarify its reproductive impact after surgery.

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Transparency: The data underlying this article are available from the corresponding author.

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SHORT COMMUNICATION

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Feasibility and early outcomes of robotic sacrocolpopexy with the Versius® platform: a prospective single-centre experience

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ABSTRACT

Minimally invasive sacrocolpopexy is considered the reference procedure for pelvic organ prolapse (POP). This study reports the first series of robotic sacrocolpopexy (RSCP) performed with the Versius® Robotic Surgical System (CMR Surgical, Cambridge, UK). Twenty women with symptomatic multicompartment POP underwent nerve-sparing RSCP. All procedures were completed successfully with no complications or conversions. Surgical and functional outcomes were consistent with those reported for other minimally invasive techniques. At three-month follow-up, complete anatomical correction was achieved in 90% of patients, with improvement in patient-reported outcomes. Our experience indicates that the Versius® system is a safe and practical option for RSCP.

Keywords: Patient-reported outcomes, pelvic organ prolapse, reconstructive surgery, robotic, robotic surgery

Introduction

Over recent decades, advances in surgical technology have supported the expansion of robot-assisted surgery (RAS), aiming to improve operative feasibility, reduce invasiveness, and facilitate the surgical learning curve.[1] In gynaecology, several robotic systems have been introduced, and their use in urogynaecology procedures has grown steadily, particularly for the management of pelvic organ prolapse (POP).[2]

Sacrocolpopexy performed either laparoscopically (laparoscopic sacrocolpopexy) or robotically [robotic sacrocolpopexy (RSCP)] is considered the gold standard treatment for apical POP, offering high anatomical success, durable functional outcomes, and reduced recurrence when compared with other approaches.[3-6] Multiple robotic platforms have become available in recent years and our group has previously reported experiences using both the Senhance® System (TransEnterix Inc., USA) and the Hugo™ RAS platform (Medtronic, Minneapolis, MN, USA) for RSCP.[7-9]

The Versius® Surgical System (CMR Surgical, Cambridge, UK) received Conformité Européenne (CE) approval in 2019. This system is composed of

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three or four independent bedside units with fully wristed instruments to enhance surgical flexibility. The surgeon operates from an open console with hand controllers, enhancing comfort and team communication, with three-dimensional high-definition vision available in either a seated or standing position. Early clinical reports have shown promising outcomes across various surgical specialities.[10]

Here, we present the first series of nerve-sparing RSCP performed with the Versius® robotic platform, with a focus on feasibility and efficiency.

Methods

This prospective, single-centre study includes the first twenty consecutive women with symptomatic multicompartment POP stage ≥III [according to the International Continence Society Pelvic Organ Prolapse Quantification (ICS POP-Q) classification] who underwent nerve-sparing RSCP using the Versius® Surgical System (CMR Surgical, Cambridge, UK) at Fondazione Policlinico Universitario A. Gemelli IRCCS, Rome, Italy, between May and December 2024.

Demographic variables and baseline clinical characteristics were collected for each participant.

Preoperative assessment included medical history and pelvic examination (POP-Q, stress test, Q-tip test, and PC test for pubococcygeus strength). Additional investigations consisted of routine laboratory tests, pelvic and urinary tract ultrasonography, and cervical cytology. Hysteroscopy was performed when endometrial thickening was identified. Urodynamic evaluation was routinely carried out according to institutional protocol to detect occult dysfunctions and support surgical planning, even in asymptomatic patients. Data collection and reporting adhered to the ICS/International Urogynecological Association recommendations.

All patients were counselled on surgical alternatives, including prosthetic and native tissue repairs, risks and potential complications, and provided written informed consent for the procedure and anonymised data use. Concomitant supracervical hysterectomy was performed to standardise the technique, preserve the integrity of the precervical ring, and minimise the risk of vaginal contamination, while also facilitating secure mesh fixation. Salpingectomy or salpingo-oophorectomy was added according to age and menopausal status. All procedures were performed by a single experienced surgeon (GP) who performs over 50 minimally invasive sacrocolpopexies annually, using a lightweight, macroporous polypropylene mesh (Restorelle®, Coloplast, USA). Contained in-bag morcellation was performed in all cases.

Intraoperative and postoperative parameters were recorded prospectively. Docking time referred to robotic unit positioning, and operative time (OT) to the interval from skin incision to closure; console time indicated the duration at the surgeon's console. Intraoperative complications included visceral or vascular injury, blood loss >500 mL, transfusion, or unexpected events. Postoperative complications within 30 days were classified according to Clavien–Dindo. Pain at 24 hours was assessed using a visual analogue scale (VAS), and length of stay was calculated from the first postoperative day to discharge.

Categorical variables were reported as frequencies and percentages, and continuous variables as medians with ranges. Analyses were performed using SPSS (SPSS Inc., Chicago, IL, USA).

Port Placement and Surgical Procedure

The procedure was performed with the Versius® robotic system following a standardised technique previously described by our group.[8,9,11]

After positioning the bedside unit, trans-umbilical open laparoscopic access is obtained, and a 10-mm port for the 3D-HD 0° scope (Richard Wolf®, Knittlingen, Germany) is inserted. Two additional 5-mm ports are placed in the right and left lower abdomen, and an additional 5-mm trocar is placed at Palmer's point for first assistant's use. A three-arm robotic configuration was used in all cases. The port placement and the setting of the mobile bedside units are illustrated in Figure 1.

Robotic instruments used included monopolar scissors, bipolar grasper, and two needle holders. Dissection was performed using monopolar scissors on the right hand and bipolar graspers on the left, while two needle drivers were used for mesh fixation. Through the accessory port, the assistant utilised graspers, a clip applier, and a suction-irrigation device.

The supplementary video demonstrates the features of the robotic platform and the key surgical steps.

Results

A total of 20 women with symptomatic multicompartment POP were included. The median age was 52.5 years (range 41-76), with a median body mass index (BMI) of

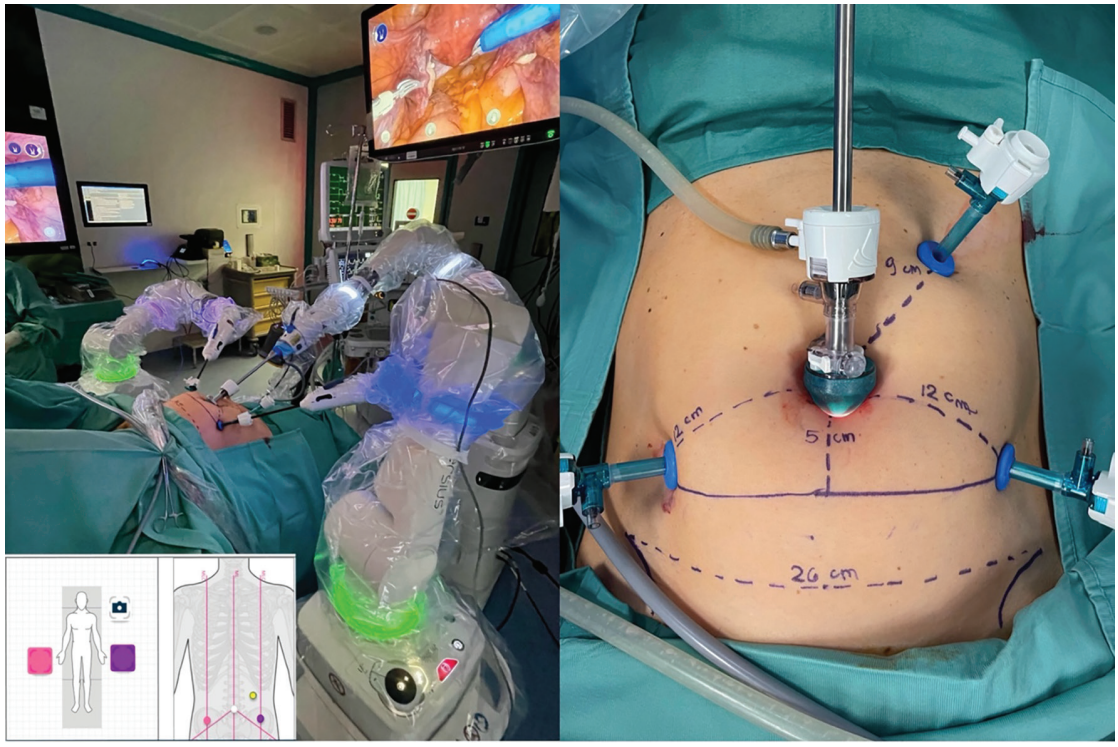

Figure 1. Detail on setting of the robotic mobile bedside units and port placement.

21 kg/m² (range 20-30), and a median parity of 2 (range 1-4). Eighteen women (90%) were postmenopausal, and two (10%) were premenopausal. Ten patients (50%) had a history of previous abdominal surgery (laparotomic or laparoscopic), and two (10%) had previously undergone prolapse repair. No patient had a prior hysterectomy or a previous caesarean section. Preoperative POP-Q evaluation showed stage III prolapse in 16 patients (80%) and stage IV in 4 patients (20%). The anterior compartment was the most affected (median stage 3, range 2-3), followed by the apical compartment (median stage 3, range 2-4), and the posterior compartment (median stage 1, range 0-2). As part of the diagnostic work-up, all patients underwent pelvic ultrasonography. Pelvic magnetic resonance imaging and hysteroscopy were performed when clinically indicated (2 cases each, 10%).

Perioperative data and surgical outcomes are summarised in Table 1. The median OT was 174 min (range 146-229). The median docking time was 4 min (range 2-12). Median estimated blood loss was 20 mL (range 10-100). Tjere were no conversions to laparoscopy or laparotomy. All patients had associated subtotal hysterectomies with bilateral salpingectomy/salpingo-oophorectomy.

No intraoperative complications were reported, and no post-operative complications were registered according to the Clavien–Dindo scale. Median time to discharge was 2 days (range 2-3). Median pain VAS score at 24 h was 2 (range 1-5).

Median follow-up was 4 months (range 3-7) with no mesh erosion or extrusion.

Among the 10 patients with preoperative stress urinary incontinence, 4 (40%) reported symptom resolution postoperatively. Two cases of *de novo* stress urinary incontinence occurred (10%), while no patient developed *de novo* urge urinary incontinence.

At three month follow-up visit, POP-Q measurements showed significant improvement, with complete anatomical restoration and symptom resolution in 90% of patients; two anterior compartment recurrences were observed (10%, POP-Q stage 3). Bulge symptoms resolved in all cases. Constipation changes were minimal, and no other *de novo* symptoms occurred. Patient-reported outcomes were favourable, with all patients (100%) reporting Patient Global Impression of Improvement-I scores of 1-2.

Table 1. Perioperative data and surgical outcomes according to POP-Q stage.

Perioperative data		**Surgical outcome**			
All cases	20		Pre-operative	Post-operative	*P*-value
Associated surgical procedures, n (%)	20 (100)	POP-Q stage, median (range)			
Ventral rectopexy, n (%)	0 (0)	Anterior	3 (2-4)	0 (0-3)	<0.001
Subtotal hysterectomy, n (%)	20 (100)	Apical	3 (2-4)	0 (0-1)	<0.001
Total hysterectomy, n (%)	0 (0)	Posterior	1 (0-2)	0 (0-1)	0.035
Salpingectomy/salpingo-oophorectomy, n (%)	20 (100)	Stress urinary incontinence, n (%)	10 (50)	6 (30)	0.673
Docking time (min), median (range)	4 (2-12)	Urgency, n (%)	6 (30)	4 (20)	0.628
Console time (min), median (range)	112.5 (87-133)	Nicturia, n (%)	4 (20)	2 (10)	1.000
Operative time (min), median (range)	174 (146-229)	Urge urinary incontinence, n (%)	6 (30)	2 (10)	0.288
Laparoscopic adhesiolysis, n (%)	0 (0)				
EBL (mL), median (range)	20 (20-100)	Hesitancy, n (%)	6 (30)	2 (10)	0.288
Time to discharge (days), median (range)	2 (2-3)	Feeling of incomplete emptying, n (%)	10 (50)	4 (20)	0.177
Conversion to laparoscopy or laparotomy, n (%)	0 (0)				
Intraoperative complications, n (%)	0 (0)	Constipation, n (%)	10 (50)	6 (30)	0.196
Post-operative complications, n (%)	0 (0)	Vaginal bulging, n (%)	20 (100)	2 (10)	<0.001
VAS score at 24 h, median (range)	2 (1-5)	PGI-I, median (range)		1 (1-2)	

POP-Q: Pelvic Organ Prolapse Quantification, EBL: Estimated blood loss, VAS: Visual analogue scale, PGI-I: Patient Global Impression of Improvement, min: Minimum.

Discussion

RAS is increasingly utilised in urogynaecology, particularly for POP surgery, where it has proven to be highly efficient.[3] In advanced urogenital prolapse, the apical segment -whether uterus or vaginal vault- is almost always involved, and inadequate apical suspension is a major determinant of recurrence. Although RSCP is generally associated with longer OTs compared with conventional laparoscopy, advantages include reduced postoperative blood loss and shorter hospital stay, with potential improvements in anatomical outcomes and postoperative morbidity.[5,6,12-14]

To our knowledge, this study represents the first case series describing nerve-sparing RSCP using the Versius® robotic platform. The CMR Versius Surgical System® offers a novel alternative to existing robotic platforms. It is composed of three to four independent bedside units and an open master console, which enhances communication with the surgical team and allows the surgeon to operate either seated or standing. Electrosurgical energy activation and camera control (zooming, rotation, translation) are managed directly through the console handgrips, eliminating the need for foot pedals. Since monopolar and bipolar energy can only be activated from the corresponding instrument handgrip, the risk of accidental activation of the wrong device is reduced.

The compact arms allow access to the patient from multiple angles and enable movement of the elbow without displacing the instrument tip. This minimises arm excursion and reduces the likelihood of collisions between robotic arms or with the bedside assistant -an issue previously reported with open-console platforms.[15] The platform's compact size also facilitates its use in smaller operating rooms and permits easy transfer between locations, making it suitable for centres without a dedicated robotic suite.

The system does not require dedicated robotic trocars, insufflators, or energy systems. Instead, standard

laparoscopic trocars can be used, and the surgeon may select the preferred method of peritoneal access (open, optical trocar, Veress, paraumbilical or subcostal entry). This flexibility enables hybrid approaches and simple conversion to conventional laparoscopy, when necessary, while also contributing to cost containment. However, unlike other platforms, abdominal wall "tenting" after docking is not possible. Another limitation is the relatively shorter length of the instruments, although this can be partially compensated for by advancing trocars without the need for re-docking.

Port placement settings are adaptable to patient BMI, planned procedure, and surgeon preference. The robotic arm architecture mimics human articulation, with wristed joints offering seven degrees of freedom, aiding precise dissection and suturing in deep anatomical fields. The platform provides partial haptic feedback and incorporates a Head-Up Display system that assigns each robotic arm a dedicated colour and icon. Parameters such as energy mode and arm activity are displayed directly on the surgeon's 3D screen, eliminating the need for external monitors and improving safety through continuous visual control.

The Versius® system has shown encouraging results in general, colorectal, gynaecologic, urologic, and thoracic surgery.[10,16-19] However, the limited number of cases and heterogeneity of procedures reported to date restrict the ability to draw definitive conclusions about outcomes for specific techniques.

With regard to RSCP, our findings on docking and OTs, anatomical correction, functional improvement, and perioperative safety are consistent with the literature on robotic platforms.[12-14] Additionally, the low 24-hour VAS pain score in our series may be attributable to the use of standard 5-mm laparoscopic trocars, which are smaller than those typically employed in other robotic systems.[20]

This study is limited by its small cohort and short follow-up. Larger case series and longer postoperative observation are necessary to confirm effectiveness, durability of anatomical correction, recurrence rates, and functional outcomes. Comparative studies between Versius® and established platforms (e.g., Da Vinci) are essential to assess potential advantages in ergonomics, cost-effectiveness, and training curves.

Early reporting of experiences with emerging robotic systems remains crucial to characterise platform performance and standardise procedures.

Conclusion

Our initial findings suggest that RSCP with the Versius® system is feasible and safe, with perioperative and early postoperative outcomes comparable to other minimally invasive techniques. Further multicentre studies with larger cohorts and extended follow-up are required to validate these findings and clarify the potential advantages of this platform within urogynaecology and pelvic reconstructive surgery.

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Informed Consent: All patients provided informed consent for the procedure and the use of anonymised clinical data.

Data sharing: The data underlying this article cannot be shared publicly due to privacy concerns and the inclusion of potentially identifiable patient information. De-identified data supporting the findings of this study are available from the corresponding author upon reasonable request and subject to institutional and ethical approval.

Transparency: The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

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Supplementary Video Link: https://youtu.be/RuT4OKjHlfY

NARRATIVE REVIEW

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Infertility management in patients with bowel endometriosis: the current landscape and the promise of randomised trials

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ABSTRACT

The management of infertility in women with bowel endometriosis remains a significant clinical challenge. The two primary therapeutic approaches include first-line medically assisted reproduction (MAR) and primary bowel surgery, with or without subsequent fertility treatments. While surgery can significantly improve fertility outcomes, the success of these interventions is influenced by several factors, and MAR may still be necessary for certain patients, especially those over 35 years or with complex disease patterns. In this narrative review, we assessed the outcomes of the main therapeutic strategies commonly offered to patients with bowel endometriosis-associated infertility and discussed the challenges inherent in evaluating reproductive outcomes in women with colorectal endometriosis.

Keywords: Bowel endometriosis, colorectal endometriosis, infertility, pregnancy rates, reproduction

Introduction

Bowel endometriosis affects approximately 8-12% of patients with deep endometriosis (DE) and is associated with severe pain and infertility.[1,2] Although medical therapies can alleviate pain in symptomatic patients, they are not suitable for patients seeking to conceive due to their contraceptive effects.[3] Thus, treatment must be individualised based on symptom severity and reproductive goals.

Several mechanisms have been proposed to explain endometriosis-associated infertility, including distorted pelvic anatomy, abnormal utero-tubal transport, immunological and peritoneal alterations, poor oocyte/embryo quality, impaired implantation,[4] and reduced frequency of sexual intercourse due to dyspareunia.[5]

However, the mechanisms contributing to subfertility in patients with bowel DE remain poorly understood

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and seem related to the inflammatory environment produced by endometriotic nodules[6,7] and the presence of posterior cul-de-sac obliteration.[8] Nevertheless, the usual coexistence of bowel endometriosis with other infertility factors such as endometriomas, hydrosalpinx, and adenomyosis complicates the attribution of subfertility to bowel lesions alone.

