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Laparoscopic Excision of Endometriosis Improves Function, Productivity, and Healthcare Utilization: A National, Multicenter Retrospective

Allyson Augusta Shrikhande
Pelvic Rehabilitation Medicine
Michael Dieciuc
mdieciuc@pelvicrehabilitation.com

Pelvic Rehabilitation Medicine
Christopher Kliethermes
Pelvic Rehabilitation Medicine
Faraj Touchan
Pelvic Rehabilitation Medicine
Ashley Davis
Pelvic Rehabilitation Medicine
Amro Elfeky
Pelvic Rehabilitation Medicine
Reza Askari
Pelvic Rehabilitation Medicine
Robyn Power
Pelvic Rehabilitation Medicine
Evan Friedman
Pelvic Rehabilitation Medicine
Ethan Goldstein
Pelvic Rehabilitation Medicine
Nairi Brown
Pelvic Rehabilitation Medicine
Gautam Shrikhande
Pelvic Rehabilitation Medicine

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Abstract

Background: Endometriosis is a complex inflammatory condition characterized by chronic pelvic pain, numerous comorbidities, and infertility. Surgical management is typically considered after conservative treatments have failed, with laparoscopic excision surgery being one of two prominent techniques. Objective: To replicate and extend previous research demonstrating positive outcomes in patients with endometriosis after undergoing laparoscopic excision surgery. Design: A national, multicenter chart review of data gathered from 12 locations and 13 surgeons. Methods: Patient records (N = 535) were examined from eClinical Works between the dates of January 1st, 2024 and July 23rd, 2026. Preoperative and postoperative data were compared within-subjects across 12 outcome variables. Analyses consisted of mixed-effects models to account for the repeated measures design. Results: Between preoperative and postoperative visits improvements were found in pain ($P < .001$), the functioning of eight different pelvic categories (Ps < .001), absenteeism ($P = .002$), presenteeism ($P < .001$), and emergency room visits ($P < .001$). Conclusion: The current study replicates previous improvements in pain after laparoscopic excision surgery. It also extends those improvements to novel metrics of pelvic functioning, workplace productivity, and healthcare utilization.

Introduction

Endometriosis is an inflammatory disease affecting 10% of women of reproductive age,[1] is the third leading gynecologic indication for hospitalization,[2] and is believed to affect 5.5 million women in the United States and Canada.[2] Endometriosis is associated with significant direct and indirect financial burdens, with estimates of $4358 in healthcare costs and $8817 in lost productivity per patient annually.[3] Despite its prevalence and impact, endometriosis is incompletely understood and often poorly managed. Endometriosis is characterized by tissue outside the uterus, with symptoms ranging from dysmenorrhea, dyspareunia, and dyschezia, to chronic pelvic pain and infertility.[4] Because there is no known way to prevent endometriosis, the burden of care is placed on early diagnosis and early intervention. However, the symptoms of endometriosis are often associated with social stigmas and taboos,[5] are frequently trivialized by healthcare professionals,[4] and overlap with other diseases.[6] Furthermore, the only definitive method of diagnosis is laparoscopic surgery followed by histological confirmation. Given this confluence of factors, perhaps then it is not surprising that the average time from symptom onset to surgical diagnosis is 7 to 10 years.[7]

Unfortunately, delays in care can result in downstream sequelae. Although not typically considered neurological in nature, untreated endometriosis can result in peripheral and central sensitization in about 70% of cases.[8] The presence of nerve growth factor in endometrial lesions links the lesions to the nervous system via neural sprouting, but also recruits mast cells that flood the area with inflammatory molecules.[9] Inflammation activates peripheral nociceptors. Over time, repeated activation causes the threshold of nociceptors to lower, dormant receptor to awaken, and signal bombardment that spills over

in the spinal cord, thereby referring the pain to other regions.[9] This likely contributes to the fact that the location of an endometrial lesion is poorly correlated with areas of reported pain.[10]

Surgical management is typically indicated in patients who have not responded to more conservative treatments. Two of the most common surgical techniques are ablation and excision. While there is a deep literature comparing the two, the analysis of the current paper largely focuses on excision. Excision surgery has been shown to reduce pain, reduce recurrence, and preserve fertility,[11] with improvements lasting at least 6 to 12 months later.[12] The purpose of this study is twofold: one, to replicate previous findings demonstrating improved outcomes after excision surgery; and two, to extend those findings to new metrics.

Methods

The current study retrospectively examines the outcomes of patients who underwent laparoscopic excision surgery. All standard protocols were followed during the procedure. Patients underwent general anesthesia and received three to five 5-12mm laparoscopic incisions. CO2 insufflation was used to create space in the abdominal wall, with pressures maintained between 10-15mmHg depending on individual surgeon preferences. Surgery typically lasted between 1 and 6 hours as was necessary to safely and fully complete the procedure. Potential endometriosis lesions were removed using surgical excision techniques and sent to pathology for evaluation. Hysterectomy, bowel resection, appendectomy, and other surgical procedures were performed as deemed necessary through appropriate patient consent and surgical decision making. The procedures were concluded in standard fashion. Patients were discharged the same or next day. Disease stage and use of adjuvant therapies were not available in a structured format and, therefore, not amenable to quantitative analysis.

