Original Research

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Extent of Myometrial Resection With Various Surgical Methods for Endometrial Polypectomy Procedures

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OBJECTIVE: To assess whether the frequency and extent of myometrial resection differs among surgical methods commonly used for endometrial polypectomy.

METHODS: We conducted a retrospective cohort study of pathology samples from polypectomy procedures performed on patients 18–50 years of age. Samples were reevaluated by a blinded pathologist to assess the following primary outcome measures: presence and percentage of myometrium on the pathology sample, prevalence of isolated myometrium, and depth of myometrial resection. Data were evaluated using Fisher exact test and Kruskal-Wallis test, followed by multiple comparisons analysis. To maintain a familywise error rate of 5% across all four primary analyses, the Bonferroni correction method was applied.

RESULTS: Of 458 pathology samples, 21.8% were obtained using hysteroscopic morcellators, 11.1% were obtained with hysteroscopic scissors, and 67.0% were obtained with hysteroscopy with dilation and curettage (D&C). Hysteroscopic morcellation demonstrated a higher prevalence of myometrium (58.0% vs 9.8% and 15.3%, for hysteroscopic scissors and hysteroscopy with D&C, respectively; $P<.001$), a larger percentage of pathology samples with more than 25% myometrium (26.0% vs 4.0% and 0.6%, respectively; $P<.001$), and a higher prevalence of isolated myometrium compared with hysteroscopy with D&C (11.0% vs 0.7%; $P<.001$).

CONCLUSION: The presence and proportion of myometrium in polypectomy samples obtained using hysteroscopic morcellators was significantly higher compared with hysteroscopic scissors and hysteroscopy with D&C.

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Endometrial polyps are growths of the endometrium that contain glands, stroma, and epithelium,[1] and have been associated with abnormal uterine bleeding, heavy menstrual bleeding, and infertility.[2–5] In addition, although a majority of endometrial polyps are benign, some reports indicate that premalignant or malignant transformation may occur in up to 13% of cases.[6] Removal of endometrial polyps has traditionally been performed using dilation and curettage (D&C), hysteroscopic scissors or loop resection; however, the use of hysteroscopic morcellators has become more common in recent years. Multiple studies have suggested that hysteroscopic morcellation is superior in regard to operative time, success rate, and intraoperative complication rate[7–9]; however, data are lacking regarding the extent of resection into the underlying myometrium with these various methods.

Which surgical method is chosen for endometrial polypectomy is likely based on many factors such as the availability and comfort with equipment, previous

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training, patient desire for future conception, menopausal status, and risk of an underlying malignancy. Understanding the extent of resection into the underlying myometrium adds additional information to consider when choosing which surgical method to use based on the desired outcome. For example, previous guidelines indicated that intraoperative pathological examination may increase the sensitivity and specificity for risk classification in a patient with suspected endometrial cancer[10]; however, more recent guidelines do not support this strategy due to poor reproducibility and concordance with final pathology.[11] The method commonly used for intraoperative examination has been D&C. If morcellation is found to have a deeper resection into the myometrium this may warrant further consideration. Conversely, in a patient who desires future fertility, choosing a method with less myometrial resection may decrease the likelihood of intrauterine adhesions. Although development of intrauterine adhesions is not fully understood, procedures associated with deeper myometrial resection, such as myomectomy, have been associated with increased risk of adhesions.[12]

It is unclear the extent to which hysteroscopic polypectomy leads to myometrial resection and whether this varies by surgical method. Therefore, our study aimed to assess whether the frequency and depth of myometrial resection differs among methods used for endometrial polypectomy. Knowledge about whether there are differences in the depth of myometrial resection could open the door to future studies' assessments of whether the benefit of one method over the other may differ depending on the specific patient situation or the specific goal of the surgery.

METHODS

IRB approval was obtained at Carilion Clinic. TriNetX, a global federated health research network that provides access to electronic medical records in aggregate counts and summaries, was used to query the medical record database for all endometrial polypectomy procedures performed in reproductive-aged patients (age 18–50 years) between January 2015 and May 2019 using Current Procedural Terminology code 58558. Polypectomy procedures performed at all locations, including hospitals, ambulatory surgery centers, and offices, were eligible for inclusion. Procedures performed on patients with a history of a müllerian anomaly, female genital tract malignancy, endometrial ablation, uterine fibroids, or menopause were excluded. During the study period, two hysteroscopic morcellators were available for use, both of which are motor driven mechanical morcellators. Demographic data were extracted from the medical record system and surgical details were obtained by manual chart review confirmed by two authors. Race was included due to known health disparities and was pulled from the electronic medical record. Data management was performed using REDCap with a single linkage file maintained by the institutional research team.