To date, the management of infertility in women with bowel endometriosis remains a significant clinical challenge. The two primary therapeutic approaches include first-line medically assisted reproduction (MAR) and primary surgical intervention, which may involve intestinal procedures.

Since patients with untreated colorectal endometriosis achieve similar fertility outcomes after *in vitro* fertilisation (IVF) compared with those without endometriosis,[9] infertile patients with minimal pain are typically advised to pursue MAR first to avoid surgical risks. On the other hand, for patients with severe symptoms, the predominant indication of surgical resection is the severity of pain.

Long-term benefits of laparoscopic resection of bowel endometriosis in relieving pelvic pain, improving bowel function, and enhancing quality of life (QoL) are well established;[8,10,11] however, its role in enhancing fertility remains uncertain. Observational data suggest that surgery may boost spontaneous conception and MAR success rates,[12-15] but no randomised trials have addressed this specifically.

This review evaluates fertility outcomes after different treatment options in patients with bowel DE, highlighting challenges in measuring reproductive efficacy in this population.

Methods

Search Strategy

We conducted a narrative review of studies published between January 2009 and March 2025 in multiple databases, including PubMed, Google Scholar, Scielo, and ClinicalTrials.gov, to identify articles related to fertility and colorectal endometriosis. Only studies published in English, French, or Spanish were included.

Medical Subject Headings terms used included "colorectal endometriosis," "bowel endometriosis," and "intestinal endometriosis," in combination with "fertility," "infertility," "pregnancy rate (PR)," "live birth rate (LBR)," "*in vitro* fertilization (IVF)," "intracytoplasmic sperm injection (ICSI)," "assisted reproductive technology (ART)," "medically assisted reproduction (MAR)," and "intrauterine insemination (IUI)." The references of included studies were also screened to identify additional relevant publications.

Definitions

Definitions and outcomes were classified according to the 2017 International Glossary on Infertility and Fertility Care.[4] "Infertility" was defined as the failure to achieve a clinical pregnancy after ≥1 year of regular, unprotected intercourse. The term "MAR" comprised ART (e.g., IVF, ICSI) and IUI, while "ART" refers exclusively to procedures involving the *in vitro* gamete handling (e.g., IVF and IVF ± ICSI).

Surgical procedures for bowel endometriosis were defined based on the updated terminology proposed in the International Endometriosis Terminology.[16] "Shaving" refers to a partial-thickness excision without entry into the bowel lumen. "Discoid excision" indicated a full-thickness resection of the bowel wall with lumen entry. "Bowel resection" involved the removal of a bowel segment followed by re-anastomosis. Surgical complications were graded using the Clavien-Dindo classification.[17]

Study Selection

We considered observational, randomised, and review articles reporting reproductive outcomes in women with documented bowel DE who desired pregnancy (with or without proven infertility). Surgical videos and case reports were excluded. Both spontaneous and MAR-related outcomes were considered. Surgical techniques and patient fertility histories were also analysed. For review articles, methodological quality was assessed using the scale for the Assessment of Narrative Review Articles criteria (Supplementary Table 1).[18]

The following data were extracted from the included studies and entered into a datasheet: study characteristics (author, year of publication, study design, and whether data were collected prospectively or retrospectively), patient characteristics (definition of the included population and the total number of women initially included in the study), fertility outcomes [i.e., cumulative PR (CPR)] and the techniques used to achieve the pregnancies (spontaneous or MAR). Figure 1 depicts the review flow chart.

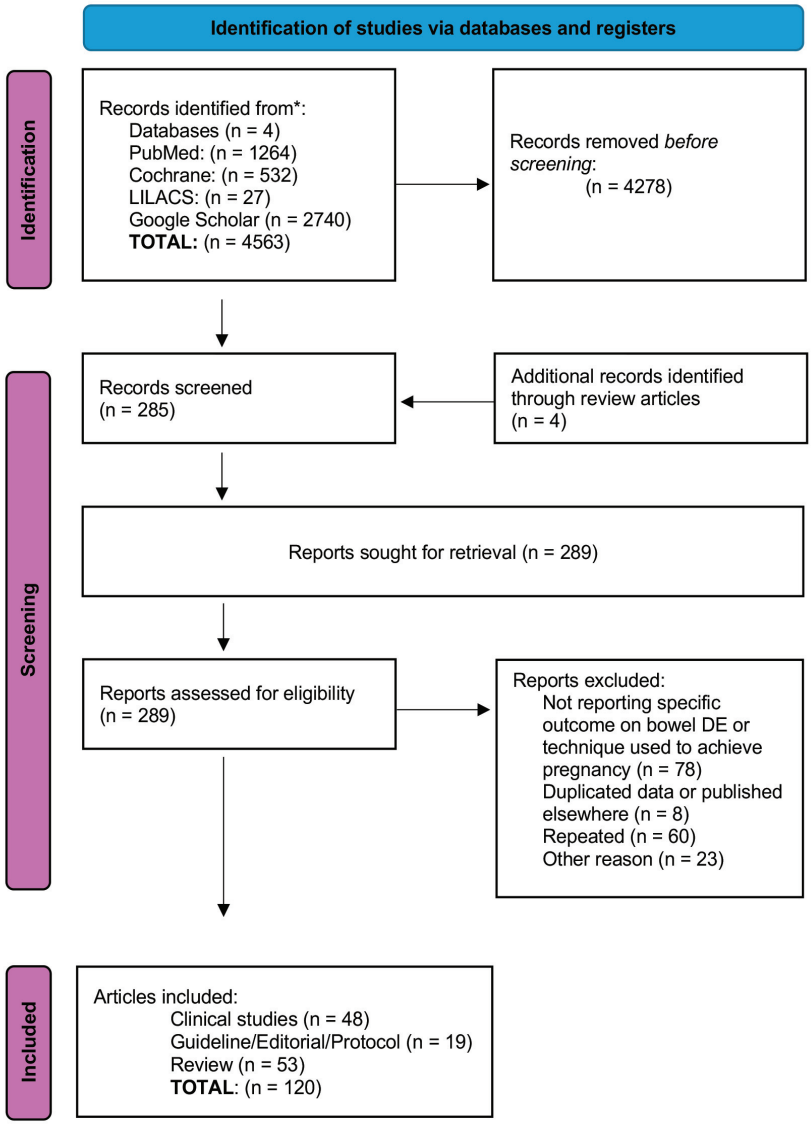

Figure 1. Flowchart for study selection reported in three studies.
DE: Deep endometriosis.

Optimising Fertility Outcomes in Women with Deep Endometriosis Affecting the Bowel

There are many challenges in understanding the best treatment options for patients desiring fertility affected by DE of the bowel. This is because assessing fertility outcomes in patients with bowel endometriosis is hindered by multiple confounding factors (Table 1).

Spontaneous Conception in Patients with Untreated Colorectal Endometriosis

In comparison to the fecundity rate of 15% to 20% per month in healthy couples, the spontaneous PR (SPR) in patients with untreated endometriosis is notably lower (2%-10%).[19] Although previous studies have estimated SPR in patients with DE,[20,21,] these studies did not specifically focus on those with colorectal involvement.

To date, there is very limited data on spontaneous fertility outcomes in patients with untreated intestinal DE lesions (*in situ*) (Table 2).[8,22,23] However, the presence of intestinal endometriosis has been associated with the lowest fertility rates (0.84% per month) and the longest time to conception among infertile patients attempting natural conception.[8] Notably, Ferrero et al.[22] reported a 38.9% spontaneous conception rate in women with untreated colorectal endometriosis, following proper patient selection for those with a good reproductive prognosis.

Given that most spontaneous pregnancies in patients with untreated colorectal endometriosis occur in those under 35 years of age and within the first year of trying to conceive,[21,23] expectant management could be considered as an initial approach for a limited period (6-12 months). In our opinion, this approach may be offered to younger patients (<35 years) with an adequate ovarian reserve (Anti Mullerian Hormone serum level >2 ng/mL), patent tubes, no evidence of adenomyosis, and normal semen analysis. In other cases, expectant management is discouraged.

Fertility Outcomes After "Medically Assisted Reproduction First" Approach in Patients with In Situ Colorectal Endometriosis

Current guidelines recommend that surgery should not be performed before ART in patients with colorectal endometriosis, with the primary goal of improving fertility.[24] As a result, primary MAR is often the first-line treatment for infertile women with bowel endometriosis who experience little or no pain. Several reasons support this approach:

Table 1. Confounders influencing the interpretation of studies on fertility outcomes in patients with bowel endometriosis.

Possible confounders	Explanation
Comorbidity of endometriosis	Bowel DE often coexists with other forms of endometriosis and infertility factors like tubal occlusion, hydrosalpinx, pelvic adhesions, endometriomas, and adenomyosis, complicating attribution of fertility outcomes to bowel lesions alone.
Surgical goals and challenges	The primary aim of DE surgery is the radical excision of all lesions, including bowel nodules, while preserving reproductive function. As such, evaluating the specific impact of removing specific endometriotic lesions on fertility outcomes is inherently tricky.
Patient populations	Many studies do not distinguish between women with proven infertility and those simply wishing to conceive.
Surgical heterogeneity	Variability in techniques -shaving, discoid excision, segmental resection -makes comparisons difficult. Most data emphasise pain relief and functional outcomes over fertility metrics.
Inconsistent definitions and reporting	Definition of pregnancy, reporting of conception methods and time to pregnancy metrics vary widely.
Terminology and reporting variability	Inconsistent use of terms like ART and MAR and a lack of consensus on cumulative live birth definitions further complicate data synthesis.
Unclear surgical classifications	Terms like "deep shaving" or "partial-thickness excision" lack standardisation across studies, hindering reproducibility.
Lack of randomised trials	Most available studies are observational and heterogeneous, precluding strong recommendations for surgery or MAR as first-line treatment.

DE: Deep endometriosis, ART: Assisted reproductive technology, MAR: Medically assisted reproduction.

Table 2. Spontaneous pregnancy in patients desiring pregnancy reported in three studies with untreated (*in situ)* colorectal endometriosis (with or without documented infertility).

Author (year) (ref)	Study design	Intervention	n	Patients wishing to conceive	Infertility diagnosis	Mean follow-up (range)	Spontaneous pregnancy rate	Mean time to pregnancy	Live-birth rate
Ferrero et al. (2021)[22]	Retrospective	No surgery expectant management	215	167	NR	31 months (13-63)	65/167 * (38.9%)	10 months (2-34)	62/167 (37.1%)
Acién et al. (2013)[23]	Retrospective	Removal of non-bowel DE lesions	10	10	NR	7 years (1-23)	6 /10 * (60%)	NR	NR
Stepniewska et al. (2009)[8]	Prospective	Removal of non-bowel DE lesions	40	39	40	26.9 months	7/23 * (30.4%)	NR	6/23 (26.1%)

*Patients who attempted to conceive naturally. DE: Deep endometriosis, NR: Not reported.

1) Avoidance of surgical risks, such as anastomotic leakage, pelvic abscesses, rectovaginal fistula formation, neurogenic bladder/bowel dysfunction, and anastomosis stenosis, without strong evidence supporting the role of surgery in improving reproductive outcomes.[25]
2) Patients with untreated colorectal endometriosis achieve similar fertility outcomes after IVF compared with non-endometriosis patients.[9] In addition, first-line ART offers favourable CPR and cumulative LBR (CLBR). A large retrospective study, spanning 12 years, compared IVF-ICSI outcomes between 120 patients with bowel DE undergoing primary ART and 69 patients managed surgically. No significant differences in CPR (56.7% vs. 58%, *P*=0.47) and CLBR (50.8% vs. 52.2%, *P*=0.43) were found. The authors concluded that IVF-ICSI outcomes were similar regardless of prior surgical intervention, suggesting no additional benefit from surgery in these patients.[26]
3) Impact of uterine adenomyosis: The prevalence of adenomyosis in patients with bowel endometriosis ranges from 17% to 88%.[15,27-29] A systematic review identified adenomyosis as a strong predictor of reproductive failure in patients with colorectal endometriosis undergoing surgery,[27] suggesting that adenomyosis may play a more significant role in infertility than the intestinal endometriotic lesions themselves. Since adenomyosis is not corrected surgically, the role of bowel surgery in asymptomatic patients solely to improve fertility may be overestimated.
4) Quality of evidence: Most available data on the impact of bowel surgery on fertility outcomes in infertile women with colorectal endometriosis come from uncontrolled cohorts where fertility was a secondary outcome. Given that non-randomised studies often report larger treatment effects than randomised controlled trials (RCTs), and cohort studies are prone to bias, the actual impact of bowel surgery on fertility may be overestimated.[25]

We identified eight studies[8,9,22,23,26,28-30] involving 363 women with documented colorectal endometriosis and pregnancy intention undergoing primary MAR without prior bowel surgery (Table 3). Among these women, 170 became pregnant, resulting in a PR of 46.8 %. Time to pregnancy after MAR was reported in two studies[8,22] and was considerably longer than the time reported for patients who conceived naturally.

Prognostic factors impacting reproductive outcomes in patients with bowel endometriosis undergoing first-line fertility treatments.

Adenomyosis

In a prospective multicentre study involving 75 patients with *in situ* colorectal endometriosis, Ballester et al.[28] demonstrated that CPR were significantly lower after IVF-ICSI in women with concomitant adenomyosis (19%) compared to those with a healthy uterus (82.4%) (*P*=0.01). However, the detrimental impact of adenomyosis was not observed in a larger prospective study involving 89 patients with documented adenomyosis undergoing primary IVF.[29]

History of Prior Surgery for Deep Endometriosis

Prior observational studies have suggested that a history of surgery for endometriosis negatively affects ART outcomes in patients with DE.[5,29,31] However, only two studies have specifically evaluated this effect in patients with bowel endometriosis. One study found no association between prior surgery for DE and worse IVF outcomes,[8] while another study reported significantly lower LBR for patients with a history of endometriosis surgery compared to those without prior surgery (64.4% vs. 41.3%, respectively; *P*=0.009).[29] Despite surgery may impair ovarian reserve and reduce IVF.

Diminished Ovarian Reserve

Low ovarian reserve, as indicated by low AMH levels (<2 ng/mL) and an antral follicle count <10, has been identified as an independent negative predictive factor for ART success in patients with *in situ* bowel endometriosis.[28,29] In these studies, low ovarian reserve parameters were associated with a significantly lower CPR (*P*=0.02)[28] and lower LBR (*P*=0.001).[29] However, it is noteworthy that the authors included in their analysis patients with and without concomitant endometrioma.

Other Factors

Other prognostic factors have been inconsistently associated with worse reproductive outcomes in patients with bowel endometriosis undergoing ART, including age over 35 years[28] and a duration of infertility exceeding 30 months.[29]

Table 3. Fertility outcomes after primary medically assisted reproduction in patients reported in eight studies with untreated (*in situ*) colorectal endometriosis (with or without documented infertility).

Author (year) (ref)	Study design	Intervention	n	Infertility diagnosis	Mean follow-up	IUI pregnancy (%)	IVF-ICSI pregnancies (%)	MAR pregnancy rate	Mean time to pregnancy	Live-birth rate	Associated adenomyosis	Prior history of surgery for endometriosis
Ferrero et al. (2021)[22]	Retrospective	No surgery expectant management	83	NR	31 months (13-63)	9/32 (28%)	29/68 (42.6%) (51 directly and 17 after IUI failure)	42.6% (IVF) (CPR after 3 cycles) 28% (IUI)	17 months (4-37)	27/68 (39.7%) (CLBR after 3 IVF cycles) 8/32 (25%) (IUI)	NR	NR
Acién et al. (2013)[23]	Retrospective	Removal of non-bowel DE lesions	10	NR	7 years (1-23)	–	1/4 (25%)	25%	NR	1/4 (25%)	NR	4.3%
Stepniewska et al. (2009)[8]	Prospective	Removal of non-bowel DE lesions	40	40	26.9 months	0/3	1/13 (7.7%)	7.7%	1417 days	1/13 (7.7%)	NR	53%
Mathieu d`Argent et al. (2010)[9]	Retrospective	No surgery first-line ART	29	29	NR	–	12/29 (41%)	41% (CPR after 1 cycle)	NR	8/29 (27.6% after 1 cycle)	NR	NR
Ballester et al. (2012)[28]	Prospective	No surgery first-line ART	75	75	–	–	32/75 (42.7%)	68.6% (CPR after 3 cycles)	NR	24/75 (32% after 3 cycles)	21 (28%)	74.7%
Rubod et al. (2024)[26]	Retrospective	No surgery first-line ART	120	120	NR	–	NR	56.7% (CPR after 4 cycles)	NR	50.8% (CLBR after 4 cycles)	33 (27.5%)	0%
Maignien et al. (2021)[29]	Prospective	No surgery First-line ART	101	101	NR	–	74/101 (73.3%)	73.3% (CPR after 4 cycles)	NR	64.4% (CLBR after 4 cycles)	89 (88.1%)	0%
Bendifallah et al. (2017)[30]	Retrospective	No surgery first-line ART	55	55	NR	–	12/55 (21.8%)	56.6% (CPR after 3 cycles)	NR	54.9% (CLBR after 3 cycles)	19 (34.5%)	58.2%

CPR: Cumulative pregnancy rate, CLBR: Cumulative live birth rate, IUI: Intrauterine insemination, IVF: *In vitro* fertilisation, ICSI: Intracytoplasmic sperm injection, ART: Assisted reproductive technology, NR: Not reported, MAR: Medically assisted reproduction, DE: Deep endometriosis.

Bowel Endometriosis-Related Complications in Women Undergoing First-Line Medically Assisted Reproduction

Although rare, infertile patients with bowel endometriosis who delay surgery should be informed about the potential complications that may arise after discontinuing hormonal therapies,[32,33] as well as during ovarian stimulation,[22] oocyte retrieval,[34] pregnancy, and even the postpartum period.[35] Theoretically, the resulting hyperestrogenism could stimulate the growth of intestinal nodules, leading to exacerbation of symptoms and even bowel obstruction or perforation.[32,36]

The estimated risk of developing occlusive symptoms during primary MAR in patients with bowel endometriosis ranges from 5% to 11.8%,[36,37] and the risk is higher in patients with undiagnosed bowel stenosis (>60%).[37] Consequently, bowel imaging to assess stenosis is strongly recommended before advising patients with bowel DE to prioritise primary MAR.