The current study is a national, multicenter chart review. Data was gathered from 12 Pelvic Rehabilitation Medicine locations, spanning 13 board-certified minimally invasive gynecological surgeons. The study was conducted in accordance with and with approval from the Feinstein Institutes for Medical Research (IRB #17–0761). Consent forms were waived due to the retrospective nature of the study.

Data consisted of records stored in eClinical Works between the dates of January 1st, 2024 and July 23rd, 2026. Records were screened according to the following criteria: Patients must have undergone surgery and must not have undergone our protocol of pelvic nerve blocks[13]; this was to reduce potential confounds in improvement. Finally, patients must have attended both a preoperative and postoperative visit. Eligibility was then determined by the following criteria. Patients with more than one surgery were excluded. This was done in order to reduce variability between patient characteristics. Note, our analyses used mixed-effects models which allow records with partial data (e.g., missing a preoperative or postoperative score) to still contribute to model estimates. This analytical approach boosted our statistical power while simultaneously compensating for within-subject correlations inherent to a pre-post design. However, in order to establish a stable sample size that superseded the variability across individual outcomes, pain scores were used to anchor further inclusion and exclusion. Preoperative visits

without a pain score were excluded, postoperative visits without a pain score were excluded, and postoperative visits less than 6 weeks from the date of surgery were excluded to minimize effects due to postoperative recovery.

As such, our total sample of analyzed records was *N* = 535. Broken down by visit type, this resulted in *N* = 526 patients with preoperative scores, *N* = 260 patients with postoperative scores, and *N* = 251 patients with both preoperative and postoperative scores. Figure 1 shows the flow of record selection, while Table 1 shows how many records contributed to each outcome across time points. Sensitivity analyses were run on both the full data set (*N* = 535) and the complete cases (*N* = 251) data set. All trends replicated. See the *Supplementary Materials* for an in-depth discussion of all sensitivity and subgroup analyses.

Patient characteristics are reported for records with available. The median age of patients was 34 (*interquartile range* = 28, 40). The majority of patients had been experiencing pain for a substantial amount of time. Roughly 76% of patients reported having pain for at least 2 years, while 56% reported 5 years or more, and 33% reported 10 years or more. Patients sampled a number of diagnostic tests, treatments, and medications prior to their operation. Roughly 75% of patients had between 1 and 3 diagnostic tests done, the most prominent being ultrasound (*N* = 408), gynecologist workup (*N* = 314), and MRI (*N* = 164). Roughly 62% had sampled between 1 and 3 treatments, the most prominent being nutrition and diet (*N* = 274), hormonal treatment or birth control (*N* = 262), and massage (*N* = 184). Finally, roughly 30% had sampled between 1 and 3 medications, the most prominent being oral muscle relaxers (*N* = 87), gabapentin (*N* = 77), and duloxetine (*N* = 41). Table 2 contains a binned summary of the above.

Results

There were twelve outcomes of interest, spanning from pain to functionality to productivity and healthcare utilization. For ease of understanding, each outcome is described in detail alongside their analyses. The analyses consist of linear, cumulative link, and logistic mixed-effects models as appropriate. Visit type (preoperative or postoperative) was treated as a fixed effect. Patient ID was treated as a random effect to account for the repeated measures design. All analyses were done in R.[14] Descriptives are summarized in Table 1 and analyses in Table 3. A comprehensive set of subgroup and sensitivity analyses are available in the *Supplementary Materials*. Here we will merely note that the trends below were robust, confirmed in 60 of 61 analyses. The lone analysis that did not replicate our findings actually demonstrated that our primary analysis may have been conservative and underestimated the degree of improvement.

Pain was measured via the Numerical Rating Scale (NRS), an 11-point scale that consists of one item: "*On a scale of 0–10, how would you rate your average pain or discomfort of your worst symptom?*"[15] Lower scores on the scale indicate better outcomes. A linear mixed-effect model was conducted utilizing 786 observations across 535 distinct patients. NRS scores decreased between preoperative (*Mean* = 7.59) and postoperative visits (*Mean* = 3.97), $t(396.72) = -21.4$, $P < .001$. See Fig. 2.