Pathology sample slides from endometrial polypectomy procedures were retrieved from archive and reevaluated by a single pathologist who was blinded to all procedure and patient-related information, including the original pathology report. Primary outcomes assessed by the blinded pathologist included: presence of myometrium (yes or no); quantity of myometrium as a percentage of total tissue (0%, 1–25%, 26–50%, 51–75%, more than 75%); presence of isolated myometrial sections (yes or no); and depth of resection into myometrium in sections adjacent to endometrium (mm). Secondary outcome measures included operative time, surgical blood loss, hysteroscopic fluid deficit, and concordance of reporting myometrium on initial pathology report and blinded reevaluation. *Operative time* was defined as the total time the patient was present in the operating room, including anesthesia induction and awakening. Surgical blood loss was estimated by the surgical team and hysteroscopic fluid deficit was calculated using the Thermedx fluid management system for procedures performed in the hospital and ambulatory surgery center, and manually for procedures performed in the office. *Concordance of reporting* was defined as both the initial pathology report and blinded reevaluation indicating the presence of myometrium, or neither indicating the presence of myometrium. If the initial pathology report indicated that myometrium was present but the blinded evaluation did not (or vice versa), this was considered discordant.

Power analysis performed using data obtained on the initial TriNetX query determined that 250 total tissue samples would allow for the detection of a statistically significant difference for all primary outcomes (80% power, 5% level of significance). Due to small cell values for some variables and for consistency, Fisher exact test was used to compare the results of all the categorical variables (race, diagnosis of infertility, presence of isolated myometrial sections) among the three surgical methods (hysteroscopic morcellator, hysteroscopic scissors, and hysteroscopy with D&C). Similarly, the distributions of the continuous variables were not normally distributed and were analyzed using the nonparametric Kruskal-

Wallis test. If the Kruskal-Wallis test resulted in a statistically significant result, the Dwass, Steel, Critchlow-Flignor multiple comparison analysis was used to identify the specific pairs of surgical methods with significant differences. Data are reported in median with interquartile range or n (%).

To maintain a familywise error rate of 5% across all four primary analyses, a Bonferroni correction was applied. The Bonferroni correction adjusts the significance level (alpha) for each individual test by dividing the overall alpha level (0.05) by the number of comparisons. Because we conducted four comparisons, the adjusted alpha level for each test becomes 0.05 divided by 4, which equals 0.0125. Therefore, for each primary outcome the statistical significance was evaluated using a significance threshold of 0.0125 to ensure that the overall probability of making at least one Type I error (false positive) among all four comparisons remains at or below 5%.

Sensitivity analyses were performed to account for situations in which the chance of myometrial resection and depth of surgical resection differed. This included a reanalysis of primary and secondary outcomes by subgroups that included the general obstetrics and gynecology physicians only (excluding all subspecialty physicians given that they may be more or less prone to a deeper resection), reproductive endocrinology and infertility (REI) physicians only, patients younger than age 35 years, and nulliparity given considerations for childbearing.

RESULTS

There were 469 endometrial polypectomy procedures that were eligible for inclusion in the study. Eleven were excluded due to lack of pathology sample and or unclear surgical method. Of the 458 procedures included in the analysis, 100 (21.8%) were performed using the hysteroscopic morcellator, 51 (11.1%) using hysteroscopic scissors, and 307 (67.0%) using hysteroscopy with D&C. Patients undergoing endometrial polypectomy had a median age of 39 years (IQR 10.0), were more likely to be White (83.0%) and multigravid (80.3%), had had body mass index (BMI, calculated as weight in kilograms divided by height in meters squared) in the obesity range (median 32.7, interquartile range 14.5). Patient demographics by surgical method are displayed in Table 1. Most notably, patients who underwent polypectomy with hysteroscopic scissors were younger and more often nulliparous when compared with patients who underwent hysteroscopic morcellation and hysteroscopy with D&C.