Fertility Outcomes After Primary Surgical Resection of Bowel Endometriosis

Observational studies conducted by experienced surgical teams have suggested the beneficial impact of complete resection of bowel DE on reproductive outcomes. In addition to improving the chances of natural pregnancy and LBR,[31,38] surgery may also enhance the MAR success rate,[14,30] while preventing potential complications associated with disease progression during ovarian stimulation. Surgery is also recommended after failed IVF,[39,40] and several studies have reported spontaneous conception following surgery in patients with previously failed IVF.[15,41,42] Studies reporting postoperative reproductive outcomes are summarised in Supplementary Table 2.[43-76]

Determinant Factors of Fertility Outcomes After Surgery in Patients Undergoing Surgical Excision of Bowel Endometriosis

Even though the results published by experienced surgeons may not be fully generalizable to all surgical teams, several key factors must be considered to maximise the chances of reproductive success (either naturally or through MAR) in patients with bowel endometriosis undergoing surgery.

Surgical Route

A randomised trial comparing fertility outcomes after laparoscopic and open colorectal resection for bowel endometriosis reported significantly higher SPR in patients who underwent laparoscopic surgery.[41] In another study by the same team, the authors demonstrated that conversion to open surgery negatively impacted PR in patients undergoing colorectal resection for DE.[42] Based on these findings, laparoscopy is considered the gold standard for treating bowel DE in patients wishing to conceive, and the procedure must be carried out in a specialised centre with a multidisciplinary team available.

Completeness of Surgery

Four studies have evaluated the impact of incomplete surgical resection in infertile women with DE. In one study, patients with documented colorectal endometriosis underwent complete eradication of non-bowel DE lesions, but intestinal nodules were left behind.[8] The authors reported both lower spontaneous and ART-induced PR in patients with residual bowel disease compared to those who had complete disease resection. Additionally, patients who underwent incomplete surgery had longer intervals to conception ($P<0.05$) and lower monthly fecundity rates ($P<0.05$).[8] Similarly, a large retrospective study involving 230 patients with posterior DE compared three groups: complete surgery, incomplete surgery, and no surgery before ART. After logistic regression analysis, the presence of a recto-uterine nodule was associated with a significantly lower chance of pregnancy after IVF.[77]

Other studies have shown no difference in fertility outcomes among patients with DE undergoing postoperative ART, regardless of whether surgery was complete or not. However, these studies included both colorectal and non-colorectal cases and did not specifically analyse fertility outcomes in the subgroup of patients with bowel disease.[31,78,79]

Therefore, for patients with colorectal endometriosis, a complete macroscopic resection should be attempted, as it is associated with better fertility outcomes and pain relief compared to incomplete procedures, especially in patients with multiple DE lesions.[31,80]

However, in selected cases, incomplete resection may be justified (e.g., low rectal lesions, nerve supply involvement) to avoid complications.[31] Centini et al.[31] found no significant impact on fertility outcomes ($P=0.37$) when small retroperitoneal nodules were left in place. Based on these data, the current recommendation is to aim for the complete removal of all macroscopic DE lesions when feasible, maintaining a balance between radical excision and functional preservation.

Other Factors

Other prognostic factors have been inconsistently associated with worse postoperative fertility outcomes in patients with bowel endometriosis, like age over 35 years, higher American Society for Reproductive Medicine (ASRM) scores, and the presence of concomitant adenomyosis.[27,30,42]

The Impact of Bowel Endometriosis Resection on Spontaneous Fertility

To accurately evaluate whether surgery improves fertility in patients with bowel DE, the preferred outcome should be the postoperative SPR. Theoretically, DE excision restores normal anatomy and significantly increases the chance of spontaneous conception,[31,81] enabling patients to avoid ART and minimise associated healthcare costs. However, assessing the impact of bowel DE excision on spontaneous pregnancy is challenging because ART is often indicated immediately after surgery (without allowing time for spontaneous conception to occur). In addition, comparative studies evaluating postoperative spontaneous fertility in patients with DE have not focused on patients with bowel involvement.[21,82]

To date, postoperative spontaneous fertility in patients with colorectal endometriosis wishing to conceive (with or without documented infertility) has been evaluated in four systematic reviews. Iversen et al.[83] reported a 21% SPR among 490 patients from three prospective studies, and 49% SPR from four retrospective studies involving 415 women. Daraï et al.[39] reported a 31.4% SPR among 855 patients wishing to conceive from 24 studies published between 1990 and 2015. Cohen et al.[84] reviewed 1320 patients with bowel DE who underwent surgery. They identified 171 spontaneous pregnancies among 597 women, resulting in a SPR of 28.6%.

Recently, a comprehensive review by Daniilidis et al.[85] estimated a 24.9% postoperative SPR in patients with bowel endometriosis. However, this estimate included two studies focusing solely on ART outcomes (which reported 0% spontaneous pregnancies), making the reported SPR potentially inaccurate.

In our study, spontaneous fertility after bowel surgery for DE was reported in 35 studies published from 2009 to the present, involving 2405 patients with pregnancy intention (with or without infertility diagnosis).[12,13,15,41,43-74] We identified 783 spontaneous pregnancies, resulting in a 32.6% SPR. Most available studies were observational and failed to report how many patients underwent surgery due to pain, infertility, or both. Three RCTs were identified,[41,43,86] though their primary outcomes were not fertility-related.

Selecting Candidates for Attempting Natural Conception After Surgery

Several factors have been associated with a lower postoperative chance of spontaneous pregnancy in patients with bowel DE, emphasising the importance of patient selection in estimating postoperative reproductive success.[87] These factors should always be considered during perioperative counselling.

Preoperative Infertility Diagnosis

Although satisfactory postoperative SPRs are reported in patients with bowel DE wishing to conceive, when only patients with documented infertility are analysed, the estimated SPR is significantly lower. A systematic review by Vercellini et al.,[87] aimed at defining SPR specifically in patients with documented infertility before surgery, reported a mean postoperative SPR of 24% among 510 infertile women with rectovaginal endometriosis from 11 studies. However, this review was not restricted to patients with bowel DE. We identified sixteen studies reporting SPR in patients with colorectal DE according to their preoperative fertility status. Among 824 infertile women undergoing digestive surgery (shaving, disc excision, segmental resection), 190 achieved a spontaneous pregnancy, resulting in an SPR of 23.1% (Table 4). It is important to note that in most studies, limited information is available on the duration of infertility and the coexistence of additional infertility factors other than endometriosis. Indeed, duration of preoperative infertility may be a determining factor of postoperative SPR after colorectal resection for endometriosis.[44]

Age at the Time of Surgery

Patient age has been consistently associated with postoperative SPR in patients with bowel DE. Stepniewska et al.[45] reported a cumulative SPR after laparoscopic segmental resection of 58% for patients younger than 30 years, and 45% for those aged 30-34 years. No pregnancies were achieved in patients older than 35 years. This result aligns with findings from Daraï et al.,[41] who observed no spontaneous pregnancies after colorectal resection in women older than 35 years. Based on these data, IVF may be prioritised for women over 35 years. Since fertility outcomes after IVF in women under 35 years were similar to those of women trying to

conceive naturally,[45] postoperative natural conception should be attempted in young women with normal tubal function and normal semen analysis.

Endometriosis Fertility Index

The Endometriosis Fertility Index (EFI) is a validated tool to predict the likelihood of natural conception after endometriosis surgery.[88] Although the EFI score has been demonstrated to correlate well with the chance of live birth and fertility prognosis after surgical resection of moderate to severe endometriosis (ASRM stage III-IV),[89] it has not been explicitly validated among women with bowel endometriosis. Then, the place of the EFI in the decision-making process after surgery in patients with bowel DE remains to be established.

Fertility Outcomes According to the Surgical Procedure Performed for Bowel Endometriosis

Postoperative SPR after rectal "shaving" has been evaluated in six retrospective studies.[13,46-50] Among 654 women with pregnancy wishes or proven infertility, 295 spontaneous pregnancies were observed, resulting in a 45.1% SPR. The mean time to pregnancy after surgery was reported in two studies[12,51] and varied from 9.4 to 14 months.

Seven studies, including 348 patients desiring pregnancy (with or without documented infertility), specifically reported fertility outcomes after "disc excision" of colorectal endometriosis.[12,50,52-56] In the entire group, 109 spontaneous pregnancies were observed after surgery, resulting in a 31.3% SPR. Time to pregnancy was reported in three studies,[12,52,55] ranging from 5 to 20.6 months.

"Segmental resection" remains the most widely performed procedure for the surgical treatment of colorectal endometriosis. Fertility outcomes were retrieved from eighteen studies,[41,43,44,46,47,50,52,55,57-66] including 675 patients with pregnancy intention in whom segmental resection was the only technique performed to treat colorectal endometriosis. In the entire group, 207 spontaneous pregnancies were observed after surgery, resulting in a 30.7% SPR.

Total pregnancy rates according to the surgical procedure performed for bowel endometriosis.

Seven studies,[13,14,47,52,55,86,90] and one meta-analysis[91] evaluated postoperative PR (both spontaneous and after MAR) by surgical approach among patients with pregnancy intention.

- Lapointe et al.[13] compared fertility outcomes of patients undergoing shaving with those undergoing

Table 4. Postoperative spontaneous conception in infertile women reported in 16 studies with bowel endometriosis who wished to conceive (2009 – present) at the end of follow-up

Author (year) (ref)	Spontaneous pregnancies	Infertile women wishing to conceive	SPR	Mean length of follow-up
Daraï et al. (2011)[41]	3	15	20%	29 months (6-52)
Daraï et al. (2010)[42]	12	39	30.8%	34 months (6-68)
Hezer et al. (2023)[15]	16	60	26.7%	47.2 months
Minelli et al. (2009)[76]	13	113	11.5%	19.6 (6-48)
Meuleman et al. (2011)[61]	8	28	28.6%	27 months (16-40)
Raos et al. (2023)[67]	39	193	20.2%	NR
Hudelist et al. (2023)[52]	15	52	28.8%	42.27±17.59 months
Ferrero et al. (2009)[44]	2	21	9.5%	49.9±21.1 months
Stepniewska et al. (2010)[45]	12	50	24%	19.6 months (6-48)
Hudelist et al. (2018)[55]	26	61	42.6%	NR
Abo et al. (2018)[50]	8	64	12.5%	40 ± 22 months
Neme et al. (2013)[65]	4	6	66.7%	12 months
Jelenc et al. (2012)[72]	8	14	57.1%	NR
Roman et al. (2018)[51]	9	23	39.1%	50-79 months
Dobó et al. (2023)[43]	4	34	11.8%	14 ± 2.6 months
Gordts et al. (2013)[68]	11	51	21.6%	776 ± 465 days
TOTAL	**190**	**824**	**23.1%**	

SPR: Spontaneous pregnancy rate, NR: Not reported.

digestive resection (discoid or segmental). While there was no difference in the overall PR between groups, spontaneous conception was significantly higher in the resection group than in the shaving group (73.6% vs. 33.3%, *P*=0.0086).

- In a prior prospective study, Ballester et al.[14] assessed fertility outcomes after IVF in infertile women following the complete removal of colorectal endometriosis. A decreased CPR was observed for women who required segmental resection compared to those who underwent shaving or disc excision (*P*=0.04). Additionally, all patients who underwent more conservative bowel surgery (n=18) became pregnant after two IVF cycles, suggesting that patients requiring shaving or disc excision may be good candidates for first-intention surgery.
- Conversely, Bourdel et al.[47] reported no differences between groups when comparing shaving to segmental resection in terms of fertility. These findings were corroborated by Roman et al.,[86] who reported similar PR in patients undergoing segmental resection compared to those who underwent shaving or disc excision (*P*=0.99) after a 7-year follow-up.
- In a previous study, Hudelist et al.[55] evaluated fertility results as a secondary outcome among 102 patients who underwent segmental resection and 32 women undergoing disc excision. No differences were found between groups. Similar results were obtained in more recent studies.[52,90]
- In a recent systematic review and meta-analysis including 13 studies and 2131 patients with pregnancy information,[91] colorectal resection was associated with a lower PR compared with the other surgical techniques [35.5% vs. 42.6%, odds ratio (OR): 0.64 (95% confidence interval (CI): 0.52-0.79), *P*<0.001]. There was a similar result when comparing colorectal resection with shaving [n=952, 17.3% vs. 38.8%, OR: 0.51 (95% CI: 0.36-0.73), *P*<0.001] and no differences were found when comparing colorectal resection with disc excision [n=432, 29.2% vs. 35.8%, OR: 0.65 (95% CI: 0.37-1.13), *P*=0.13]. However, when SPR was specifically evaluated, there was no difference between colorectal resection and the other techniques.

Nevertheless, the question of which approach is best for removing bowel DE to improve reproductive outcomes in these women remains difficult to answer. Most of the aforementioned studies used fertility outcome as a secondary result, and the decision to perform one technique over another is largely based on the characteristics of the endometriotic bowel lesions.[1]

Complications After Surgery and Their Impact on Fertility Outcomes

Although surgical resection of bowel endometriosis exposes patients to serious complications, the impact of such complications (Clavien-Dindo III-IV) on fertility outcomes is not well-defined. Kondo et al.[92] evaluated fertility outcomes in 23 patients who experienced major postoperative complications following DE resection. Although the study was not specifically focused on patients with bowel involvement, overall PR was significantly lower among women who experienced intestinal complications, compared with those who presented urinary complications (33.3% vs. 83.3%, *P*=0.04).

Specifically, the reproductive outcome of patients who underwent colorectal surgery for bowel endometriosis and experienced severe complications has been reported in four studies.[12,42,50,67] In a recent study by Raos et al.,[67] 16.6% of patients experienced Clavien-Dindo Grade III complications. Notably, the presence of such complications did not affect the chances of pregnancy, time-to-pregnancy, or LBR. These findings align with previous reports on women who developed severe surgical complications after bowel endometriosis resection.[12,42,50] However, the occurrence of postoperative complications was associated with a longer delay in achieving pregnancy.[12,50]

Ferrier et al.[93] retrospectively analysed reproductive outcomes in 48 patients who experienced major complications (Clavien-Dindo ≥ Grade III) after colorectal surgery for endometriosis. After a median follow-up of 5 years, the CPR was 46%, and the LBR was 29.2%. Although the occurrence of such complications seemed to have little impact on fertility outcomes, a significantly lower CPR was observed in patients who developed septic complications such as deep pelvic abscesses (*P*=0.04) and anastomotic leakage (*P*=0.02). Additionally, the median time between surgery and the first pregnancy was longer than that observed in patients without complications.

Hence, surgery should not be avoided due to the risk of complications affecting pregnancy chances. However, efforts should be made to achieve pregnancy during the first postoperative year. For patients experiencing septic complications, rapid ART may be a good option.

First-line Surgery Followed by Assisted Reproductive Technologies

The potential influence of surgical excision of bowel endometriosis before IVF on fertility outcomes has been evaluated in three studies,[14,26,30] and one systematic review,[94,] providing conflicting results.

Casals et al.[94] reported a benefit of surgery before ART in patients with colorectal endometriosis (OR: 2.43, 95% CI: 1.13-5.52). However, this result was based on a single retrospective study.[30] This study compared the impact of first-line ART versus first-line colorectal surgery followed by ART on fertility outcomes in 110 women with proven infertility and documented bowel DE using propensity score matching analysis to reduce bias. Patients were allocated into two groups: 55 in the first-line IVF arm and 55 in the first-line colorectal surgery arm. The authors reported significantly higher PR (21.8% vs. 49%, *P*=0.003), CPR (56.6% vs. 79.7%, *P*=0.037), and CLBR after 3 IVF cycles (54.9% vs. 70.6%, *P*=0.008) in women who underwent first-line surgery. Additionally, a subgroup of patients with a worse reproductive prognosis (those over 35 years old, with AMH ≥2 ng/mL, and with concomitant adenomyosis) was identified. For patients with at least one negative factor, first-line surgery resulted in significantly higher PR (*P*=0.01). However, no significant differences were found between the two strategies in patients over 35 years or those with adenomyosis.

In a separate analysis from the same cohort (n=60), Ballester et al.[14] reported a 78.1% CPR after 3 IVF cycles. However, a trend toward a decreased CPR was observed for women who received their first IVF cycle more than 18 months following surgery (*P*=0.07). Interestingly, a 44% (4/9 patients) postoperative PR was found after the first IVF cycle in a group of patients with previous IVF failure. Similarly, prior data indicated no benefit after three IVF cycles in patients with *in situ* colorectal endometriosis, reinforcing the indication for colorectal surgery after IVF failure.[28]

A third study,[26] not included in the meta-analysis, was published in 2024. The authors retrospectively compared fertility outcomes in 189 patients with colorectal endometriosis and proven infertility: 120 patients undergoing IVF alone and 69 patients undergoing surgery followed by IVF. Both the CPR and CLBR were similar between the groups.

Ongoing Trials

The ENDOFERT study (NCT0294897) is an open, multicentre, parallel-group, controlled trial aimed to evaluate the impact of complete surgery of colorectal DE on IVF outcomes. Patients are randomised into two groups: one group undergoing complete surgery of colorectal DE before IVF and the other group undergoing IVF alone (ratio 1:1). The Primary outcome will be the occurrence of a clinical pregnancy (6 weeks of gestation with ultrasound confirmation) after 2 IVF cycles.

The TOSCA study (NCT05677269)[95] is a multicentre prospective observational cohort study that will compare surgery (potentially combined with IVF/ICSI) versus IVF/ICSI-only treatment in women with colorectal endometriosis and subfertility, in order to provide evidence on the value of surgery as a fertility-enhancing procedure. The duration of time to allow natural conception will be determined based on the EFI score. The primary outcome will be the cumulative ongoing PR resulting in a live birth, measured by CLBR. The total follow-up time per patient will include 40 months unless the study endpoint is achieved earlier. The endpoint criteria of the study are: 1) live birth or 2) no live birth after 40 months of follow-up despite IVF/ICSI (maximum three cycles), colorectal resection surgery, or a combination of both treatments. The choice between surgery and IVF/ICSI treatment will be determined through shared decision-making while considering the patient's current QoL.

The EFFORT study (NCT 04610710)[96] is a multicentre, parallel-group, controlled trial aimed at determining the CPR and LBR after first-line surgery compared with first-line IVF for women with colorectal endometriosis and pregnancy intention. Patients are randomised 1:1 to either surgical management or IVF (at least two cycles if not pregnant after the first cycle). Women in the surgical intervention group will attempt to get pregnant after surgery, by either spontaneous conception or ART, depending on the EFI score.

Conclusion

Bowel endometriosis-associated infertility remains a complex condition requiring individualised management. Laparoscopic surgical excision can improve fertility outcomes - especially in younger patients, those without adenomyosis, and those with minimal additional infertility factors.