The degree to which pain interfered with daily activities was measured using the Functional Pelvic Pain Scale.[16] The scale spans eight different categories: bladder, bowel, intercourse, walking, running, lifting more than 20 pounds, pain at work/while sitting, and sleeping. Responses consisted of a five-point ordinal scale between 0 (no interference) and 4 (extreme interference), and a "*Not Applicable*" option for any function the patient did not engage in. Given the ordinal response scale, cumulative link mixed-effect models were conducted for each category. There was a significant improvement between preoperative and postoperative visits in all eight categories, (*Ps* < .001). See Table 1 for descriptives, Table 3 for a summary of all model statistics, and Fig. 3 for a plot.

Changes in work productivity were operationalized by two questions. The first item measured absenteeism via the question, "*How many days of work did you miss in the past 3 months due to your pain or discomfort?*" Response options were ordinal bins of "*0 days*", "*1–5 days*", "*6–9 days*", "*10 + days*", and "*Not Applicable*." A cumulative link mixed-effect model was conducted utilizing 611 observations across 441 unique patients. Absenteeism improved between preoperative and postoperative visits, β = − .58, *SE* = .18, *Z* = -3.16, *P* = .002. Patients at postoperative experienced a 44% reduction in the odds of reporting a higher category of absenteeism compared to their preoperative evaluation, *OR* = 0.56, 95% *CI* [0.39, 0.80]. See Fig. 4.

The second question measuring work productivity asked about presenteeism: "*On average, how many hours a week is your work productivity affected due to your pain or discomfort?*" Response options were bins of "*0 hours*", "*1–4 hours*", "*5–10 hours*", "*11 + hours*", and "*Not Applicable.*" A cumulative link mixed-effect model was conducted utilizing 634 observations across 462 unique patients. Presenteeism improved between preoperative and postoperative visits, β = -1.38, *SE* = .18, *Z* = -7.3, *P* < .001. The odds of a patient reporting higher presenteeism at postoperative dropped 75% compared to their preoperative baseline, *OR* = .25, 95% *CI* [.17, .36]. See Fig. 4.

Visits to the emergency room were measured via a one-item question: "*Have you visited the ER in the past 12 months due to your pain or discomfort?*" Responses were "*Yes*", "*No*", and "*Not Applicable*." A mixed-effects logistic regression (i.e., a generalized linear mixed-effect model with a logit link function) was conducted utilizing 747 observations across 518 unique patients. Visits to the emergency room decreased between preoperative and postoperative visits, β = -1.73, *SE* = .29, *Z* = -5.95, *P* < .001. The odds of a patient visiting the emergency room at postoperative dropped by 82% compared to their preoperative baseline, *OR* = .18, 95% *CI* [.1, .31]. See Fig. 5.

Discussion

Numerous studies have shown improvements in pain relief following excision surgery.[11,12,17–22] In our study, pain improved in 80% of patients, dropping an average of 47%. As such, the current study replicates the literature on pain remediation post-excision surgery. Furthermore, it also extends those improvements to novel outcomes: namely those of pelvic functionality, work productivity, and healthcare utilization. Pelvic functionality improved for 46% of patients by an average of 44%, when averaged across

all eight categories. Workplace productivity improved for 46% of patients by an average of 17%, when averaged across absenteeism and presenteeism. Finally, healthcare utilization, as operationalized by visits to the emergency room, improved for 24% of patients, representing a 70% drop in visits. This is encouraging given previous research examining the often neglected financial burden of endometriosis.[3,4,23] The years of reported pain and the variety of diagnostics, treatments, and medications sampled by our patients is consistent with the diagnostic delays found in the literature.[7] Our study reinforces the continued need for early diagnosis and intervention.

Although our study had a short postoperative period—a median of 8 weeks—previous research has found sustained, long-term improvement after excision surgery. Randomized-control trials have found improvements lasting at least 6[24] and 12 months later[12]. One cohort study found sustained benefits up to 42 months later,[11] while another found improvements up to 6.8 years later.[21] Similarly, a long-term study found improvements after a median follow-up of 48 months postoperatively, with deep-infiltrating and adenomyosis patients showing the most pronounced quality of life benefits.[25] In regards to ovarian endometriosis, there is a fair amount of evidence that improvements in dysmenorrhea and dyspareunia may last for up to two years after surgery.[26] While not measured in the current study, the supposition that our patients would also demonstrate long-term improvements appears to be consistent with the literature at large. Despite this theoretical grounding, actual long-term improvement in our patients remains an empirical question, one that will be the subject of a forthcoming study.