The presence of myometrium on pathology was statistically more common for procedures performed using hysteroscopic morcellation, in comparison with hysteroscopic scissors and hysteroscopy with D&C (58.0% vs 9.8% and 15.3%, respectively; $P<.001$, Fig. 1). The presence of isolated myometrium was also more common for procedures that used the hysteroscopic morcellator, compared with the procedures using hysteroscopy with D&C (11.0% vs 0.7%; $P<.001$, Fig. 1); however, the other pairwise comparisons were not statistically significant. Similarly, samples obtained with hysteroscopic morcellators were more likely to contain a larger percentage of myometrium compared with both of the other methods (more than 25% myometrium was found on 26.0% of pathology samples from hysteroscopic morcellation vs 4.0% for hysteroscopic scissors and 0.6% for hysteroscopy with D&C; $P<.001$, Fig. 2) and demonstrated a larger depth of myometrial resection in sections with adjacent endometrium in comparison with hysteroscopy with D&C ($P<.001$, Fig. 3); samples did not differ from those in procedures performed with hysteroscopic scissors.

Sensitivity analysis demonstrated similar findings in primary outcomes when assessed by subgroup (generalist division, REI division, patients younger than age 35 years, and nulliparity) (Table 2). Similar to the overall cohort, all subgroups, with the exception of procedures performed by the REI division, demonstrated increased presence and percentage of myometrial tissue with hysteroscopic morcellation in comparison with both of the other procedures, as well as increased depth of resection in comparison with hysteroscopy with D&C. In the REI subgroup, there was increased presence and percentage of myometrial tissue when compared with hysteroscopic scissors, but did not differ from hysteroscopy with D&C, and no differences were found for depth of resection among any of the procedure types. Although the presence of isolated myometrium was significantly higher with hysteroscopic morcellation compared with hysteroscopy with D&C in the generalist group, it did not reach statistical significance in the REI division subgroup, the younger-than-35-years subgroup, or the nulliparous subgroup, likely due to the low prevalence of isolated myometrium in these groups.

Hysteroscopic fluid deficit was significantly higher for procedures performed using the hysteroscopic morcellator in comparison with hysteroscopy with D&C (265 mL vs 130 mL; $P<.001$) but did not differ statistically from procedures performed with hysteroscopic scissors (170 mL). There were no differences noted in estimated blood loss (10 mL the morcellator

Table 1. Demographics of Patients Undergoing Hysteroscopic Polypectomy

Demographic*	Hysteroscopic Morcellator (n=100)	Hysteroscopic Scissors (n=51)	Hysteroscopy With D&C (n=307)	*P*
Age (y) [median (IQR)]	40 (8.5) β	36 (12) βλ	39 (10) λ	.004
BMI (kg/m^2) [median (IQR)]	33.9 (15.4)	33.6 (13.1)	32.1 (15.4)	.69
Race [n (%)]†				.07
Black	14 (14)	1 (2)	29 (9.5)	
White	82 (82)	44 (86.3)	254 (82.7)	
Additional races and ethnicities	4 (4)	6 (11.8)	24 (7.8)	
No. of previous pregnancies [median (IQR)]	2 (1)	2.5 (2)	2 (2)	.252
Living children [median (IQR)]	1 (2) β	0 (2) βλ	2 (2) λ	<.001
Diagnosis of infertility [n (%)]‡	22 (22.5)	21 (41.2) λ	37 (12.2) λ	<.001
Endometrial polyp seen on preoperative imaging [n (%)]§	56 (59) θ	29 (61.7)	106 (41.3) θ	.002

D&C, dilation and curettage; IQR, interquartile range; BMI, body mass index.
* Matching Greek letters across the rows indicate statistically significant pairwise comparisons using the Bonferroni correction of 0.0125.
† Race was included due to known health disparities and was extracted from the electronic medical record.
‡ Data missing for five procedures.
§ Data missing for 59 procedures.

vs 10 mL for scissors vs 10 mL for D&C,) or operative time (61 minutes for the morcellator vs 60 minutes for scissors vs 60 minutes for D&C). The reporting of myometrium on initial the pathology report was higher for procedures performed with the hysteroscopic morcellators in comparison with hysteroscopic scissors and hysteroscopy with D&C (40.0% vs 3.9% and 9.5%, $P<.001$). Concordance of reporting the presence of myometrium between initial pathology report and blinded reevaluation was high (82.0–86.0%) and did not differ significantly among surgical methods. Subgroup analysis of secondary outcomes demonstrated findings consistent with the overall cohort (data not shown).