Completeness of resection, surgical expertise, and proper candidate selection are key determinants of reproductive success. However, the evidence base is primarily observational. The benefit of surgery in improving outcomes -especially when performed

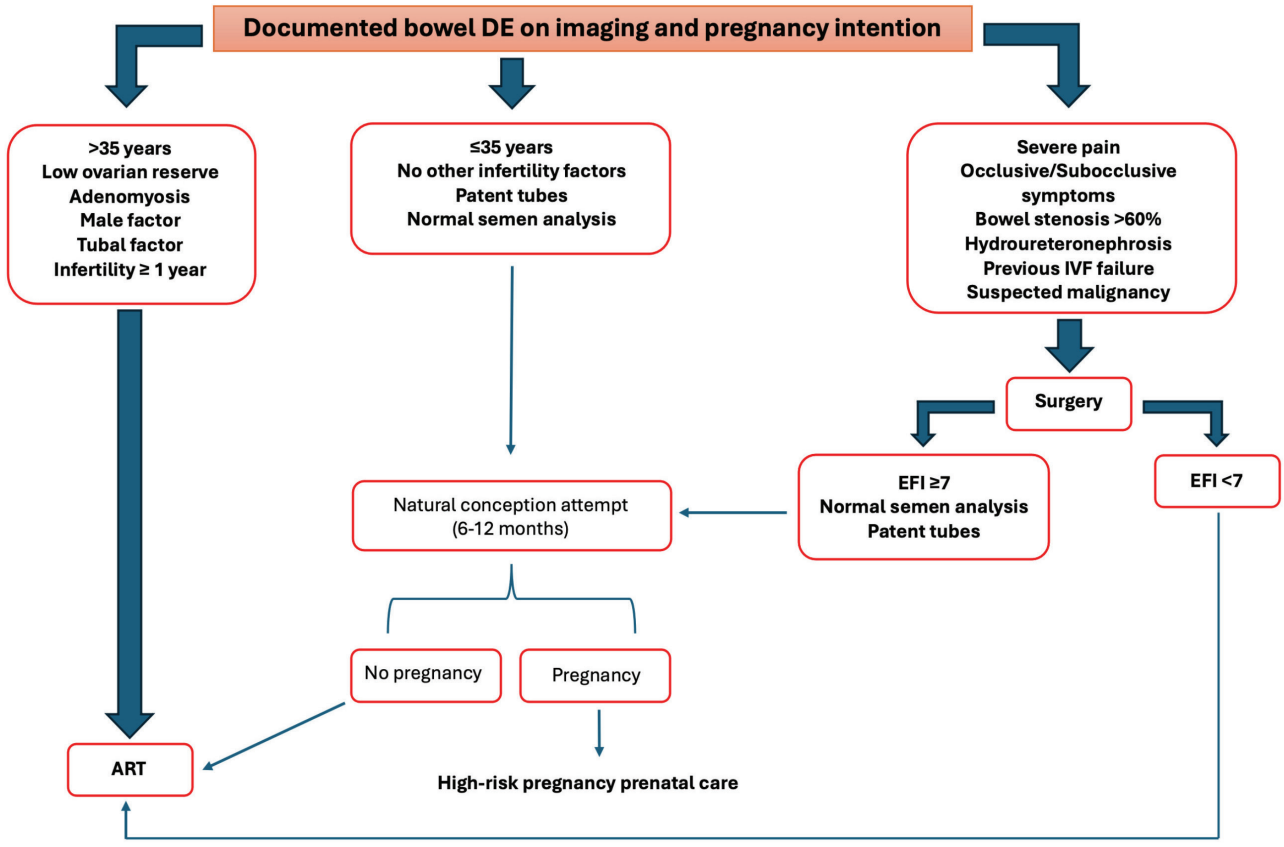

Figure 2. Proposed algorithm for the management of patients with bowel deep endometriosis and pregnancy intention.
DE: Deep endometriosis, ART: Assisted Reproductive Technology, EFI: Endometriosis Fertility Index.

before ART- remains uncertain. In patients with a good reproductive prognosis (age <35, no adenomyosis, patent tubes, normal ovarian reserve), natural conception after surgery is a reasonable goal. Conversely, for older patients or those with diminished ovarian reserve or prior ART failures, IVF should not be delayed (Figure 2).

Surgical complications, though infrequent, may delay conception but do not necessarily reduce LBRs - except in cases of septic events. Notably, the timing between surgery and ART initiation appears to impact outcomes, with earlier treatment yielding better results.

First-line ART remains a viable option in patients without obstructive bowel disease or pain, although fertility outcomes are influenced by adenomyosis and prior surgeries.

Ongoing trials are expected to provide needed clarity. Until randomised trials are published, the choice between surgery-first or ART-first must be guided by shared decision-making, individual clinical profiles, and a balance between fertility goals, surgical risk, and symptom burden.

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Supplementary Table 1. SANRA- quality assessment of the included reviews.

	Importance for readership	Statement of aims or questions	Description of literature search	Referencing	Scientific reasoning	Appropriate presentation of data	Total score
Abrão et al. (2015)[1]	2	2	2	2	2	2	12
Vercellini et al. (2021)[3]	2	2	2	2	2	2	12
Yin et al. (2023)[6]	1	1	0	2	2	2	8
Habib et al. (2020)[7]	2	1	0	2	2	2	9
Barra et al. (2021)[32]	2	1	0	2	1	1	7
Vercellini (2014)[27]	2	2	2	2	2	2	12
Melado et al. (2024)[34]	1	1	0	2	1	1	6
Grigoriadis et al. (2024)[38]	2	2	0	2	2	2	10
Daraï et al. (2017)[39]	2	2	2	2	2	1	11
Cohen et al. (2014)[84]	2	2	2	2	2	2	12
Daniilidis et al. (2022)[85]	2	2	2	2	2	2	12
Vercellini et al. (2012)[87]	2	2	2	2	2	2	12

Supplementary Table 2. Fertility outcomes after primary bowel surgery were reported in 42 studies in patients with colorectal endometriosis (2009-present).

Author (year) (ref)	Study design	Intervention	n	Infertility diagnosis	Women with pregnancy intention	Mean follow-up	SP (SPR)	MAR PR	Total PR (SP+MAR)	Mean time to pregnancy	Live-birth rate	Associated adenomyosis	Complications (Clavien-Dindo ≥ 3)	Prior history of surgery for endometriosis
Kavallaris et al. (2011)[58]	Retrospective	Segmental resection	55 (25 lost to follow-up)	42 (76.4%)	17 (56.7%)	94 months (34-114)	7 (23.3%)	4 (13.3%) (IVF)	36.6%	NR	NR	NR	7.3%	100% (16.4% laparotomy)
Turco et al. (2020)[57]	Retrospective	Segmental resection	50	NR	16 (32%)	42.5 months (12-157)	3 (18.8%)	5 (31.3%) (IVF)	50%	NR	100%	44%	6%	98%
Juhasz-Böss et al. (2010)[75]	Retrospective	Segmental resection	6	6 (100%)	3 (50%)	20 months	NR	1 (33.3%) (IVF)	33.3%	NR	100%	NR	16.7%	0%
Gordts et al. (2013)[68]	Retrospective	Shaving (n=59), disc excision (n=1), no treatment (n=4)	64	51 (79.7%)	51 (79.7%)	776 ± 465 days	11 (21.6%)	NR	NR	NR	100%	NR	1.4%	17.6%
Marty et al. (2017)[46]	Retrospective	Shaving	110	44 (40%)	32 (29.1%)	1 and 3 years	5 (15.7%)	12 (37.5%) (IVF)	53.1%	11.4 ± 7.4 months	NR	NR	6.4%	64.5% (13.6% laparotomy)
Malzoni et al. (2025)[59]	Ambispective	Segmental resection with transanal NOSE	81	38 (46.9%)	26 (32.1%)	21 months (12-29)	5 (19.2%)	4 (15.4%) (IVF)	34.6%	NR	77.8%	14.8%	3.7%	45.7%

Supplementary Table 2. Continued.

Author (year) (ref)	Study design	Intervention	n	Infertility diagnosis	Women with pregnancy intention	Mean follow-up	SP (SPR)	MAR PR	Total PR (SP+MAR)	Mean time to pregnancy	Live-birth rate	Associated adenomyosis	Complications (Clavien-Dindo ≥ 3)	Prior history of surgery for endometriosis
Dobó et al. (2023)[43]	Randomized	Segmental resection with transanal NOSE (n=42), conventional laparoscopic segmental resection (n=49)	91	34 (37.4%)	34 (37.4%)	14 ± 2.6 months	4 (11.8%)	18 (52.9%)	64.7%	NR	63.6%	NR	2.2%	68.1%
Wills et al. (2017)[69]	Retrospective	Segmental resection (n=136), disc excision (n=146), other (n=25)	307	107 (34.9%)	122 (39.7)	NR	28 (22.9%)	39 (32%)	54.9%	NR	NR	NR	11.4%	NR
Bafort et al. (2020)[70]	Retrospective	Segmental resection (n=171), shaving (n=33), disc excision (n=28)	232	203 (87.5%)	152 (65.5%) (9 missed data)	41.2 ± 29 months	26 (18.2%)	70 (49%)	67.1%	NR	NR	NR	9.9%	53.4%
Bendifallah et al. (2017)[30]	Retrospective (propensity score matching analysis)	Shaving, disc excision, segmental resection (n=NR)	55	55 (100%)	55 (100%)	NR	-	27 (49%) (IVF)	NR	NR	CLBR 70.6% after 3 cycles	45.5%	NR	58.2%
Hudelist et al. (2023)[52]	Prospective	Segmental resection (n=125), disch Disc excision (n=37)	162 (20 lost to follow-up)	52 (43%)	52 (43%)	42.27 months (±17.59)	15 (28.8%)	15 (28.8%) (IVF)	57.7%	10 months (3-24)	63.3%	52%	4.3%	NR
Rubod et al. (2024)[26]	Retrospective	Shaving (n=18), segmental resection (n=48), disc excision (n=3)	69	69 (100%)	69 (100%)	NR	-	58% CPR after 4 IVF cycles	NR	NR	CLBR 52.2%	37.7%	8.7%	0%
Lapointe et al. (2022)[13]	Retrospective	Shaving (n=55), resection (disc or segmental) (n=39)	94	37 (39.4%)	94 (100%)	24 months	24 (25.5%)	25 (26.6%) (IVF)	52.1%	15.8 months	NR	6.4%	4.3%	55.3%
Bourdel et al. (2018)[47]	Retrospective	Shaving (n=172), segmental resection (n=23)	195	89 (45.6%)	138 (70.8%)	60 ± 42 months	51 (37%)	49 (35.5%) (IVF/IUI)	72.5%	13 ± 12 months	83%	NR	6.7%	29.7% (2.6% laparotomy)

Supplementary Table 2. Continued.

Author (year) (ref)	Study design	Intervention	n	Infertility diagnosis	Women with pregnancy intention	Mean follow-up	SP (SPR)	MAR PR	Total PR (SP+MAR)	Mean time to pregnancy	Live-birth rate	Associated adenomyosis	Complications (Clavien-Dindo ≥ 3)	Prior history of surgery for endometriosis
Dabi et al. (2024)[12]	Retrospective	Disc excision	49	28 (57.1%)	49 (100%)	15 months (1-57)	15 (30.6%)	10 (20.4%) (IVF)	51%	NR	75%	NR	2%	38.8%
Stepniewska et al. (2010)[45]	Retrospective	Segmental resection (n=60) Ileal resection (n=2)	62	62 (100%)	50 (80.6%)	19.6 months (6-48)	12 (24%)	5 (10%) (IVF/IUI)	34%	NR	94%	20%	8%	63%
Hezer et al. (2023)[15]	Retrospective	Shaving (n=25) Disc excision (n=1) Segmental resection (n=53)	77	60 (77.9%)	77 (100%)	47.2 months	26 (33.8%)	22 (28.6%) (IVF)	62.3%	8.4 months (1.48-61)	89.1%	26.7%	6.5%	37.7%
Raos et al. (2023)[67]	Retrospective	Disc excision (n=44) Segmental resection (n=149)	193	193 (100%)	193 (100%)	NR	39 (20.2%)	78 (40.4%) (IVF/IUI)	60.6%	12.2 months (0.4-58)	53.9%	14.5%	16.6%	38.9%
Meuleman et al. (2014)[60]	Prospective	Segmental resection	76	NR	54 (71%)	20 months (1-45)	18 (33%)	30 (55.6%) (IVF/IUI)	88.9%	NR	NR	NR	2%	NR
Ferrero et al. (2009)[44]	Prospective	Segmental resection (laparoscopy n=33, laparotomy n=13)	46	21 (45.7%)	46 (100%)	49.9 ± 24.1 months	9 (19.6%)	13 (28.3%) (IVF/IUI)	47.8%	12.5 months (6-46)	86.4%	17.4%	8.7%	63%
Millochau et al. (2018)[71]	Retrospective	Multiple bowel nodules removal (disc excision + segmental resection)	21	11 (52.4%)	9 (42.9%)	30 ± 25.4 months	2 (22.2%)	4 (44.4%) (IVF)	66.6%	NR	83%	NR	28%	66.7% (4.8% laparotomy)
Darai et al. (2011)[41]	Randomized	Segmental resection (laparoscopy n=26, laparotomy n=26)	52	23 (44.2%)	28 (53.8%)	29 months (6-52)	6 (21.4%)	5 (17.9%) (IVF)	39.3%	14 months (1-24)	NR	NR	11.5%	67.3%
Roman et al. (2018)[51]	Randomized	Shaving (n=3), Disc excision (n=11), Segmental resection (n=22)	36	23 (63.9%)	36 (100%)	50-79 months	17 (47.2%)	12 (33.3%) (IVF/IUI)	80.6%	NR	NR	NR	NR	25%

Supplementary Table 2. Continued.

Author (year) (ref)	Study design	Intervention	n	Infertility diagnosis	Women with pregnancy intention	Mean follow-up	SP (SPR)	MAR PR	Total PR (SP+MAR)	Mean time to pregnancy	Live-birth rate	Associated adenomyosis	Complications (Clavien-Dindo ≥ 3)	Prior history of surgery for endometriosis
Meuleman et al. (2011)[61]	Retrospective	Segmental resection	45	40 (88.9%)	28 (62.2%)	27 months (16-40)	8 (28.6%)	5 (17.8%) (IVF)	46.4%	NR	NR	NR	0%	87%
Malzoni et al. (2016)[62]	Retrospective	Segmental resection	248 (56 excluded from follow-up)	72 (29%)	72 (29%)	12 months	44 (61.1%)	6 (8.3%) (IVF)	69.4%	8.4 ± 4.1 months	48%	NR	8.1%	84%
Roman et al. (2015)[53]	Prospective	Disc excision	50	19 (38%)	20 (40%)	NR	10 (50%)	6 (30%) (IVF/ IUI)	80%	NR	60%	NR	26%	NR
Jelenc et al. (2012)[72]	Retrospective	Segmental resection (n=52) Disc excision (n=4)	56	14 (25%)	14 (25%)	NR	8 (57.1%)	2 (14.3%) (IVF)	71.4%	NR	64.3%	NR	11.5%	NR
Meuleman et al. (2009)[63]	Retrospective	Segmental resection	56	49 (87.5%)	33 (59%)	29 months (6-76)	7 (21.2%)	9 (27.3%) (IVF/ IUI)	48.5%	NR	NR	NR	11%	75%
Donnez et al. (2010)[48]	Prospective	Shaving	500	324 (64.8%)	388 (78%)	3.1 years (2-6)	221 (57%)	107 (27.5%) (IVF)	84.5%	NR	NR	NR	3%	NR
Minelli et al. (2009)[76]	Retrospective	Segmental resection	357 (71 lost to follow-up)	129 (36.1%)	113 (31.7%)	19.6 months (6-48)	NR	NR	41.6%	NR	NR	NR	9.8%	36.7%
Roman et al. (2016)[49]	Retrospective	Shaving	122 (4 lost to follow-up)	40 (32.8%)	26 (38.2%)	36 months (12-60)	10 (38.5%)	7 (26.9%) (IVF/ IUI)	65.4%	NR	NR	NR	9%	NR
Koh et al. (2012)[73]	Retrospective	Segmental resection (n=26), Disc excision (n=66)	92	30 (38%)	28 (30.4%)	16 months (0.5-116)	8 (26.6%)	5 (16.7%) (IVF)	43.3%	NR	NR	NR	1.1%	80.2% (2.2% laparotomy)

Supplementary Table 2. Continued.

Author (year) (ref)	Study design	Intervention	n	Infertility diagnosis	Women with pregnancy intention	Mean follow-up	SP (SPR)	MAR PR	Total PR (SP+MAR)	Mean time to pregnancy	Live-birth rate	Associated adenomyosis	Complications (Clavien-Dindo ≥ 3)	Prior history of surgery for endometriosis
Fanfani et al. (2010)[54]	Case-control	Disc excision (n=48)	48 (12 lost to follow-up)	22 (45.8%)	NR	33 months (16-46)	6 (27.3%)	NR	NR	NR	NR	NR	4.4%	41.6%
Darai et al. (2010)[42]	Prospective	Segmental resection	83	39 (47%)	55 (66.2%)	34 months (6-68)	NR	NR	43.6%	11 months (2-68)	NR	20%	12%	54.2%
Ballester et al. (2017)[14]	Prospective	Shaving (n=15), Disc excision (n=3), Segmental resection (n=42)	60	60 (100%)	60 (100%)	NR	–	36 (60%) (IVF) 78.1% CPR after 3 cycles	NR	NR	NR	43.5%	NR	45%
Hudelist et al. (2018)[55]	Prospective	Segmental resection (n=102), Disc excision (n=32)	134 (22 lost to follow-up)	72 (53.7%)	73 (54.5%)	36.5 ± 21.9 months	30 (41.1%)	16 (21.9%) (IVF)	63%	7 months (2-51)	46.6%	47%	5.9%	31.3%
Parra et al. (2021)[74]	Retrospective	Segmental resection (n=36), Disc excision (n=23), Shaving (n=18)	77	47 (61%)	45 (58%)	27.6 months (6-78)	10 (22.2%)	12 (26.7%) (IVF/ IUI)	48.9%	NR	NR	19.5%	NR	45.5%
Ceccaroni et al. (2021)[56]	Retrospective	Disc excision	371 (9 lost to follow-up)	207 (55.8%)	232 (64.1%)	60 months (1-168)	67 (28.9%)	31 (13.4%) (IVF)	42.2%	NR	NR	NR	20.8%	40.4%
Rocha et al. (2018)[64]	Prospective	Segmental resection	46	21 (45.6%)	26 (56.5%)	28.4 months	7 (26.9%)	8 (30.8%) (IVF)	57.6%	NR	NR	NR	8.7%	NR

Supplementary Table 2. Continued.