There is a deep literature comparing excision and ablation surgery. Current evidence suggests that pain relief and fertility outcomes after excision and ablation are comparable for mild, peritoneal endometriosis[11,19] but that excision is preferred for severe cases in terms of pain relief and reoccurrence.[17,18] A systematic review and meta-analysis further corroborates this distinction, arguing that excision is only favorable over ablation in severe cases of endometriosis.[17] Similarly, one study points out that time since surgery had a greater impact on symptoms than surgical technique in regards to peritoneal endometriosis.[11]

Patient considerations are also important, particularly given that there is frequent discordance between patient and physician perceptions of symptoms.[27] A recent crowd-sourced study found that excision was favored over ablation, with ablation worsening a number of functional, sexual, psychoemotional, and economic outcomes[28]; although, it should be noted, these conclusions are based on potentially biased data from an excision advocacy group. Nonetheless, the push for incorporating patient perspectives is a valid and potentially rich vein for improving patient outcomes.[29]

Furthermore, there are medical reasons beyond the effectiveness of outcomes and patient perceptions for why one technique may be favored over another. For example, excision is favored when histological confirmation is desired.[17] In contrast, ablation may be favored when the boundary between cyst wall and the ovarian cortex is unclear as excision has be found to inadvertently reduce ovarian reserves.[30] Additionally, patients may favor ablation for being slightly less invasive.[11] While the single-arm nature of

our study prevents us from contributing to the literature comparing excision and ablation surgery, we would like to echo the call of others and emphasize how the overall nuances in the literature reinforce the importance of individualized, patient-centered approaches over that of standardized, disease-centered approaches.

This study has several limitations to consider when interpreting and generalizing its results. For one, as a retrospective design, it inherently lacks an active control group, randomization, blinding, preregistration, and other aspects of higher-tiered evidence. The flow of data selection and completeness should also be taken into account. While mixed-effects analyses are well suited to dealing with missing data and our sensitivity analyses corroborate our primary findings, incomplete documentation and the potential for self-selection should be acknowledged. Although there is theoretical reason to believe in the long-term benefits of the observed outcomes, the current study did not directly test it and cannot make any empirical claims to the effect. As a single-arm design, it also cannot make any direct comparisons between excision and ablation surgery. Finally, we did not assess the additive effect of adjuvant therapies such as hormones, which has been shown to reduce reoccurrence.[31] Nor did we stratify the data based on disease staging or location, although evidence suggests disease stage does not correlate with symptom severity.[10]

Despite these limitations, a potential strength of our study is the national, multi-centered nature of its data. Collecting data from 13 facilities and 14 surgeons increases the regional diversity of our patient population, reduces the effect of institutional biases, and mitigates effects attributable to differences in surgeon skills, experience, and practice. Another potential strength is the robustness of our results across numerous sensitivity and subgroup analyses. Our primary conclusions were consistent across differences in sample selection, model specification, and outcome variables.

Conclusion

Our retrospective study demonstrates the short-term, beneficial outcomes of excision surgery on endometriosis. It replicates previous reductions in pain while also extending those benefits to pelvic function, work productivity, and healthcare utilization. Our conclusions highlight the continued need for randomized controlled trials with long-term follow-ups and active controls.

Declarations

Ethics approval and consent to participate:

This study was approved by the Institutional Review Board of the Feinstein Institutes for Medical Research (IRB #17–0761) and conducted in accordance with the Declaration of Helsinki. Due to exempt

status, the requirement for informed consent was waived.

Consent for publication:

All authors have read and agreed to the published version of the manuscript.

Competing interests:

All authors are employed by Pelvic Rehabilitation Medicine. The authors declare no other financial or personal competing interests.

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Author Contribution

A.S., M.D., N.B., and G.S. contributed to conception, analysis, drafting, and revision. C.K., F.T., A.D., A.E., R.A., R.P., E.F., and E.G. contributed to data acquisition.

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Not applicable.

Data Availability

The datasets are available from the corresponding author upon reasonable request.

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Tables

Table 1. Summary of descriptives

		Preoperative			Postoperative			% of People	AVG %
Outcomes		N	Mean	SD	N	Mean	SD	Improved	Change
NRS		526	7.59	2.36	260	3.97	2.84	80%	-47%
FPPS	Bladder	498	1.34	1.22	252	0.88	1.02	44%	-34%
	Bowel	496	1.78	1.25	252	1.12	1.06	54%	-37%
	Intercourse	443	1.65	1.14	160	0.96	1.06	50%	-42%
	Lifting	463	1.09	1.17	195	0.67	1	37%	-39%
	Running	364	1.35	1.35	145	0.68	1.09	39%	-50%
	Sitting	447	1.59	1.17	226	0.79	0.96	55%	-50%
	Sleeping	492	1.08	1.1	250	0.56	0.82	43%	-48%
	Walking	500	1.08	1.07	249	0.53	0.74	44%	-51%
Absenteeism		434	2.01	1.02	177	1.85	1.21	38%	-8%
Presenteeism		452	2.54	1.05	182	1.87	1.12	54%	-26%
		N	% Yes	% No	N	% Yes	% No	% of People Improved	% Reduction in Yes
Visited the ER		507	33%	67%	240	10%	90%	24%	-70%

Table 1 Caption: The number of patients, group means, and standard deviations are shown for preoperative and postoperative visits. Because visits to the emergency room were binary (yes or no), the percentage of those visiting or not visiting is shown in lieu of means and standard deviations. The percentage of patients improved and the average percent change across visits are also shown.