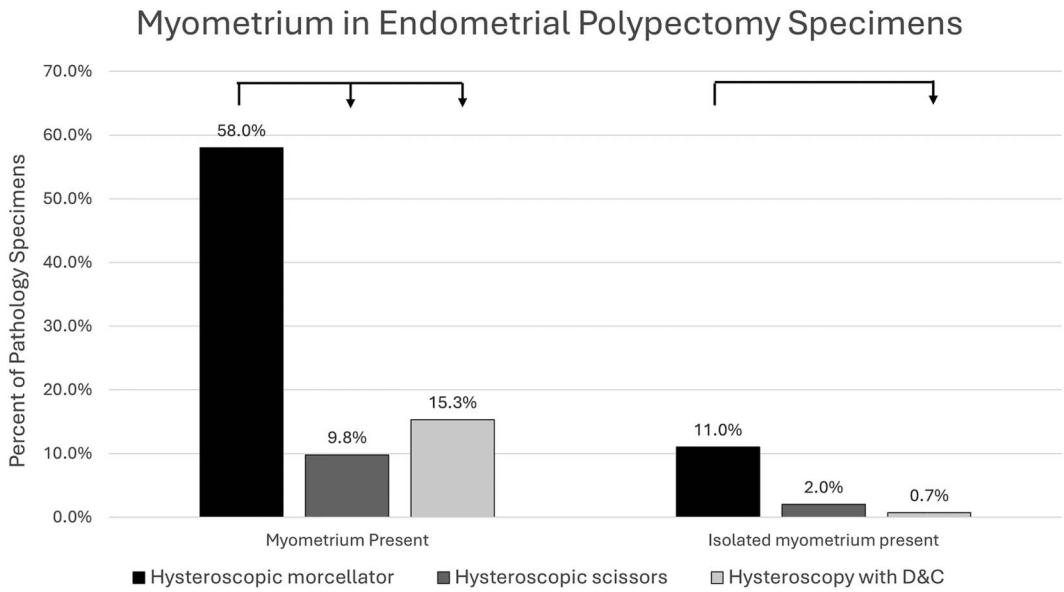

Fig. 1. Presence of myometrium and isolated myometrium on pathology samples. Percentage of pathology specimens with myometrium present is demonstrated on the *left side* of the graph, and percentage of pathology specimens with isolated myometrium (myometrium without adjacent endometrium) is on the *right*. Pairwise comparisons indicated that the hysteroscopic morcellator had statistically more myometrium present than the scissors or dilatation and curettage (D&C) methods. It had statistically more isolated myometrium present than the D&C method only.

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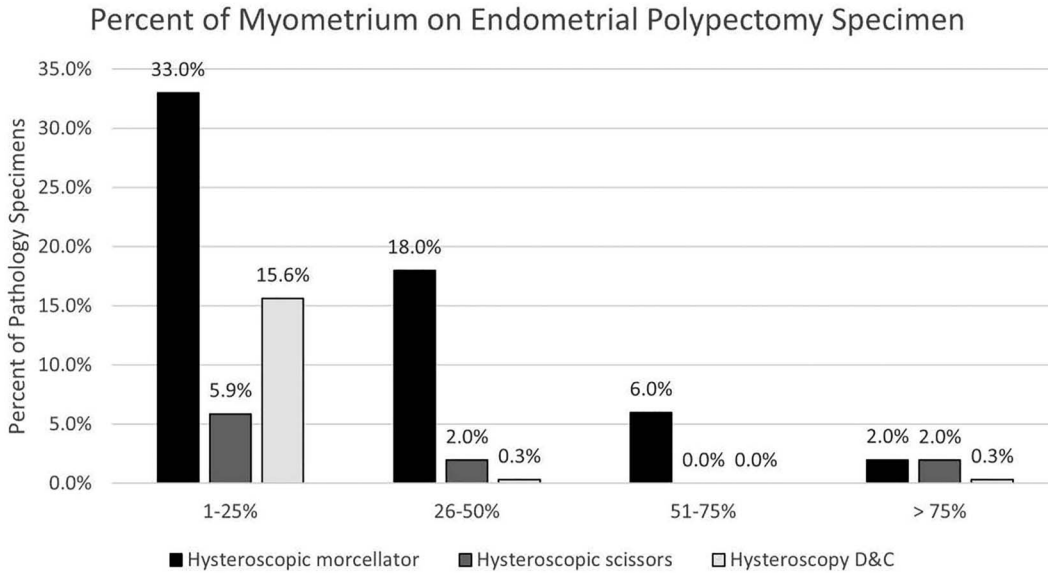

Fig. 2. Percentage of myometrium present on pathology samples. Data represent the amount of myometrium on pathology samples presented as a percentage of the total tissue. Pairwise comparisons indicated that the breakdown of the percentage of myometrial resection (mm) was statistically higher with the hysteroscopic morcellator than with the hysteroscopic scissors ($P<.001$) or hysteroscopy with dilatation and curettage (D&C) ($P<.001$). There was no significant difference between the hysteroscopic scissors or the hysteroscopy with D&C methods ($P=.042$) when applying the Bonferroni correction for pairwise comparisons.