Author (year) (ref)	Study design	Intervention	n	Infertility diagnosis	Women with pregnancy intention	Mean follow-up	SP (SPR)	MAR PR	Total PR (SP+MAR)	Mean time to pregnancy	Live-birth rate	Associated adenomyosis	Complications (Clavien-Dindo ≥ 3)	Prior history of surgery for endometriosis
Abo et al. (2018)[50]	Retrospective	Segmental resection (n=139), Disc excision (n=80), Shaving (n=145)	364	128 (35.2%) (35 lost to follow-up)	64 (17.6%)	40 ± 22 months	8 (12.5%)	16 (25%) (IVF)	37.5%	NR	31.3%	NR	14.8%	NR
Neme et al. (2013)[65]	Retrospective	Segmental resection	10	6 (60%)	6 (60%)	12 months	4 (66.7%)	2 (33.3%) (IVF)	100%	NR	NR	NR	0%	NR
Tuominen et al. (2021)[66]	Retrospective	Segmental resection	132	NR	74 (56.1%)	4.9 ± 3.5 years	18 (24.3%)	38 (51.4%) (IVF/ IUI)	75.7%	2.6 years	66.2%	NR	17.5%	43.2%

CPR: Cumulative pregnancy rate, CLBR: Cumulative live birth rate, IUI: Intrauterine insemination, IVF: In vitro fertilisation, ICSI: Intracytoplasmic sperm injection, ART: Assisted reproductive technology, SP: Spontaneous pregnancy, SPR: Spontaneous pregnancy rate, MAR: Medically assisted reproduction, NOSE: Natural orifice specimen extraction, NR: Not reported.

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A European Society for Gynaecological Endoscopy survey of hysteroscopic practice

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ABSTRACT

Background: Hysteroscopy is recognised as the gold standard for diagnosing and treating intrauterine pathologies. Despite its broad acceptance, management practices appear to be diverse.

Objectives: To explore gynaecologists' approaches to managing intrauterine pathologies, assessing their diagnostic habits, therapeutic strategies, and the surgical techniques adopted in clinical practice.

Methods: The project was undertaken by the European Society for Gynaecological Endoscopy (ESGE) Special Interest Group on hysteroscopy. All ESGE members were invited to participate in the study through an online questionnaire hosted on the SurveyMonkey platform.

Main Outcome Measures: Procedural setting, equipment availability, preferred instruments, pain management, and satisfaction with hysteroscopic practices.

Results: Four hundred and fifty-one of 4000 (11.25%) gynaecologists from 57 countries responded. Two hundred eighty one (74%) of the participants performed hysteroscopy using a vaginoscopic approach. Pain management practices varied, with 46% of respondents reporting minimal or no use of analgesics. Procedural settings were distributed across office-based environments 107 (23.7%), outpatient facilities 183 (40.6%), and operating rooms 161 (35.6%). Two hundred and ninety-nine (87.9%) of respondents reported that diagnostic facilities were well-equipped, and 282 (74.4%) expressed satisfaction with the available operative equipment. Polypectomy was the most frequently performed operative procedure.

Conclusions: The observed variability in the practice of hysteroscopy among ESGE members highlights the need for standardised guidelines to improve consistency and patient outcomes.

What is New? This survey provides an overview of the hysteroscopic management of intrauterine pathologies among ESGE members.

Keywords: Hysteroscopy, outpatient, intrauterine pathologies, polyp, survey

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Introduction

Hysteroscopy is a minimally invasive procedure for examining the uterine cavity and cervical canal and is considered the gold standard for diagnosing and treating intrauterine and intracervical pathologies. It can be performed safely in an outpatient or office setting without general anaesthesia.[1] Hysteroscopy has gained popularity due to its effectiveness, convenience, and reduced recovery time.[2-4]

The concept of "see-and-treat hysteroscopy" refers to performing operative procedures immediately at the time of hysteroscopic diagnosis, rather than scheduling them for a later date.[2,5] This approach allows for a more efficient single-session management of intrauterine pathologies. In addition, the simultaneous use of ultrasound and hysteroscopy has been proposed to enable a "one-stop" diagnostic and therapeutic pathway, which has been implemented in so-called Digital Hysteroscopic Clinics.[2]

Hysteroscopy is generally safe but carries risks such as infection, uterine perforation, bleeding, and pain. Pain levels can vary, making it important to anticipate and apply appropriate pain management strategies. An international consensus that involved the European Society for Gynaecological Endoscopy (ESGE) refers to five hierarchical levels of pain management. Level 1 represents no medication or use of non-sedative oral medication and can include adjuncts such as verbal reassurance, music during procedure and virtual reality prior or during the procedure.[6-8] Level 2 is local anaesthetic to the genital tract. Level 3 is conscious sedation (3a are oral or inhalational medication with sedative effect, 3b are parenteral medication with sedative effect). Level 4 is regional anaesthesia and level 5 general anaesthesia.[1]

For outpatient hysteroscopy, oral non-steroidal anti-inflammatory drugs administered one hour before the procedure is recommended, as they significantly reduce intra- and post-procedural pain. Alternative strategies such as opioids, antispasmodics, transcutaneous electrical nerve stimulation, or inhaled nitrous oxide may also be considered in selected patients.[9-11] Ongoing advancements in hysteroscopic technologies and techniques have expanded the application and safety of outpatient hysteroscopy. Innovations, including smaller instruments and improved imaging can reduce patient discomfort and enhance diagnostic and therapeutic accuracy.[12] Outpatient hysteroscopy through vaginoscopic approach is feasible and better-tolerated, especially in patients with no previous vaginal sexual intercourse.[7,8,13]

Despite its widespread acceptance and recent publication of evidence-based guidance, a range of diagnostic and therapeutic approaches appear to be employed globally.[3,9] We therefore designed a survey to better understand the habits of ESGE member gynaecologists in managing intrauterine pathologies, as well as their familiarity with the available surgical techniques.

Methods

The project received formal approval from the Executive Board of the ESGE. All ESGE members were invited to participate from October 2023 until March 2024. Invitation letters were disseminated to 4000 ESGE members via email, inviting them to participate in the online platform SurveyMonkey (www.surveymonkey.com). The questionnaire included multiple-choice questions covering various aspects, including the background of the procedure, preparation, diagnostic and operative hysteroscopy, pain management, patient feedback, and participant satisfaction with the available equipment. Some questions allowed multiple responses and open specification when applicable. Response options for pain management, healthcare settings, and models of care were standardised according to the international consensus terminology.

The survey questionnaire can be found in the Supplementary Figure 1. No financial incentives were offered to survey participants.

Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics software (version 25.0, IBM Corp., Armonk, NY, USA). Descriptive statistics were applied to summarize the data, including frequencies and percentages for categorical variables. For items with missing responses, percentages were calculated using the number of respondents who answered the specific question as the denominator rather than the total study population. Continuous variables were expressed as means with standard deviations where appropriate. No inferential statistical tests were conducted, as the primary objective of the study was to provide a descriptive overview of current hysteroscopic practices across ESGE members.

Results

A total of 451 people responded to the survey from 57 different countries (Supplementary Figure 2), including

different continents: Europe, North America, South America, Africa and Asia. This equated to a response rate of 11.25%. 379 respondents from 451 (84%) answered questions regarding their hysteroscopic pre-procedure and procedure practice.

Pre-procedure

Two hundred and fifty-four (67%) respondents offered patient information leaflets, and 347 (91.6%) participants obtained written consent. A minority of respondents, 106 (28%), routinely performed pregnancy tests before procedures in women of reproductive age. Eighty-five (22.4%) respondents reported routinely administering antibiotics perioperatively and 62 (16.4%) respondents used postoperative antibiotic prophylaxis. Pharmacological cervical preparation was offered prior to the procedure by 94 (24.8%) respondents. Two hundred twelve participants (55.9%) provided a standardised report of the procedure with images.

Procedure

Hysteroscopic procedures were performed using a vaginoscopic approach in 281 cases (74%) and approach with speculum in 98 cases (26%). Three hundred forty one (90%) reported that a nurse was always present during the procedure. Ninety (23.7%) respondents reported performing procedures in an office setting, 154 (40.6%) in an outpatient clinic, and 135 (35.6%) in an operating room. Thirty five participants (9.2%) mostly followed an "office" model of care, 245 (64.6%) an "outpatient or ambulatory" model, 35 (9.2%) an "extended recovery" regimen and 64 (16.9%) an "inpatient" model. One hundred sixty seven (44.1%) respondents had access to digital hysteroscopy clinics where the simultaneous use of ultrasound and hysteroscopy was available. Two hundred and ninety-nine (78.9%) respondents were satisfied with the quality of endoscopic imaging technology and 333 (87.9%) reported adequately equipped facilities to perform diagnostic procedures and 282 (74.4%) for operative procedures.

Pain Management

The overall pain control measures are shown in Table 1. For polypectomy, 317 respondents answered the question on pain management with 429 responses provided. Among these, 141 (44.5%) respondents reported not using any medication, 50 (15.7%) used local anaesthesia of the genital tract, 44 (13.9%) used oral or inhalational medications with a sedative effect, 67 (21.1%) used parenteral medications with a sedative effect, 48 (15.1%) used regional anaesthesia, and 79 (24.9%) used general anaesthesia. For myomectomy, 306 gynaecologists responded, yielding a total of 420 responses. Of these, 59 (19.3%) reported using oral non-sedative medication or no medication at all, 38 (12.4%) used local anaesthesia of the genital tract, 43 (14.1%) used oral or inhalational medications with a sedative effect, 68 (22.2%) used parenteral medications with a sedative effect, 83 (27.1%) used regional anaesthesia, and 129 (42.1%) used general anaesthesia.

Diagnostic Hysteroscopy

For diagnostic procedures, 173 (41.7%) hysteroscopists responded to the question regarding the type of the hysteroscope. Of those, 162 of surgeons (93.6%) adopted rigid hysteroscopes, while the remaining 11 (6.4%) used flexible instruments. Among 357 (79.3%) respondents, the most frequent choice of hysteroscope diameter was 4 or 5 mm, used by 175 (49%) surgeons. One hundred twenty three (34.5%) used hysteroscopes thinner than 4 mm and 59 (16.5%) wider than 5 mm. Regarding the optic degree, among 254 respondents (56.3%), 217 of participants (85.4%) used 30° optic, while the rest 37 (14.6%) used 0°optic. Vast majority of 317 (70.3%) respondents, 308 (97.2%), used saline solution as distention medium. Seven (2.2%) used Sorbitol-Mannitol and only 2 respondents (0.6%) used CO_2.

Operative Hysteroscopy

Among 379 respondents (84%), operative hysteroscopy was most often, in 243 surgeons (54.1%) performed in office setting, 76 surgeons (20,1%) offered outpatient setting, while 90 surgeons (23.7%) usually hospitalized their patients. Remaining 8 (2.1%) offered extended recovery setting. As in diagnostic hysteroscopy, among 317 respondents (70.3%), 270 participants (85.2%) used saline solution as distension medium. Forty-six used Sorbitol-Mannitol (14.5%) and 1 used carbon dioxide (0.3%).

Hysteroscopic polypectomy was the most common procedure. Prior to performing polypectomy, 45 (14.2%) participants reported using hormonal therapy to prepare the endometrium. One hundred thirteen participants (35.6 %) performed fewer than 50 polypectomies annually, 104 (32.8%) 50 to 100, 56 (17.7%) 100 to 200 and 44 (13.9%) performed more than 200 polypectomies per year. The preferred instrument for polypectomy was a 4-5 mm hysteroscope with 5 Fr instrument used by 224 (43.2%) of 317 participants that responded (70.3%) to

Table 1. Levels of pain management.

What is the predominant pain management in your hysteroscopic facility?	n	Percentage (%)
Level 1: No medication or use of oral non-sedative medication	145	46
Level 2: Local anaesthetic to the genital tract	31	10
Level 3a: Oral or inhalational medication with sedative effect	20	6
Level 3b: Parenteral medication with a sedative effect	44	14
Level 4: Regional anaesthesia	26	8
Level 5: General anaesthesia	51	16
Total	317	100

the question about polypectomies with 519 responses provided (Figure 1).

Three hundred seventy of 451 participants (70.3%) responded to questions about myomectomies, yielding a total of 491 responses. Of those 45 (14.2%) respondents gave hormonal preparation before a myomectomy procedure. One hundred and forty-five (45.7%) participants performed less than 20 myomectomies per year, 113 (35.6%) performed 20 to 50, 47 (14.8%) 50 to 100 and 12 (3.8%) more than 100 myomectomies yearly. 26 Fr bipolar resectoscopes was the preferred technology (198, 40.3%) amongst respondents (Figure 2).

Fifty three (16.7%) respondents used anti-adhesive gel and 44 (13.9%) placed an intrauterine device after myomectomy. Eighty four (26.5%) respondents gave postoperative oestrogen therapy. One hundred ninety eight (62.5%) of responders performed ultrasonographic evaluation after the procedure. One hundred fifty seven (49.5%) participants reported performing a hysteroscopic control a few months after the index procedure, usually within 3 months later (Figure 3). In case of potential residual fibroid, 62 (19.6%) reported directly performing a second surgical step with 155 (48.9%) reporting treatment in an office setting if the residual fibroid is <1 cm in size. One hundred (31.5%) respondents reported never removing residual fibroid tissue in an office setting.

Three hundred and eighty-one responses were provided by 317 (70.3%) respondents of those 272 (85.8%) respondents reported treating fewer than 20 cervical niche cases per year, 37 (11.7%) 20 to 50, seven (2.2%) 50 to 100 cases and one surgeon (0.3%) reported more

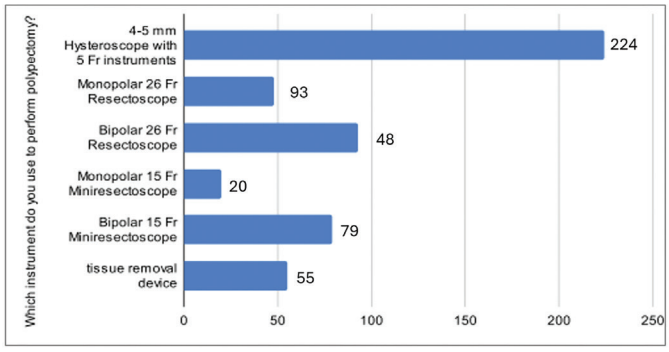

Figure 1. Instruments used to perform polypectomy (n=519 responses).

Note: Multiple responses allowed.

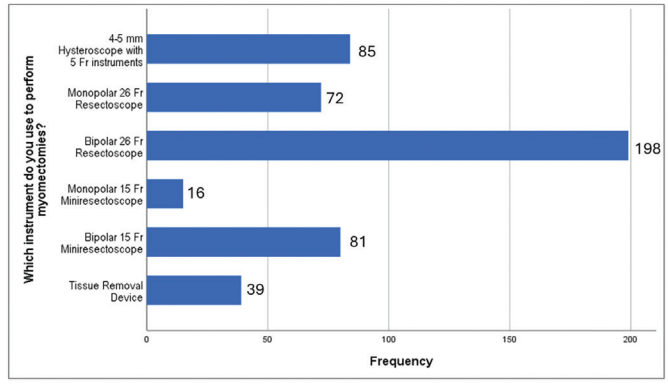

Figure 2. Instruments used to perform myomectomy (n=491 responses).

Note: Multiple responses allowed.

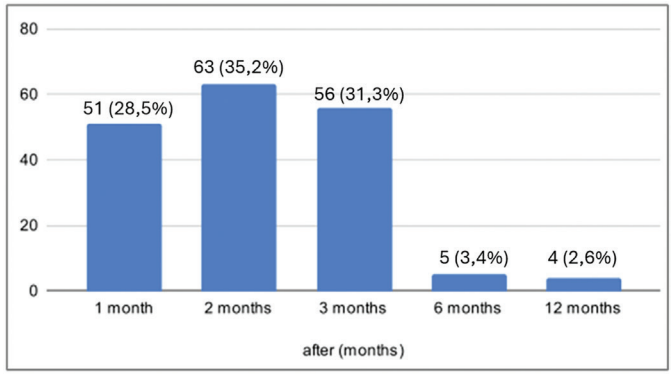

Figure 3. Time of hysteroscopic control after the myomectomy (n=179 responses).

Note: Multiple responses allowed.

than 100 cases treated per year (Figure 4). Of 317 (70.3%) respondents, 203 (64.0%) surgeons treated fewer than 10 uterine malformation cases per year, 62 (19.6%) 10 to 20 cases, 32 (10.1%) 20 to 50 cases and 20 (6.3%) more than 50 cases yearly, yielding a total of 424 answers (Figure 5). Among 371 respondents (70.3%), most reported use a 4-5 mm hysteroscopes (166; 39.2%), followed by 26 Fr bipolar resectoscopes (98; 23.1%), providing 424 responses (Figure 5). Among the less frequent hysteroscopic procedures was the treatment of Asherman's syndrome: 92 (29.0%) respondents did not have any cases, while 117 (36.9%) treated 1 to 2 cases per year, 60 (18.9%) two to five cases and 48 (15.1%) more than five cases annually.

In the case of the conservative treatment of endometrial cancer, 276 (87.1%) respondents performed fewer than five conservative treatments for endometrial cancer per year, 22 (6.9%) five to 10, seven (2.2%) 10 to 20 and 12 (3.8%) reported undertaking more than 20 procedures per year.

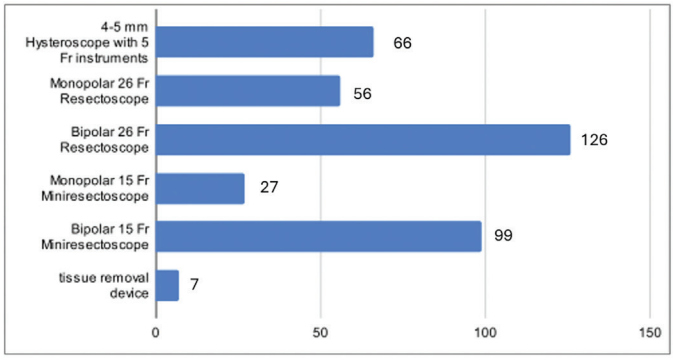

Figure 4. Instruments used to treat cervical niche (n=381 responses).

Note: Multiple responses allowed.