Table 2. Pain and Medical History.

	Count	Percentage
Duration of Pain		
Less than 6 months ago	49	10.02%
Greater than 6 months ago	33	6.75%
1 year ago	34	6.95%
2 years ago	41	8.38%
3 years ago	27	5.52%
4 years ago	28	5.73%
5 years ago	20	4.09%
5-10 years ago	94	19.22%
10-15 years ago	69	14.11%
15+ years ago	94	19.22%
Treatments		
0	88	17.32 %
1-3	316	62.2 %
4-6	90	17.72 %
7-10	13	2.56 %
11+	1	0.2 %
Medications		
0	324	63.78 %
1-3	153	30.12 %
4-6	28	5.51 %
7 or more	3	0.59 %
Diagnostics		
1-3	356	75.74 %
4-6	114	24.26 %

Table 2 Caption: Ranges are shown for duration of pain, number of treatments, medications, and diagnostics undergone prior to the current treatment. Both total counts and percentages are shown.

Table 3. Summary of analyses.

Outcomes		Model	*Observations*	*PIDs*	*β*	*SE*	*DF*	*T*	*P*
NRS		LME	786	535	-3.66	0.17	396.72	-21.40	*P* < .001
					β	***SE***	***Z***	***P***	***Odds Ratio***
FPPS	Bladder	CLMM	750	515	-0.93	0.17	-5.50	*P* < .001	0.40
	Bowel	CLMM	748	512	-1.40	0.19	-7.53	*P* < .001	0.25
	Intercourse	CLMM	603	452	-1.49	0.22	-6.89	*P* < .001	0.23
	Lifting	CLMM	658	483	-0.86	0.19	-4.57	*P* < .001	0.42
	Running	CLMM	509	386	-1.33	0.23	-5.77	*P* < .001	0.27
	Sitting	CLMM	673	470	-1.77	0.21	-8.59	*P* < .001	0.17
	Sleeping	CLMM	742	511	-1.32	0.20	-6.76	*P* < .001	0.27
	Walking	CLMM	749	515	-1.36	0.19	-7.11	*P* < .001	0.26
Absenteeism		CLMM	611	441	-0.59	0.19	-3.17	*P* = .002	0.56
Presenteeism		CLMM	634	462	-1.38	0.19	-7.30	*P* < .001	0.25
ER Visits		GLMM	747	518	-1.73	0.29	-5.95	*P* < .001	0.18

Table 3 Caption: All models utilized mixed-effects, with a fixed effect of visit type (preoperative, postoperative) and a random effect of patient ID. LME = Linear Mixed-Effect. CLMM = Cumulative Link Mixed-Effect Model. GLMM = Generalized Linear Mixed-Effect Model with logit link function.

Figures

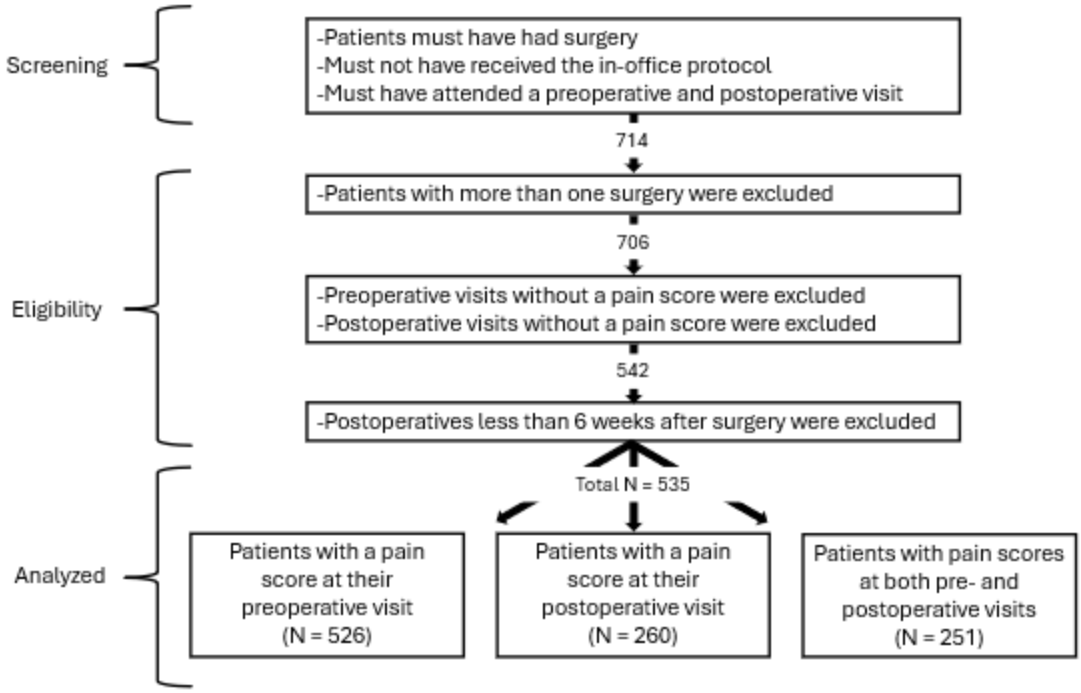


Figure 1

Flow of record selection.