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DISCUSSION

In this study of hysteroscopic polypectomy pathology samples, the use of the morcellator was associated with increased prevalence and percentage of myometrium in comparison with hysteroscopic scissors and hysteroscopy with D&C. In addition, compared with hysteroscopy with D&C, hysteroscopic morcellation demonstrated increased depth of resection and isolated myometrium. Patients who underwent polypectomy with hysteroscopic scissors were younger and more often nulliparous, suggesting that the choice of surgical method may have been influenced by desire for future fertility; therefore, multiple subgroup analyses were performed and demonstrated findings similar to those in the overall cohort.

Certain surgical methods may be inherently biased toward overidentification of isolated myometrium due to the size of tissue sections obtained for pathology (ie, smaller tissue sections may be more likely to exhibit isolated myometrium); therefore, multiple measures of myometrial resection were used. Although a smaller tissue section may be more likely to overestimate isolated myometrium, it may also be more likely to underestimate the depth of resection; thus, inconsistencies would be expected if these findings were due solely to tissue size. Additionally, assessing the presence and percentage of myometrium in the total sample allows for analysis of the tissue sample as a whole, rather than as individual tissue sections.

Previous studies assessing the efficacy and safety of hysteroscopic resection methods do not include a direct measure of myometrial resection and frequently do not include hysteroscopic scissors or hysteroscopy with D&C. Previous studies have evaluated postoperative intrauterine adhesions, which may be more common in procedures with increased myometrial resection; however, these data most often do not include hysteroscopic polypectomy procedures and do not directly evaluate myometrial resection. A randomized trial of hysteroscopic morcellation compared with bipolar resection of placental remnants reported a 3% incidence of postoperative intrauterine adhesions for both methods.[13] In contrast, the incidence of intrauterine adhesions after sharp curettage has been reported to range from 16%[14] to 40%.[15] These differences suggest that use of a sharp curette may be associated with increased myometrial resection; however, the findings of this study do not support that hypothesis in the setting of endometrial polypectomy procedures. This inconsistency is potentially related to the type of procedure being performed and or that adhesions may not be a reliable marker for myometrial resection.