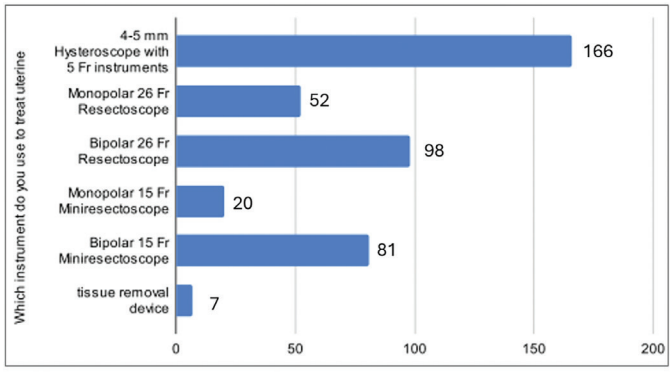

Figure 5. Instruments used to treat uterine malformations (n=424 responses).

Note: Multiple responses allowed.

Quality Assurance

Of 313 (69.4%) respondents, 220 (70.3%) participants reported routinely collecting post-procedure patient feedback and 182 (58.1%) had a reporting system for complications. One hundred fifty two (48.6%) respondents reported producing a routine annual report.

Discussion

The results of this ESGE survey provide a comprehensive look into the different practices and challenges associated with hysteroscopic procedures worldwide. The diversity in responses reflects not only the flexibility of hysteroscopy as a minimally invasive procedure but also the influence of regional differences in healthcare resources, national health system funding, and patient demographics. Additionally, differences in practitioner training and the availability and accessibility of advanced training programs may contribute to the observed variations in survey responses.

The survey highlights significant trends in procedural approaches, equipment usage, and patient management, offering a detailed snapshot of how hysteroscopy is performed differently worldwide. The data shows that while there is a consensus on certain practices, such as the preference for saline solution as a distention medium and the widespread use of rigid hysteroscopes, there is also considerable variability in other aspects, such as pain management and postoperative care.

Main Findings

This survey highlights the varied practices among the ESGE members in the hysteroscopic management of intrauterine pathologies. The survey identified significant variability in the settings where hysteroscopic procedures are performed, ranging from office environments to fully equipped operating rooms. The fact that 40% of respondents conduct procedures in outpatient settings points to a growing trend to provide convenient and efficient diagnosis and treatment with minimal disruption to women's daily lives. However, the continued use of operating rooms by over a third of respondents indicates that for more complex or higher-risk procedures, the controlled operating room environment, allowing provision of anaesthesia and access to advanced surgical resources is still deemed necessary.

Clinicians reported being well-equipped for diagnostic procedures, but a quarter were not satisfied with the equipment available to them for operative procedures,

reflecting the greater resources and infrastructure needed for operative hysteroscopy. However, less than half of respondents reported integrating ultrasound with hysteroscopy.[2] Such a combined approach may enhance both the precision and effectiveness of hysteroscopy, especially for complex cases. Greater access to ultrasound at the time of hysteroscopic procedures has the potential to enhance the quality of care provided and improve patient outcomes.

Polypectomy was the most performed operative procedure, followed by hysteroscopic myomectomy. Small diameter hysteroscopes (4-5 mm), which are associated with less pain and fewer complications, were most used reflecting a trend towards minimally invasive techniques that prioritise patient safety and comfort. A previous study showed that the use of the 4-5 mm hysteroscope is safer than the 26 Fr resectoscope.[14] Despite this, the 26 Fr resectoscope was the second most used instrument. Insertion requires cervical dilation and level 3a and higher pain control (i.e., sedation, regional or general anaesthesia) and increases the risk of uterine perforations. It was surprising the relative infrequency of use of tissue removal systems for removing polyps. High-quality evidence shows these technologies to be superior to conventional electrosurgical approaches, especially in an outpatient setting.[15-17] Wider adoption of small diameter hysteroscopic tissue removal systems should be encouraged across Europe.

Regarding myomectomy, a 26 Fr resectoscope is most used for removing submucosal fibroids. However, the introduction of smaller devices like the 15 Fr mini-resectoscope and hysteroscopic tissue removal systems were also adopted offering less dilation and, potentially, fewer complications such as cervical injury.[18] For uterine malformations, the most often popular instrument was the 4-5mm hysteroscope, followed by the 26 Fr resectoscope. Previous studies have shown that the 15 Fr mini-resectoscope reduce need for cervical dilation and anaesthesia, reducing cervical trauma, make it a compelling alternative to the larger resectoscope.[19]

Of note, for all operative procedures where energy was used, bipolar systems were more popular but monopolar systems are still widely used. Bipolar systems are safer with significant decrease in hyponatraemia from fluid overload and associated with reduced operative times and post-operative hospital stay. Thus, bipolar energy is recommended in preference to monopolar energy.[20,21]

Clinical and Policy Implications

The variability in procedural settings and pain management practices suggests that there is no one-size-fits-all approach to the setting and model of care for hysteroscopy. However, to improve the quality and range of care patients can receive necessitates greater standardisation of practice where evidence exists. Understanding the variation in practice is the first step to develop policies to provide more consistency in access to care and clinical outcomes. Such strategies should be multifactorial encompassing research, guideline development prioritisation of funding and provision of equipment. In addition, education and training are of key importance. For example, the ESGE's structured educational initiatives, particularly the Gynaecological Endoscopic Surgical Education and Assessment programme, which over the past 12 years has provided standardised training and assessment in minimally invasive gynaecological surgery are innovations that can develop clinicians' skills and ensure hysteroscopy is more widely adopted as the preferred approach for managing intrauterine pathologies.

Strengths and Limitations

The survey provides a snapshot of hysteroscopic practice for intrauterine pathologies from over 50 European countries. However, whilst the results appear to be generalisable across Europe geographically, the external validity is restricted because of the low, overall response rate; only 11.3% response rate from ESGE members. The reliance on self-reported data may introduce reporting bias, with participants may overestimate or exaggerate their adherence to best practices. As a result, the findings may not accurately reflect real-life practice. Validity may have been further compromised by deficiencies in the design of the survey: Responses to individual questions were not mandatory, resulting in variable numbers of participants responding to questions. Some questions only allowed to one response where multiple responses would have better reflected an individuals practice e.g., many hysteroscopists perform procedures in more than one setting or use more than one technology according to their preferences, case complexity and pathology characteristics. Questions pertaining to the annual number of procedures did not include the response of "zero", a limitation that could have influenced the reported frequency of less common procedures, such as the conservative management of endometrial cancer. Finally, retained pregnancy tissue is increasingly being

removed using hysteroscopic systems but an opportunity to enquire about current practices for treating this type of acquired intrauterine pathology was overlooked.[22]

Conclusion

Our survey highlights several key areas for future research and development. There is a clear need for more robust, standardised guidelines that can help harmonise practices across different regions and healthcare settings. These guidelines should address the disparities in pain management, the use of postoperative care measures, and the integration of advanced imaging technologies. Future research should also investigate barriers to the broader adoption of newer mini-invasive hysteroscopic instruments and technologies to facilitate their integration into routine practice. Additionally, further studies should focus on the barriers to adopting best practices, particularly in low-resource settings, and explore ways to overcome these challenges through targeted training and resource allocation.

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Informed consent: Completion of the survey implied informed consent.

Data sharing: The datasets generated and analysed during the current study are available from the corresponding author upon reasonable request.

Transparency: This manuscript is an honest, accurate, and transparent account of the study. No important aspects have been omitted, and any discrepancies from the original study plan have been explained.

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Supplementary Figure 1. Survey.

PART 1. General characteristics (personal information)
1. Country of practice (Countries list)

2. Practice type
- Public non-academic
- Public academic
- Private
- Others

3. How many diagnostic hysteroscopies do you perform/year?
- < 100
- 100-250
- 250-500
- > 500

4. How many operative hysteroscopies do you perform/year?
- < 100
- 100-250
- 250-500
- > 500

5. Is Hysteroscopy your preferred activity (more than 50% of activity)?
- Yes
- No

6. Did you have a specific training in hysteroscopic surgery?
- Yes
- No

PART 2. Facility and General Characteristic of Hysteroscopic Procedures

7. What is the pain management (according to the "International Consensus Statement for Recommended Terminology Describing Hysteroscopic Procedures") that can be offered to the patients in your facility?
- Level 1
- Level 2
- Level 3a
- Level 3b
- Level 4
- Level 5

8. What is the healthcare setting (according to the "International Consensus Statement for Recommended Terminology Describing Hysteroscopic Procedures") offered to the patients?
- Office
- Outpatient Clinic
- Operating Room

9. What is the model of care for operative hysteroscopy (according to the "International Consensus Statement for Recommended Terminology Describing Hysteroscopic Procedures") offered to the patients?
- Office
- Outpatient or Ambulatory
- Extended recovery
- Inpatients

10. What is your approach to hysteroscopic procedure?
- Vaginoscopic approach
- Speculum assisted

11. Nurse presence:
- Always
- Never
- Sometimes

12. Digital hysteroscopic Clinic concept available (2D-3D ultrasound evaluation + hysteroscopy in the same room):
- Yes
- No

13. Does your hysteroscopy room have adjoining patient changing facilities and toilets?
- Yes
- No

14. Are you happy with the quality of your endoscopic imaging technology?
- Yes
- No

15. Do you consider your hysteroscopy room to be appropriately equipped to perform diagnostic procedures?
- Yes
- No

16. Do you consider your hysteroscopy room to be appropriately equipped to perform operative procedures?
- Yes
- No

17. Do you provide patient information leaflets prior to the appointment?
- Yes
- No

18. Is written consent obtained from the patients prior to the procedure?
- Yes
- No

19. Do you provide patient a standardize report of the procedure with images?
- Yes
- No

20. Do you ROUTINELY perform pregnancy tests for all premenopausal patients prior to the procedure?
- Yes
- No

21. Routine administration of antibiotics perioperatively:
- Yes
- No

22. Routine administration of antibiotics postoperatively:
- Yes
- No

23. Do you offer cervical preparation with medication prior to the procedure?
- Yes (Specify: _____)
- No

PART 3. Detailed Characteristic of Hysteroscopic Procedures

24. Which level of pain management (according to the "International Consensus Statement for Recommended Terminology Describing Hysteroscopic Procedures") do you use for diagnostic hysteroscopies?
- Level 1
- Level 2
- Level 3a
- Level 3b
- Level 4
- Level 5

25. Which instrument do you use to perform diagnostic hysteroscopy? (Multiple answers allowed)
- <4 mm Hysteroscope
- 4-5 mm Hysteroscope
- > 5 mm Hysteroscope
- Flexible
- Rigid
- 0° optic
- 30° optic

26. Which distension medium do you use for diagnostic hysteroscopies?
- Saline Solution
- CO2
- Sorbitol-Mannitol

27. Which distension medium do you use for operative hysteroscopies?
- Saline Solution
- CO2
- Sorbitol-Mannitol

28. How many polypectomies do you perform/year?
- < 50
- 50-100
- 100-200
- > 200

29. Which level of pain management (according to the "International Consensus Statement for Recommended Terminology Describing Hysteroscopic Procedures") do you use for polipectomies? (Multiple answers allowed)
- Level 1
- Level 2
- Level 3a
- Level 3b
- Level 4
- Level 5

30. Which instrument do you use to perform polypectomy? (Multiple answers allowed)
- 4-5 mm Hysteroscope with 5 Fr instruments (scissors, forceps, electrodes)
- Monopolar 26 Fr Resectoscope
- Bipolar 26 Fr Resectoscope
- Monopolar 15 Fr Miniresectoscope
- Bipolar 15 Fr Miniresectoscope
- Tissue Removal Device

31. Do you use any preoperative hormonal therapy to prepare the endometrium before performing polipectomy?
- Yes (specify: _____)
- No

32. How many myomectomies do you perform/year?
- < 20
- 20-50
- 50-100
- > 100

33. Which level of pain management (according to the "International Consensus Statement for Recommended Terminology Describing Hysteroscopic Procedures") do you use for myomectomies? (Multiple answers allowed)
- Level 1
- Level 2
- Level 3a
- Level 3b
- Level 4
- Level 5

34. Which instrument do you use to perform myomectomies? (Multiple answers allowed)
- 4-5 mm Hysteroscope with 5 Fr instruments (scissors, forceps, electrodes)
- Monopolar 26 Fr Resectoscope
- Bipolar 26 Fr Resectoscope
- Monopolar 15 Fr Miniresectoscope
- Bipolar 15 Fr Miniresectoscope
- Tissue Removal Device

35. Do you use any preoperative hormonal therapy to prepare the endometrium before performing myomectomies?
- Yes (specify...)
- No

36. Do you use anti-adhesion gel after the procedure?
- Yes
- No

37. Do you insert coil after the procedure to prevent intrauterine adhesions?
- Yes
- No

38. Do you use oestrogen therapy after the procedure?
- Yes
- No

39. Do you perform any post-procedural ultrasound evaluation?
- Yes
- No

28. How many polypectomies do you perform/year?
- < 50
- 50-100
- 100-200
- > 200

29. Which level of pain management (according to the "International Consensus Statement for Recommended Terminology Describing Hysteroscopic Procedures") do you use for polipectomies? (Multiple answers allowed)
- Level 1
- Level 2
- Level 3a
- Level 3b
- Level 4
- Level 5

30. Which instrument do you use to perform polypectomy? (Multiple answers allowed)
- 4-5 mm Hysteroscope with 5 Fr instruments (scissors, forceps, electrodes)
- Monopolar 26 Fr Resectoscope
- Bipolar 26 Fr Resectoscope
- Monopolar 15 Fr Miniresectoscope
- Bipolar 15 Fr Miniresectoscope
- Tissue Removal Device

31. Do you use any preoperative hormonal therapy to prepare the endometrium before performing polipectomy?
- Yes (specify: _____)
- No

32. How many myomectomies do you perform/year?
- < 20
- 20-50
- 50-100
- > 100

33. Which level of pain management (according to the "International Consensus Statement for Recommended Terminology Describing Hysteroscopic Procedures") do you use for myomectomies? (Multiple answers allowed)
- Level 1
- Level 2
- Level 3a
- Level 3b
- Level 4
- Level 5

34. Which instrument do you use to perform myomectomies? (Multiple answers allowed)
- 4-5 mm Hysteroscope with 5 Fr instruments (scissors, forceps, electrodes)
- Monopolar 26 Fr Resectoscope
- Bipolar 26 Fr Resectoscope
- Monopolar 15 Fr Miniresectoscope
- Bipolar 15 Fr Miniresectoscope
- Tissue Removal Device

35. Do you use any preoperative hormonal therapy to prepare the endometrium before performing myomectomies?
- Yes (specify...)
- No

36. Do you use anti-adhesion gel after the procedure?
- Yes
- No

37. Do you insert coil after the procedure to prevent intrauterine adhesions?
- Yes
- No

38. Do you use oestrogen therapy after the procedure?
- Yes
- No

39. Do you perform any post-procedural ultrasound evaluation?
- Yes
- No

40. Do you perform control hysteroscopy after the primary procedure?
- Yes
- No

41. If yes, how many months after the procedure do you perform office hysteroscopy?
- 1 months
- 2 months
- 3 months
- 6 months
- 12 months

42. If you have a residual myoma after the primary procedure:
- If it is <1cm, I will treat it in an office setting
- I always treat myomas in two surgical times
- I never remove the residual myoma in an office setting

43. How many isthmocele do you treat hysteroscopically/year?
- < 20
- 20-50
- 50-100
- > 100

44. Which instrument do you use to treat isthmocele? (Multiple answers allowed)
- 4-5 mm Hysteroscope with 5 Fr instruments (scissors, forceps, electrodes)
- Monopolar 26 Fr Resectoscope
- Bipolar 26 Fr Resectoscope
- Monopolar 15 Fr Miniresectoscope
- Bipolar 15 Fr Miniresectoscope
- Tissue Removal Device

45. How many uterine malformations (complete and partial septum, T-shaped uterus) do you treat/year?
- < 10
- 10-20
- 20-50
- > 50

46. Which instrument do you use to treat uterine malformations? (Multiple answers allowed)
- 4-5 mm Hysteroscope with 5 Fr instruments (scissors, forceps, electrodes)
- Monopolar 26 Fr Resectoscope
- Bipolar 26 Fr Resectoscope
- Monopolar 15 Fr Miniresectoscope
- Bipolar 15 Fr Miniresectoscope
- Tissue Removal Device

47. How many Asherman Syndrome do you treat/year?
- 0
- 1-2
- 2-5
-> 5

48. How many conservative treatments for endometrial cancer do you perform/year?
- < 5
- 5-10
- 10-20
- > 20

PART 4. After the Hysteroscopic Procedures

49. Do you collect any patient feedback?
- Yes
- No

50. Do you have an incidence reporting system for hysteroscopic procedures?
- Yes
- No

51. Do you routinely audit (annual) your service?
- Yes
- No

PART 5. COMMENTS ON THE SURVEY

52. Comments on the survey

Supplementary Figure 2. Respondents by country.

Country	Respondents
Albania	3
Algeria	2
Argentina	4
Azerbaijan	1
Belgium	11
Bolivia	4
Bosnia and Herzegovina	2
Brazil	10
Bulgaria	3
Canada	1
Chile	1
Colombia	10
Croatia	20
Denmark	3
Dominican Republic	2
Ecuador	11
Estonia	3
France	4
Germany	16
Greece	4
Guatemala	1
Honduras	1
Hungary	1
India	7
Indonesia	5
Iran	1
Israel	1
Italy	96
Kenya	1
Kosovo	1
Lithuania	1
Malta	1
Mexico	16
Morocco	1
Netherlands	7
Nicaragua	1
North Macedonia	4
Norway	3
Panama	1
Peru	16
Philippines	22
Poland	6
Portugal	8
Romania	18
Russia	1
Saudi	1
Serbia	3
Slovakia	1
Slovenia	29
South Africa	1
Spain	33
Switzerland	2
Turkey	1
Ukraine	11
United Kingdom	14
Uruguay	6
Venezuela	12
Total	**451**

CASE REPORT

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Facts Views Vis Obgyn 2025;17(4):402-406

Caesarean scar endometriosis involving the uterine wall

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ABSTRACT

Endometriosis in a surgical scar is a rare but important clinical phenomenon that can lead to significant morbidity, especially in women with a history of caesarean sections. We present a case of a 35-year-old woman with chronic right iliac fossa pain and prolonged, heavy menstrual bleeding (HMB) with minimal improvement after hormonal treatment with the combined oral contraceptive pill. She had undergone two prior caesarean deliveries, and imaging raised the suspicion of utero-abdominal wall scar endometriosis at the site of the previous uterine incision. Intraoperative findings confirmed a mass extending from the abdominal wall into the uterine scar. The lesion was completely excised, and histopathology confirmed endometriosis. Post-surgical recovery was uneventful, with resolution of pain and HMB. This case highlights the importance of considering scar endometriosis in the differential diagnosis of abdominal wall masses and pain in patients following caesarean section, and underscores that surgical excision can be curative.