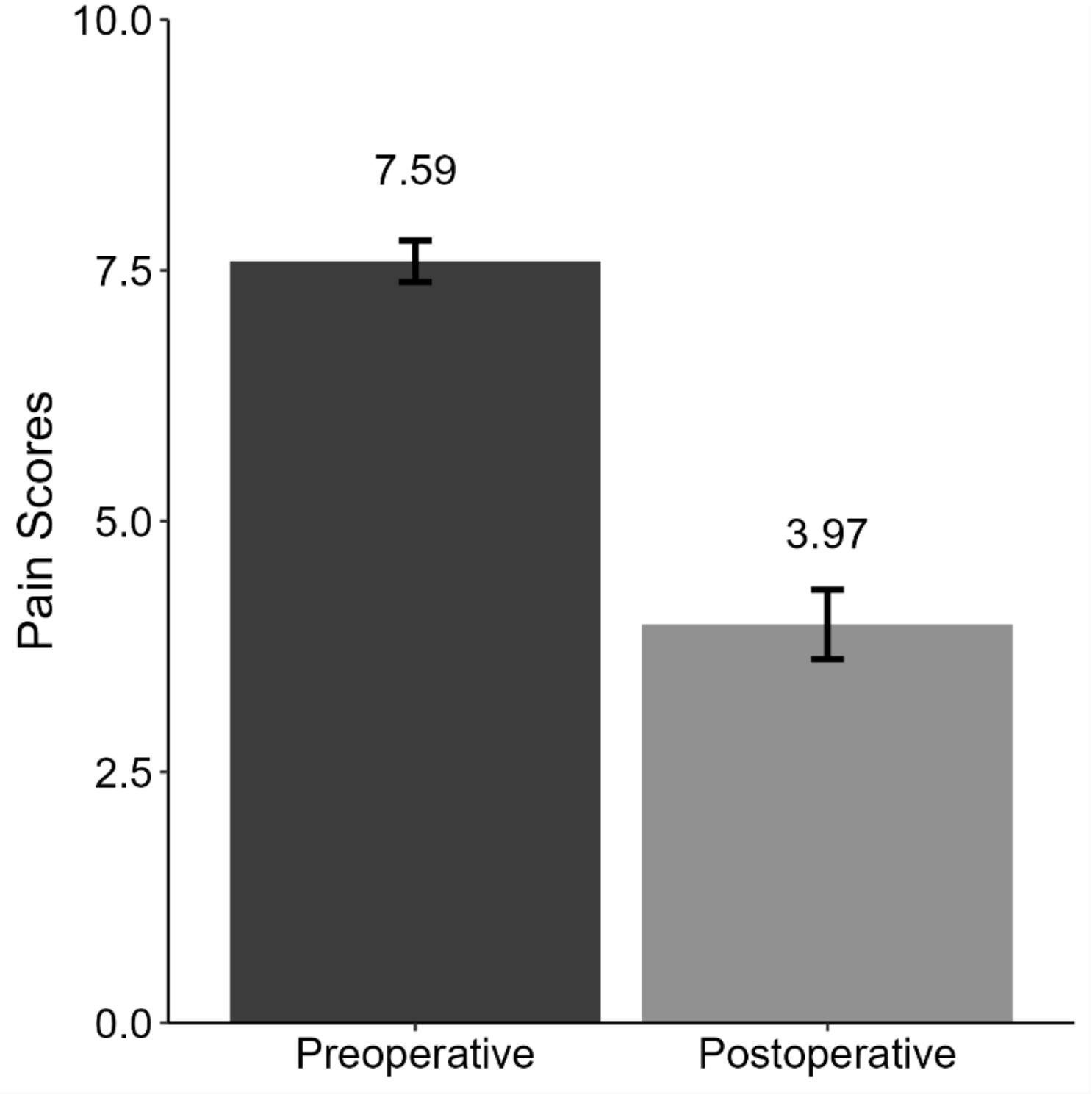


Figure 2

Numerical Rating Scale of Pain Scores. Means are shown. Error bars represent 95% confidence intervals.