Keywords: Abdominal wall, caesarean section, endometriosis, heavy menstrual bleeding, pain, scar endometriosis

Introduction

Endometriosis is a common gynaecological disorder characterised by the presence of functional endometrial glands and stroma outside the uterine cavity. While it typically involves pelvic structures, extra-pelvic endometriosis is rare. One such manifestation is scar endometriosis, also called incisional endometriosis, where endometrial tissue implants in a surgical scar, most often following obstetric or gynaecological surgeries. Caesarean section scars are the most frequently reported site, with incidence estimates ranging from 0.03% to 0.4% of caesarean deliveries. A 30-year review reported an incidence of about 0.08% after caesareans.[1] The majority of scar endometriosis cases involve the abdominal wall alone (74.1-84.6%), while 15-26% of cases have both abdominal wall and uterine/pelvic involvement.[2-4]

Scar endometriosis usually presents as a painful nodule at or near the scar, often with cyclical pain associated with menses, although up to half of cases can present with non-cyclical pain.[5] These lumps are sometimes misdiagnosed as an incisional hernia, abscess, granuloma, lipoma, or desmoid tumor. The pathogenesis is most commonly attributed to mechanical implantation of endometrial cells into the surgical wound during caesarean delivery. Viable endometrial tissue from the uterine incision can implant into the abdominal wall layers and respond cyclically to hormonal stimulation. Risk factors include multiple caesarean deliveries, poor surgical technique, or inadequate irrigation of the wound.[3] Some authors suggest that failure to change gloves or instruments before closing the abdomen may also increase the risk.[6] Regardless of the exact mechanism,

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the outcome is ectopic endometrial tissue in the scar that responds to hormonal cycles. Over time (sometimes months to years after the surgery), the implant can grow and present clinically.

The interval between surgery and symptom onset is variable, ranging from as soon as 6 months to over 10-20 years in some reports.

Because of the non-specific nature of the symptoms, diagnosis is often delayed. Imaging studies such as ultrasound or magnetic resonance imaging (MRI) can be helpful to identify a mass in the abdominal wall and its characteristics, but definitive diagnosis of scar endometriosis is made only after surgical excision and histopathological confirmation.

We report here a case of an unusual presentation of caesarean scar endometriosis that involved both the abdominal wall and the uterine scar (a utero-abdominal wall endometriosis). This case is distinctive in that it demonstrates a rare contiguous extension of endometrial tissue from the uterine scar into the anterior abdominal wall, forming dense adhesions between the two structures. This presentation expands the known spectrum of caesarean scar endometriosis and underscores key aspects of diagnosis and management of this condition, and the importance of awareness among clinicians.

Case Report

Written informed consent was obtained from the patient for the publication of this case report and all associated clinical information and images, Identifying details have been removed to ensure anonymity.

A 35-year-old woman (gravida 3, para 2) presented to the gynecology clinic with complaints of chronic pain in the right lower quadrant of the abdomen for the past eight months. The pain was localised to the area of her Pfannenstiel transverse lower abdominal scar from previous caesarean deliveries. She noted that the pain often worsened during her menstrual periods. Additionally, she reported prolonged and heavy menstrual bleeding (HMB) that had improved only slightly with hormonal treatment on the combined oral contraceptive pill. She has undergone two emergency caesarean sections, three and five years previously, because of cephalopelvic disproportion. She had no known history of endometriosis or other pelvic pathology in the past.

On physical examination, the patient had a well-healed transverse lower abdominal scar. There was a palpable, approximately 2 cm firm nodule under the right lateral aspect of the scar. The nodule was mildly tender on deep palpation, and it felt adherent to deeper tissues (non-mobile). No overlying skin discoloration, sinus tract, or discharge was noted on inspection of the scar. Pelvic examination did not reveal any adnexal masses or uterine tenderness, aside from the localised area in the abdominal wall.

Transabdominal ultrasound of the scar region showed a heterogeneous mass in the right abdominal wall at the level of the rectus abdominis muscle, measuring about 2.5×2 cm. The mass had irregular margins and contained some cystic areas, with doppler evidence of minimal internal vascularity. The lesion appeared to extend to the peritoneal surface near the site of the uterine incision, but the uterus and ovaries appeared normal on imaging. An MRI was subsequently performed for better delineation, and it demonstrated the uterus is anteflexed and retroverted in position and fixed to the ventral abdominal wall at about 65 mm below the umbilical level. The lesion appeared hypointense on T1-weighted images and hyperintense on T2-weighted images, with mild post-contrast enhancement, consistent with endometriotic tissue. A surgical scar was seen with a niche at the anterior wall of the uterus 4cm away from the uterine fundus. There was an apparent connection of the scar to a small midline anterior abdominal wall lesion measuring about 1.5x1x1.3 cm (CCxAPxTS) that seemed to be contiguous with the anterior uterine wall (Figure 1) at the site of the prior hysterotomy. These findings were highly suggestive of caesarean scar endometriosis with possible involvement of the uterine scar.

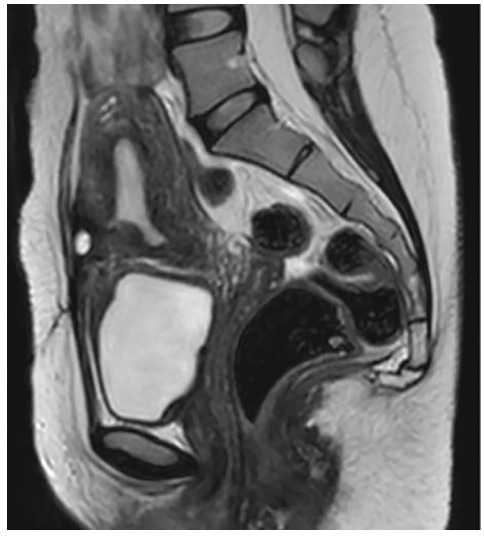

Figure 1. Magnetic resonance imaging sagittal view showing ventrofixated uterus and the lesion of uterine scar endometriosis measuring about 1.5x1x1.3 cm.

The patient underwent a planned diagnostic and therapeutic laparoscopy. Upon entry, dense adhesions were noted between the anterior abdominal wall and the anterior surface of the uterus along the right side of the previous caesarean section scar (Figure 2). Careful laparoscopic adhesiolysis was performed, allowing the uterus to be completely released from the abdominal wall while maintaining clear identification and preservation of the bladder. Following adhesiolysis, a well-defined, approximately 3-cm fibrotic nodule was identified within the rectus muscle and fascia, extending to and involving the uterine serosa at the site of the prior uterine incision. The lesion caused focal thickening of the anterior uterine wall but did not extend into the endometrial cavity.

The mass was excised laparoscopically in its entirety using a monopolar hook and bipolar cautery, together with a margin of surrounding scar tissue (Figures 2-4). The nodule contained thick, dark "chocolate-like" material, consistent with endometriotic content. Resection included the involved area of uterine serosa and a small portion of the anterior myometrium; the resulting ~1-cm uterine wall defect was repaired in two layers with absorbable sutures, and additional reinforcement stitches were placed to ensure integrity. The abdominal wall defect was closed primarily, as the remaining tissue after excision was sufficient for a tension-free closure. Hemostasis was secured, and intraoperative blood loss was minimal.

The excised specimen was sent for histopathological examination. Grossly, on cut section, the mass was tan-white with focal areas of haemorrhage. Microscopically, the sections showed endometrial glands and stroma dispersed within fibrous scar tissue and skeletal muscle, consistent with endometriosis. No atypia or malignant changes were observed. These findings confirmed the diagnosis of endometriosis in the caesarean scar involving the abdominal wall and uterine scar.

The patient's postoperative course was uneventful. She was discharged on the third postoperative day. At her 6-month follow-up, she reported complete resolution of abdominal pain. Her menstrual cycles had normalised, with no further prolonged bleeding. On examination, the scar was healing well with no evidence of a recurrent nodule or mass. The patient continues to remain symptom-free one year after surgery, with no signs of recurrence.

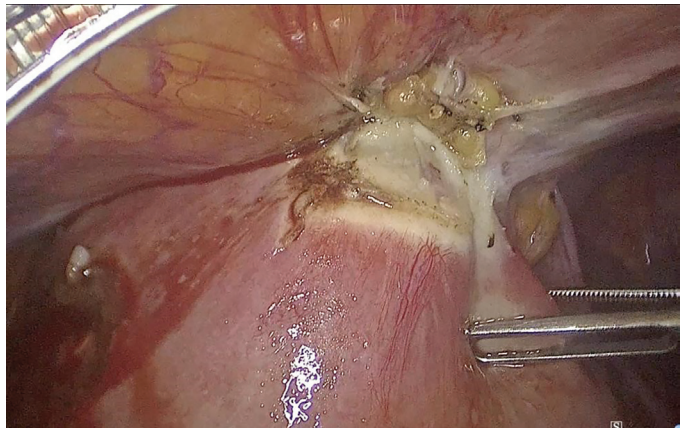

Figure 2. Intraoperative photograph of the abdominal wall endometriosis attached to the anterior uterine wall at the scar site.

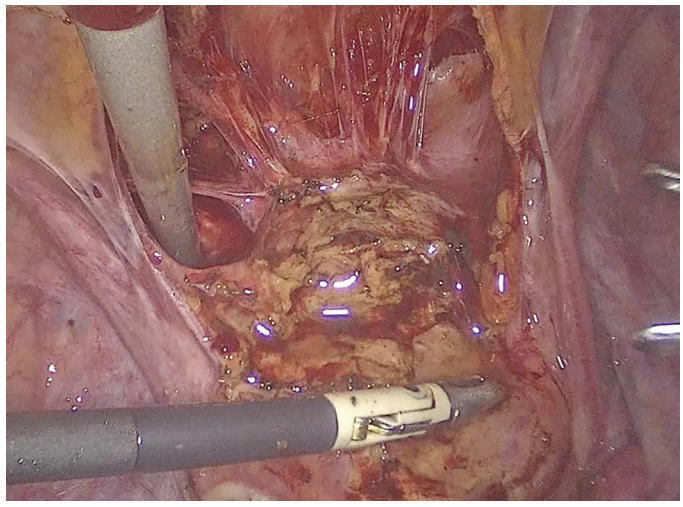

Figure 3. Intraoperative photograph of the abdominal wall endometriosis attachment to the uterus after partial dissection.

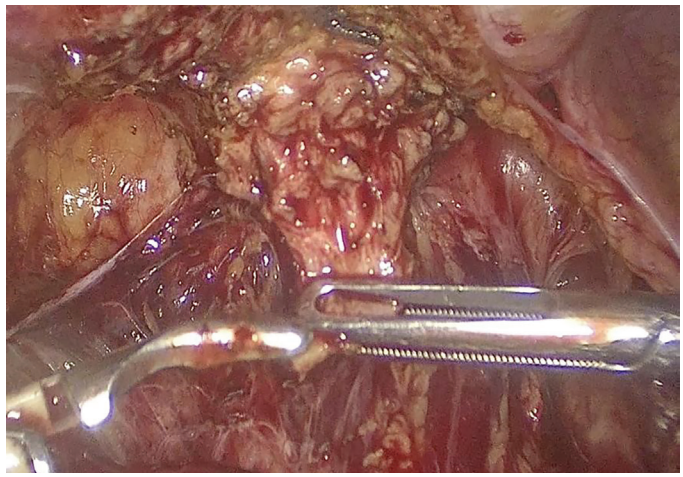

Figure 4. Intraoperatively, the excised abdominal wall scar endometriosis, during resection with monopolar energy to reveal fibrous tissue with scattered hemorrhagic areas.

Discussion

Utero- abdominal wall endometriosis is a term we use to describe the contiguous extension of endometrial tissue from the uterine scar to the abdominal wall. Although abdominal wall endometriosis in a caesarean scar has been reported in the literature, involvement of the uterine scar itself (a lesion spanning from the uterus to the subcutaneous tissue) is unusual representing the key distinguishing feature of this report. A similar phenomenon was described by Nepali where an endometriotic lesion extended from the subcutaneous plane through the rectus muscle up to the anterior uterine surface.[7] Such cases underscore that scar endometriosis can sometimes infiltrate deeply, mirroring the tract of the original surgical incision.[8]

The clinical presentation in our patient; chronic pain at the scar site with menstrual exacerbation, a palpable scar nodule, and abnormal vaginal bleeding, is consistent with scar endometriosis as described in previous reports.[9] The additional symptom of prolonged bleeding was probably due to involvement of the uterine incision site (cervical niche) given the alleviation of HMB after surgical excision. However, another coincidental etiology for the HMB cannot be excluded.

Typically, patients present with a triad of a history of surgery, a localised mass at the scar, and cyclical pain related to menses. However, it is noteworthy that a significant proportion of cases, estimated to be up to 50%, may not have strictly cyclical pain.[10] In our case, the pain was mostly cyclical, but the patient also experienced some continuous discomfort, which aligns with the literature that non-cyclic symptoms do not exclude the diagnosis.

Imaging modalities are useful for evaluation but not diagnostic on their own.[11] Ultrasound is usually the first-line imaging; it often reveals a hypoechoic or heterogeneous mass in the abdominal wall, sometimes with small cystic echogenic areas corresponding to hemorrhagic foci. MRI can provide better characterisation, showing lesions with signal intensity changes from repeated bleeding (for example, areas of hyperintensity on T1-weighted images due to haemorrhage). In our patient, MRI was helpful in determining the extent of the lesion and its connection to the uterus. Nonetheless, definitive diagnosis rests on histopathological confirmation after excision, as was obtained in this case.

An important aspect of managing suspected scar endometriosis is to distinguish it from other conditions.[12] Differential diagnoses for an abdominal wall mass in a post-surgical scar include incisional hernia, suture granuloma, abscess, hematoma, neuroma, and neoplasms such as desmoid tumour or soft tissue sarcoma. A desmoid tumor (aggressive fibromatosis) in particular can present as a firm post-operative abdominal wall mass and can be mistaken for scar endometrioma and vice versa. In this patient, the imaging and the cyclical nature of pain strongly pointed towards an endometriotic process. Fine-needle aspiration or core biopsy can be performed preoperatively to confirm diagnosis if doubt exists, but there is a risk of seeding the tract with endometrial cells. In this case, given the high clinical suspicion and the plan for definitive surgery, we proceeded directly to the excision without a biopsy.

The mainstay of treatment for utero-abdominal scar endometriosis is surgical excision of the lesion with clear margins.[13,15] Wide local excision (with about 1 cm margin) is recommended to ensure complete removal of all ectopic endometrial tissue. Complete excision not only alleviates the symptoms but also minimises the risk of recurrence. Recurrence of scar endometriosis after adequate excision is uncommon, with only a few cases reported in the literature. Incomplete removal, however, can lead to persistent or recurrent disease. In our reported case, we achieved clear margins by removing the involved section of the uterine wall and abdominal wall en bloc, which likely contributed to the excellent postoperative outcome. In some reports where the defect in the abdominal wall is large after excision, mesh repair or tissue reconstruction may be necessary. Medical management using hormonal therapy for scar endometriosis has a limited role.

Hormonal treatments such as progestins, danazol, or gonadotropin-releasing hormone analogues may temporarily reduce lesion size or symptom severity, but they usually do not eradicate the ectopic tissue. Symptoms often recur once the therapy is stopped, and the mass typically persists. Therefore, medical therapy might be considered only for patients who are poor surgical candidates or to reduce symptoms before surgery, rather than as a definitive treatment.

Although scar endometriosis is a benign condition, there have been isolated reports of malignant transformation in long-standing endometriosis lesions. Malignant

transformation of abdominal wall endometriosis in a caesarean scar is exceptionally rare, but it has been documented.[10] For example, clear cell and endometrioid carcinomas arising in caesarean scar endometriosis have been reported in the literature. This possibility, albeit rare, reinforces the need for complete excision and careful histological examination of all suspected scar endometriosis cases. In our patient, no malignancy was present in the excised tissue.

Prevention of scar endometriosis is an important consideration. Given the implantation theory of pathogenesis, surgical techniques to minimise endometrial cell contamination of the wound are advisable. Some authors recommend steps such as delivering the placenta and cleansing the uterine cavity prior to closing the uterine incision, using separate instruments or changing gloves when closing the abdominal wall, and copiously irrigating the wound to remove debris.[3] While these measures are not yet based on high-level evidence, they are simple interventions that could potentially reduce the risk of seeding endometrial cells into the incision. Awareness of scar endometriosis as a possible complication among obstetric surgeons is important so that such precautions may be considered, especially in patients with endometriosis or those having surgery at term when endometrial tissue is thickest.

Conclusion

Endometriosis should be considered in any woman presenting with cyclical pain or a mass at a caesarean section scar.[11] Our case demonstrates that the lesion can extend from the abdominal wall into the uterine scar. Prompt diagnosis using imaging and definitive surgical excision provides effective and lasting relief. Awareness of this condition and intraoperative preventive measures such as irrigation, changing gloves, and careful uterine closure may help reduce its occurrence.

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VIDEO COMMENTARY

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Da Vinci Single-Port surgery in an obese woman affected by endometrial cancer

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ABSTRACT

Background: Minimally invasive surgery in obese patients is advantageous in terms of postoperative recovery and estimated blood loss. In literature several retrospective studies comparing robot-assisted and laparoscopic surgery are present, while a randomised case-control study will better define the advantages prospectively.

Objectives: Here we present the video of the surgical radical management for endometrial cancer in an obese woman using the Da Vinci Single-Port (SP) robotic platform.

Participant: A 66-year-old woman with a body mass index (BMI) of 44 kg/m² and hypertension, diagnosed with grade 1 endometrioid endometrial cancer.

Intervention: The patient underwent a SP Robotic assisted radical class a hysterectomy (as per the Querleu-Morrow classification), bilateral salpingo-oophorectomy and sentinel lymph-node biopsy. A 2.7 cm umbilical incision was performed, and the single port robotic trocar was easily positioned. A uterine manipulator was not employed; traction was achieved using vaginal valves. Due to her constitution, a pneumoperitoneum with an intra-abdominal pressure greater than 8 mmHg and a Trendelenburg inclination greater than 19° could not be achieved.

Results: Docking time was 8 minutes, the console time was 84 minutes, and the total operation time was 128 minutes. The estimated blood loss was 200 mL. The pain scores were irrelevant. The duration of hospitalisation was 2 days. No perioperative early complications were recorded. The aesthetic result was good.

Conclusions: To our knowledge, this is the first Da Vinci SP endometrial cancer treatment in an obese woman presented in a step-by-step video. Robotic surgeries were successfully performed, the triangulation of the instrument allowed for comfortable surgery. Therefore, this surgical system may also be applicable to patients with a high BMI; however, further studies are required to confirm these preliminary findings.

What is New? Minimally invasive surgery offers important benefits in terms of recovery, pain control, and reduced blood loss; however, its application in obese patients often remains challenging. The technical limitations imposed by body habitus-restricted working space, limited Trendelenburg positioning, and difficulties in trocar placement-can compromise both surgical exposure and oncologic radicality. In this context, the introduction of the Da Vinci SP robotic platform may represent a meaningful evolution in the management of this increasingly common patient population. The flexibility of the multi-jointed SP instruments and the ergonomic advantages of robotic control allow surgeons to overcome the typical restrictions encountered in this population.

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ABSTRACT

We believe that this report highlights an important step toward expanding the accessibility of minimally invasive radical surgery to all patients, regardless of BMI. The SP robotic approach combines surgical radicality, patient safety, and reduced invasiveness, suggesting a new paradigm for treating endometrial cancer in obese women.

Keywords: Endometrial cancer, hysterectomy, laparoscopic surgery, pain, robotic-assisted, robotic surgery

Video 1. Minimally invasive surgery is currently the gold standard in the treatment of most gynaecological pathologies,[1,2] both benign and oncological. In particular, robotic surgery offers us greater surgical precision and allows us to treat patients with high body mass indexes (BMIs) that would be more complex with laparotomic or laparoscopic approach.[3-5] In this article we report step by step the surgical treatment using Da Vinci Single-Port platform for endometrial carcinoma in a patient with severe obesity for which there were important limitations in terms of the need for Trendelemburg reduction and the use of low pneumoperitoneum pressure. We report the timing of each surgical step and the clinical outcomes of this case. It's conceivable this new surgical system could be applied also in patients with high BMI.

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Transparency: Authors affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

Video 1. Da Vinci Single-Port surgery in an obese woman affected by endometrial cancer: https://youtu.be/P3ZK26Lgs0k

VIDEO COMMENTARY

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Robotic secondary cytoreduction in recurrent ovarian cancer: a tailored approach for kidney transplant recipients

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ABSTRACT

Background: The rate of kidney transplantation has been steadily increasing worldwide, accompanied by significant improvements in post-transplant survival rates. However, transplant recipients have a higher incidence of malignancies compared with the general population, and their oncological management often poses unique challenges. In recent years, major advances in the treatment of ovarian cancer (OC) have expanded the therapeutic options available for recurrent disease. Two randomised trials have underscored the role of surgery in platinum-sensitive recurrent OC while minimally invasive approaches have demonstrated reduced morbidity without compromising oncologic outcomes in carefully selected patients. For frail and immunosuppressed individuals, the minimally invasive approach may offer substantial advantages- including fewer wound complications, shorter hospitalisation, and earlier resumption of oral intake and immunosuppressive therapy. Despite these potential benefits, evidence regarding the feasibility and safety of minimally invasive secondary cytoreduction in kidney-transplanted patients remains limited.

Objectives: To demonstrate the feasibility and outcomes of robotic surgery in a platinum-sensitive OC recurrence in a frail, kidney-transplant patient.

Participant: A woman in her 50s with a history of kidney transplantation presented with isolated pelvic high-grade serous OC recurrence. Positron emission tomography scan revealed a 15 mm solid lesion with increased uptake infiltrating the rectum.

Intervention: A robot-assisted rectal resection was performed using the Da Vinci Xi Surgical System. The approach included four 8 mm robotic trocars: trans umbilical optical port, right and left iliac fossa, suprapubic region, and one 10 mm laparoscopic port at the left Palmer's point. Colorectal anastomosis was completed using the Ethicon Endo-Surgery 60 mm stapler by a specialised peritoneal and retroperitoneal team.

Conclusions: R0 resection was achieved with no complications or delays in immunosuppressive therapy resumption; final histology confirmed rectal involvement, and adjuvant chemotherapy was promptly initiated. At the two-year follow-up, the patient was disease-free.

What is New? This case supports minimally invasive surgery as a valid approach in selected, frail, immunosuppressed patients with isolated OC recurrence.

Keywords: Feasibility, kidney transplantation, ovarian cancer, robotic-assisted, robotic surgery

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***This surgical video was presented at the 16th Annual SERGS 2024, Madrid.**

Video 1. Robotic secondary cytoreduction for platinum-sensitive recurrent ovarian cancer in a kidney-transplant patient. The video demonstrates a minimally invasive rectal resection in a frail, immunosuppressed patient using the Da Vinci Xi Surgical System. This tailored approach allowed for complete cytoreduction (R0) without delaying the resumption of immunosuppressive therapy. The case supports the feasibility of robotic surgery in selected post-transplant oncologic cases.[1-5]

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Transparency: The authors affirm that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

Video 1. Robotic secondary cytoreduction in recurrent ovarian cancer: a tailored approach for kidney transplant recipients: https://youtu.be/6SMeR6lZM34

VIDEO COMMENTARY

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Fluorescence-guided nerve-sparing surgery for deep endometriosis using indocyanine green

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ABSTRACT

Background: Although the benefit of nerve-sparing surgery for deep endometriosis (DE) with postoperative voiding dysfunction has been demonstrated, it requires a high level of surgical skill to accurately remove endometriosis lesions while preserving autonomic nerves in situations of severe adhesions and fibrosis and has been performed only by expert surgeons. However, endometriosis is a common disease, and methods for intraoperative identification of endometriosis lesions, ureters, vessels, and nerves using near-infrared imaging with indocyanine green (ICG) have been explored to enable more surgeons to safely offer such procedures to their patients.

Objectives: To demonstrate the step-by-step technique of single-port robotic nerve-sparing DE surgery with ICG navigation.

Participant: The patient was a 48-year-old woman with chronic pelvic pain. Magnetic resonance imaging revealed uterine adenomyosis and a right ovarian endometrioma with DE involving the uterosacral ligament and surface of the rectum.

Intervention: An intravenous injection of 0.25 mg/kg body weight of ICG for intraoperative near-infrared fluorescence (NIR) imaging with the da Vinci Single-Port.

Conclusions: The use of ICG with NIR during nerve-sparing DE surgery may improve the surgeon's decision-making process. ICG may be useful in highlighting pelvic autonomic nerves, identifying DE lesions, checking for pelvic organ injury, and assessing tissue perfusion and haemostasis. However, further research is needed to confirm the possible role of ICG in this setting.

What is New? This video illustrates the potential of ICG fluorescence to enhance intraoperative visualisation of autonomic nerves and DE lesions, offering educational insights into safer and more widely accessible advanced surgical techniques.

Keywords: Chronic pelvic pain, endometriosis, indocyanine green, robotic surgery, surgical techniques

Video 1. Although the benefit of nerve-sparing surgery for deep endometriosis (DE) with postoperative voiding dysfunction has been demonstrated, it requires high surgical skill to accurately remove DE lesions while preserving autonomic nerves in severe adhesions and fibrosis.[1] Since endometriosis is common, near-infrared imaging with indocyanine green (ICG) has been explored to help more surgeons identify DE lesions, ureters, vessels, and nerves intraoperatively.[2-4]

This video demonstrates step-by-step nerve-sparing surgery with ICG navigation.

The patient was a 48-year-old woman with severe dysmenorrhea and chronic pelvic pain. Magnetic resonance imaging showed adenomyosis, a right

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ovarian endometrioma with DE involving the uterosacral ligament and rectal surface, and cul-de-sac obliteration. A nerve-sparing modified radical hysterectomy, right salpingo-oophorectomy, and complete DE removal were performed using the da Vinci Single-Port.

The surgery was conducted in seven steps: Step 1, adhesiolysis and adnexal surgery; Step 2, separation of the nerve plane; Step 3, dissection of the ureter; Step 4, reopening of the pouch of Douglas; Step 5, complete removal of DE lesions while avoiding injury to the nerve plane; Step 6, hysterectomy (if the patient desires non-fertility-sparing surgery); Step 7, checking for pelvic organ injury, assessing tissue perfusion, and hemostasis. ICG (0.25 mg/kg) was administered intravenously during Steps 2, 5, and 7.

There are no standardised recommendations for ICG dose, timing, or visualisation. Fluorescence assessment is subjective and varies by imaging system. While white light remains primary, ICG is a useful adjunct. ICG is not nerve-specific. We used low-dose intravenous injection to transiently visualise neurovascular bundles via surrounding vessel fluorescence. Nerve-specific fluorophores are in development and may become available in the future.[5] ICG serves as an adjunctive tool, enhancing anatomical recognition and intraoperative decision-making. Further research is needed to confirm its role in this setting.

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Ethical approval: Ethical approval was obtained from the institutional review board at our hospital (IRB number: 985).

Informed consent: Informed consent was obtained from all individual participants included in the study.

Data sharing: Data are available from the authors upon reasonable request.

Transparency: The lead author affirms that this manuscript is an honest, accurate, and transparent account of the work being reported; that no important aspects have been omitted; and that any discrepancies from the work as planned have been explained.

Video 1. Fluorescence-guided nerve-sparing surgery for deep endometriosis using indocyanine green: https://youtu.be/78SokoFgHJE

VIDEO COMMENTARY

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Hysteroscopic removal of a retained intrauterine foreign body: a step-by-step technique

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ABSTRACT

Background: Retained intrauterine foreign bodies are rare but may cause abnormal uterine bleeding (AUB) and pelvic pain. Hysteroscopy is the preferred approach for diagnosis and management.

Objectives: This video describes a step-by-step hysteroscopic technique for intrauterine foreign body removal.

Participant: A 60-year-old woman presented with pelvic pain and AUB. She underwent resectoscopic polypectomy three years before. A computed tomography scan revealed a cylindrical foreign body (12x8 millimetres) in the uterine cavity. The patient was referred to the Digital Hysteroscopic Clinic CLASS Hysteroscopy in Fondazione Policlinico Universitario A. Gemelli IRCCS in Rome, where she was scheduled for a minimally invasive hysteroscopic procedure.

Intervention: Hysteroscopic evaluation identified a tubular foreign body firmly adherent to the posterior uterine wall. Removal was performed using a hysteroscopic approach combined with a traction suture technique. First, 5 Fr scissors were used to detach the foreign body from the posterior uterine wall. Then, a Collins electrode of a 15 Fr bipolar miniresectoscope was employed to incise the lateral isthmic walls to facilitate extraction. Finally, a 0 Vicryl traction suture loop, inserted through the foreign body using 5 Fr grasping forceps, enabled controlled removal under hysteroscopic guidance. The foreign body was successfully extracted.

Conclusions: This video demonstrates a step-by-step hysteroscopic technique for intrauterine foreign body removal, highlighting the safety and precision of this minimally invasive approach.

What is New? This is the first reported case of hysteroscopic removal of a retained intrauterine foreign body, using a traction suture technique under hysteroscopic guidance for a controlled extraction.

Keywords: Foreign body, grasping forceps, hysteroscopy, minimally invasive surgery, pelvic pain. uterine bleeding

Video 1. This video demonstrates a structured, step-by-step hysteroscopic strategy to remove a retained intrauterine foreign body under continuous visualisation. Hysteroscopy represents the preferred and safest approach for the diagnosis and management of intrauterine pathology.[1,2] In our case, the foreign body was a cylindrical object adherent to the posterior uterine wall, and the removal was performed in an ambulatory model of care.[3] After diagnostic vaginoscopy confirmed the lesion, 5 Fr scissors were used to gently release the adhesions, avoiding blind traction. A 15 Fr bipolar miniresectoscope with a Collins electrode was used to incise the lateral isthmic walls, creating a controlled egress path for extraction. A 0 Vicryl traction loop was fashioned by passing the thread through the lumen of the foreign

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body with 5 Fr graspers, allowing for progressive, atraumatic removal under direct hysteroscopic guidance. The video also illustrates completion polypectomy and final cavity check. Educational highlights include the selection of appropriate instruments for miniaturised, outpatient hysteroscopy, and the use of a traction loop to achieve controlled extraction in challenging cases. Previous literature has described hysteroscopic retrieval of intrauterine materials,[4] but to our knowledge, this is the first case demonstrating a traction-suture-assisted extraction performed entirely under hysteroscopic guidance. This approach is reproducible in expert hands and ensures safety, precision, and preservation of uterine integrity within a minimally invasive framework.

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Video 1. Hysteroscopic removal of a retained intrauterine foreign body: a step-by-step technique: a step-by-step technique: https://youtu.be/v4ugHZzi_h8

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Facts Views Vis Obgyn 2025;17(4):415-416

Letter to the Editor: Iatrogenic breaching of the junctional zone: the unintended path to placenta accreta spectrum?

Jolien Haesen, Kobe Dewilde, Hannes van der Merwe, Thierry Van den Bosch

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Dear Editor,

We have read with great interest the paper by Gillet et al.[1] Over the past four decades, hysteroscopy has become a widely used diagnostic and therapeutic tool in gynaecology. We therefore strongly support research including clinical follow-up data after hysteroscopic procedures.

In this study, patients with repeated implantation failure underwent a five-part intervention: 1) gonadotropin-releasing hormone suppression, 2) hysteroscopic sub-endometrial exploration, 3+4) budesonide-loaded hyaluronic acid application and 5) intramuscular platelet-rich plasma, none of which have compelling evidence supporting improved outcome according to the European Society of Human Reproduction and Embryology guidelines.[2]

Patients showed no "major pathology" and a regular junctional zone (JZ) on three-dimensional ultrasound, yet magnetic resonance imaging (MRI)- performed at random cycle timing- showed complete loss of JZ. Both techniques have a similar suboptimal accuracy for minimal adenomyosis. For instance, the transient nature of MRI features during the menstrual cycle and during myometrial contractions is a common pitfall.[3,4] Additionally, patients in the presented cohort had already undergone hysteroscopic procedures prior to inclusion in the study, in which the disruption of the JZ could be secondary to these procedures.

All patients underwent "hysteroscopic sub-endometrial exploration" aiming to increase diagnostic sensitivity. This technique implies focal breaching of the JZ. As previously reported by the authors, adenomyosis often arises from JZ disruption due to myometrial hypercontractility, pregnancy or intrauterine surgery.[5] However, focal adenomyosis is a heterogeneous entity, and the causal link with intra-uterine procedures remains unclear.[6]

Our main concern is that JZ scarring caused by this hysteroscopic procedure may induce focal adenomyosis, leading to mal-placentation and placenta accreta spectrum (PAS) in subsequent pregnancies. In one cohort, 30% developed major obstetrical complications, including placenta previa, severe PAS, of which one necessitated a postpartum hysterectomy. Of the postpartum hysterectomies performed for PAS at the University Hospital Leuven in the last five years, four patients had no history of caesarean section. In these patients, one had a curettage and three underwent hysteroscopies (two for fertility exploration and one for polyp resection).

Taking all this data into account, we believe any iatrogenic trauma of the JZ should be avoided in the

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absence of any compelling potential clinical benefit. Therefore, although unproven, we consider that the possible harm due to hysteroscopic subendometrial exploration does not allow it to be included in routine clinical practice.

We thank the authors for publishing their results highlighting this potential health issue. We strongly recommend an audit of the obstetrical outcome of consecutive women who have undergone hysteroscopic subendometrial exploration.

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Data sharing: Not applicable as only a letter to the editor, no data used.

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Facts Views Vis Obgyn 2025;17(4):417-418

Reply: Iatrogenic breaching of the junctional zone: the unintended path to placenta accreta spectrum?

Evy Gillet[1,2], Panayiotis Tanos[1,2], Helena Van Kerrebroeck[1], Stavros Karampelas[1,2], Marion Valkenburg[1], Istvan Argay[1], Alessa Sugihara[1], Stephan Gordts[1], Rudi Campo[1]

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Keywords: Recurrent implantation failure, hysteroscopy, budesonide, hyaluronic acid, junctional zone, magnetic resonance imaging

Dear Editor,

Our study concerns a highly selected group of patients with longstanding infertility and recurrent implantation failure, all of whom had exhausted conventional treatment strategies before referral. The article does not present any of the described interventions -such as gonadotropin releasing hormone suppression, platelet-rich plasma, or adjuvant medications- as validated therapies; these were clearly documented as part of patients' prior management. We fully agree that such approaches currently lack robust evidence and should be confined to research settings.

The statement that patients showed "no major pathology" refers exclusively to transvaginal ultrasound findings. Ultrasound and magnetic resonance imaging (MRI) assess fundamentally different aspects of myometrial structure and cannot be used interchangeably. Whereas ultrasound evaluates macroscopic echotexture and gross anatomical irregularities, MRI provides detailed insight into tissue composition, water diffusion, iron distribution, and the microstructural integrity of the junctional zone (JZ). In our cohort, many women with recurrent implantation failure had reassuring ultrasound and hysteroscopic findings, yet MRI consistently demonstrated complete loss of JZ differentiation -a pathological feature that would otherwise have remained undetected. This discrepancy cannot be attributed to transient physiological changes, which do not mimic a diffuse global absence of JZ structure. Rather, it underscores MRI's superior sensitivity for detecting diffuse JZ disruption, a finding that in our experience correlates strongly with impaired reproductive outcomes.

All MRIs were performed before any procedures at our centre. In over 90% of cases, diffuse loss of JZ differentiation corresponds histologically to adenomyosis; these data will be published soon. Focal adenomyosis is more heterogeneous, and while a causal relationship with intrauterine procedures cannot be excluded, it remains unproven. The fact that not all women develop adenomyosis despite universal uterine peristalsis suggests that genetic or epigenetic contributors, such as KRAS mutations, likely play a substantial role.

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Contractions may confound assessment of focal JZ thickness but do not account for the complete absence of JZ definition, in which all myometrial cells display similar water and iron content. No significant variations in JZ thickness across menstrual phases have been reported.[1,2]

Hysteroscopic sub-endometrial exploration is not an indiscriminate "breaching" technique. In carefully selected patients with recurrent failure or pregnancy loss, a standardized full-thickness biopsy is performed using a bipolar resectoscope designed to minimize thermal injury. Postoperative evaluation shows no adhesion formation or changes in MUSA criteria.

We thank you for raising the concern that targeted biopsies might increase placenta accreta spectrum (PAS) risk. Our recent data indicate proper healing after cytoreductive surgery, high pregnancy rates, and acceptable obstetric outcomes, with no evidence thus far of elevated PAS risk.[3] Observed differences appear more closely linked to maternal age and donor-oocyte use.

We agree that meticulous follow-up and prospective registration are essential. Our intention is not to establish a new routine intervention but to stimulate further investigation into recurrent implantation failure within centres of excellence.

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Transparency: The authors affirm that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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