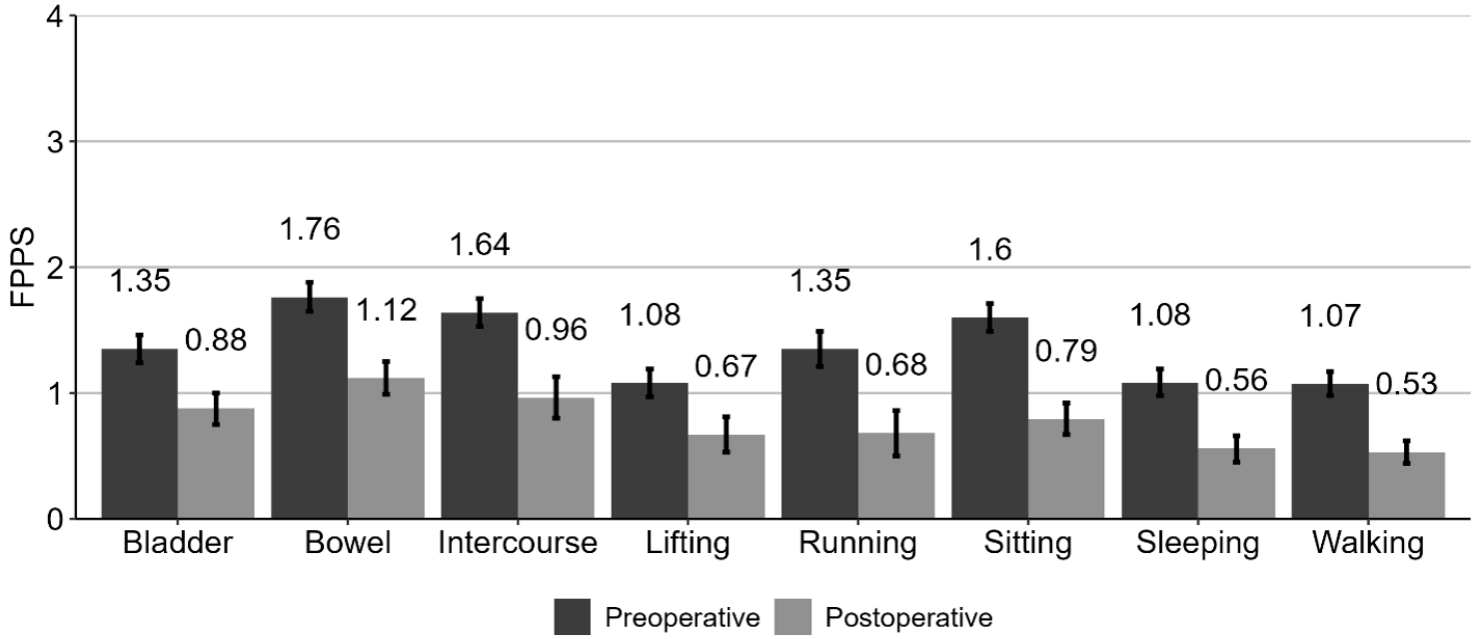


Figure 3

FPPS = functional pelvic pain score. Means are shown for each category. Error bars represent 95% confidence intervals.

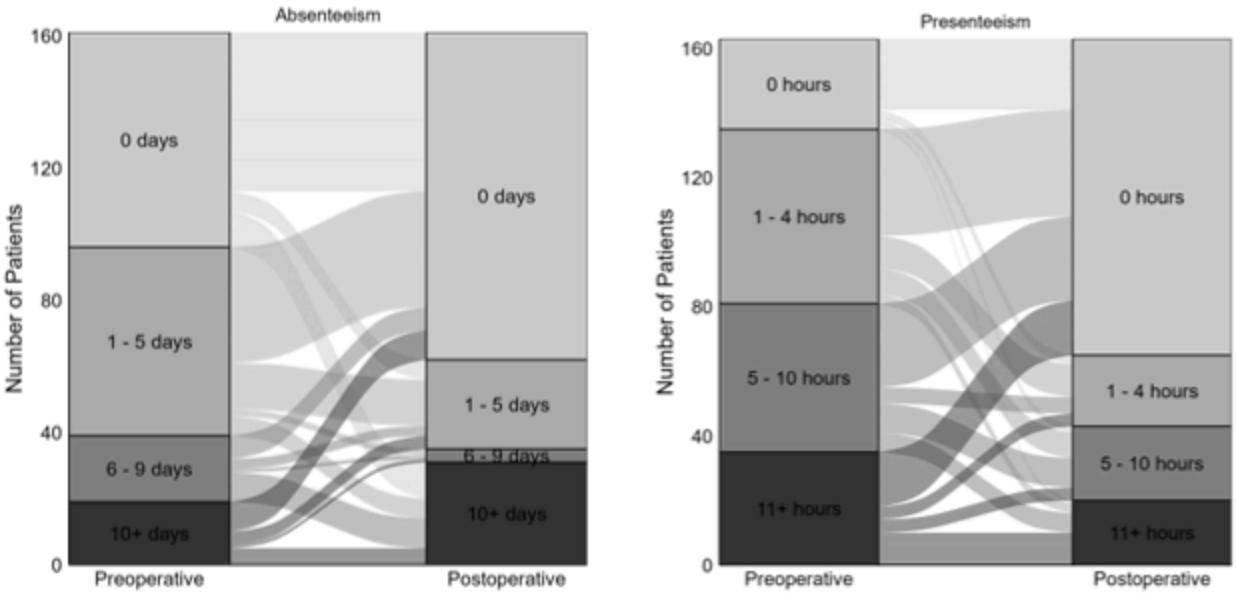


Figure 4

Absenteeism and Presenteeism. The alluvial diagrams show the relative proportion of responses in each bin (the stacked bars) as well as the direction of change between bins (the shaded ribbons) across preoperative and postoperative visits.

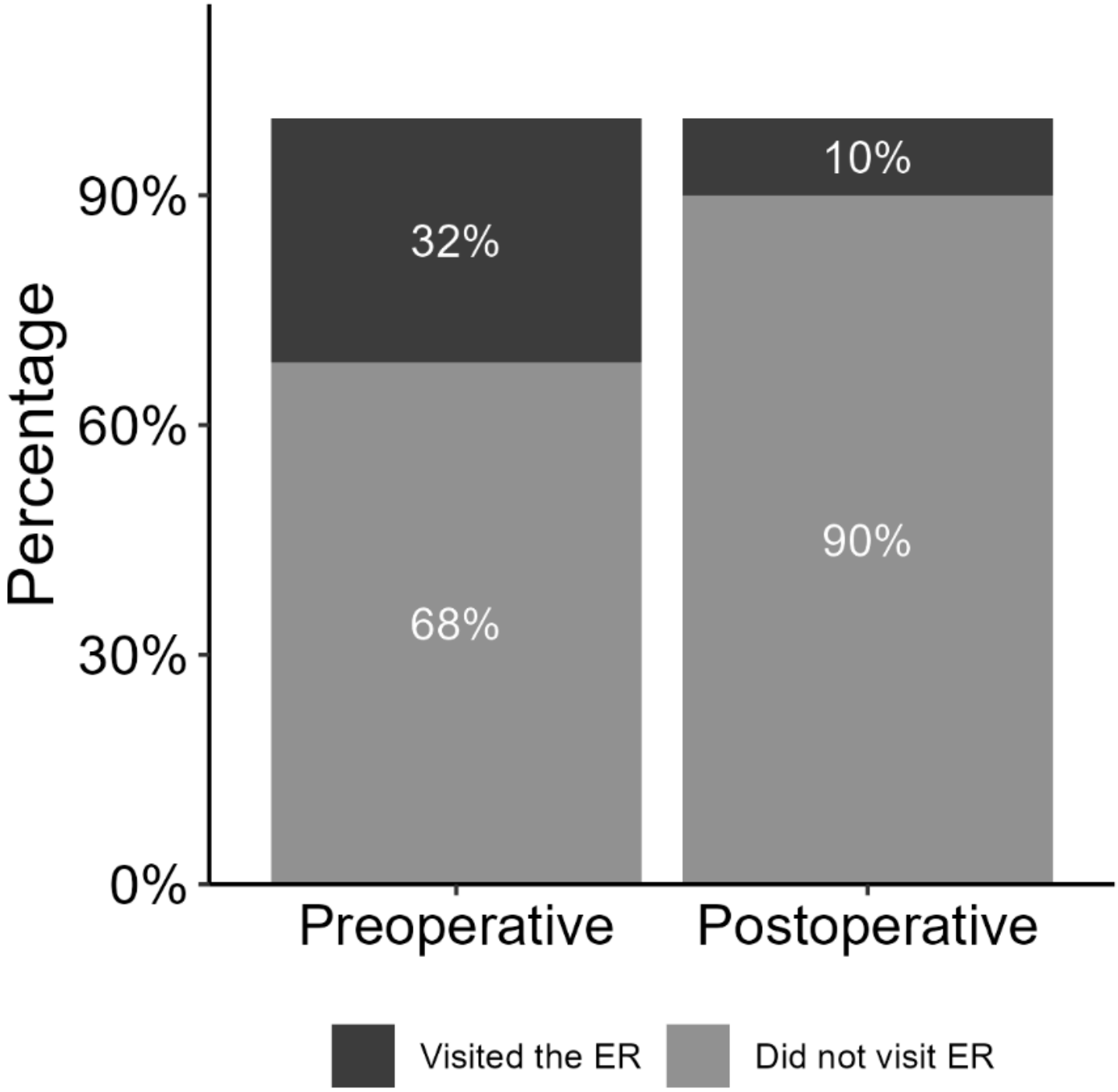


Figure 5

Visits to the emergency room.

Supplementary Files

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- ManuscriptSurgeryNewSupplementaryMaterials.docx