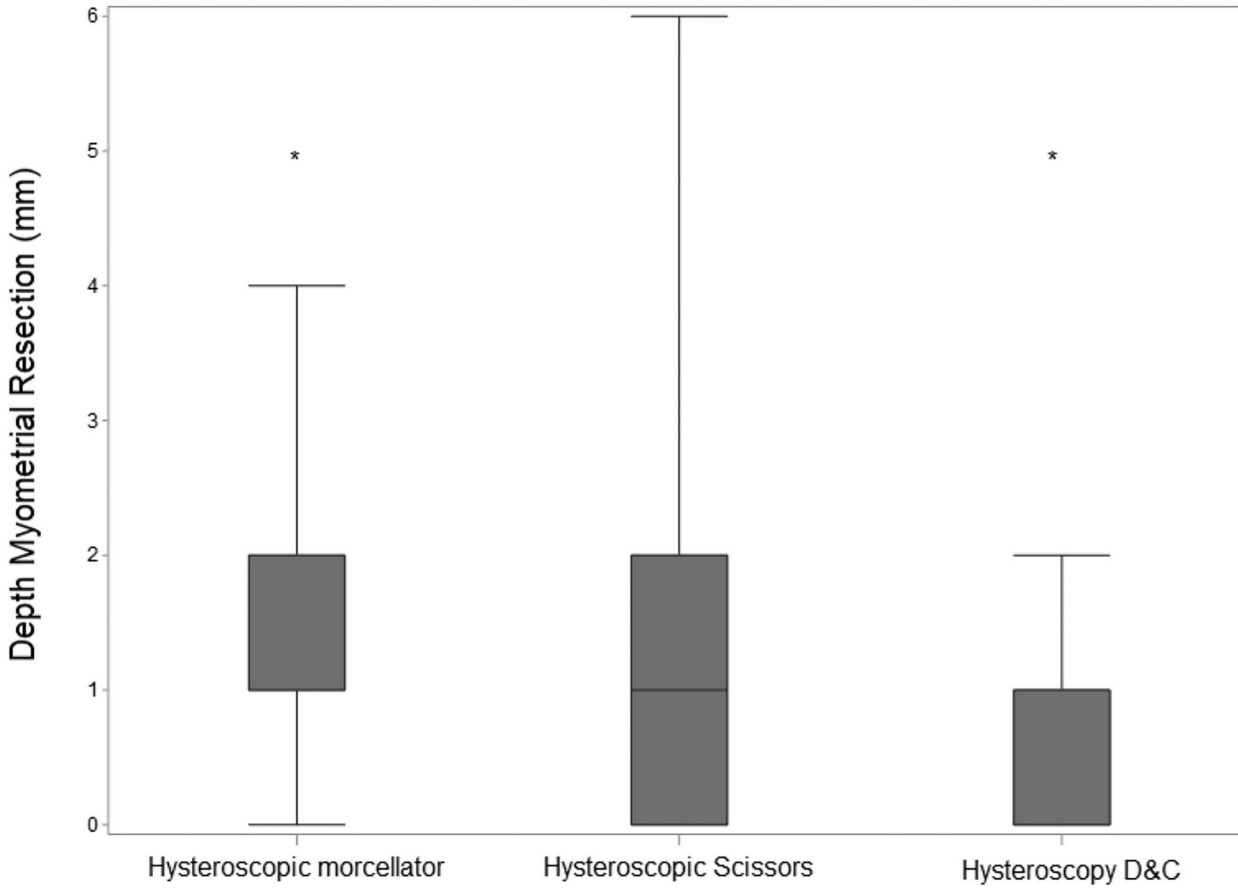

Fig. 3. Depth of myometrial resection in sections adjacent to endometrium on pathology samples. The Dwass, Steel, Critchlow-Flignor multiple comparisons indicated that the depth of myometrial resection (mm) was statistically increased with the hysteroscopic morcellator compared with hysteroscopy with dilatation and curettage (D&C) only ($P<.001$).
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Initial pathology reports more often mentioned the presence of myometrium when hysteroscopic morcellation was performed. Pathologists consulted during the development of this study indicated that reporting of myometrium is inconsistent and may not be reliable; thus, a comparison was made between initial report and blinded reevaluation. Concordance ranged between 82% and 86% and did not differ significantly between surgical methods, suggesting that mention of myometrium on initial pathology report was a relatively reliable marker for the procedures included in this study.

Regarding polypectomy surgical complications, a meta-analysis of eight randomized trials demonstrated that hysteroscopic morcellation was superior for operative time, success rate, and surgical complication rate compared with monopolar or bipolar electrode, diode laser, and traditional resectoscopy.[8] Multiple other studies have corroborated these findings, though few have offered comparisons to hysteroscopic scissors or hysteroscopy with D&C. The findings in this study do not support a significant benefit regarding fluid deficit, blood loss, or operative time when compared with hysteroscopic scissors or hysteroscopy with D&C. Though hysteroscopic fluid deficit was higher with hysteroscopic morcellation in comparison with hysteroscopy with D&C, it did not differ from hysteroscopic scissors, and average fluid deficits for all surgical methods were found to be within widely accepted ranges. There were no differences in estimated blood loss or operative time, though the average operative time reported in this study is significantly longer than in previously published literature (5 minutes 28 seconds to 10 minutes 10 second).[7,9,16–20] This is likely due to widely varying surgical practices, surgical settings (private practice vs teaching institutions), varying resources, and use of various definitions of operative time, including morcellation time and total time in the operating room.

Strengths of this study include its large sample size, the use of a single blinded pathologist, and use

Table 2. Sensitivity Analysis of Primary Outcomes by Subgroup

Outcome*	Hysteroscopic Morcellator	Hysteroscopic Scissors	Hysteroscopy With D&C	P†
Presence of myometrium				
Generalist division (n=351)	44 (63.8) βθ	4 (17.4) β	39 (15.1) θ	<.001
REI division (n=72)	8 (38.1) β	1 (3.9) β	3 (12.0)	.007
Younger than 35 y (n=133)	12 (60.0) βθ	1 (4.8) β	10 (10.9) θ	<.001
Nulliparous (n=118)	16 (64.0) βθ	3 (12.5) β	11 (15.9) θ	<.001
Presence of isolated myometrium				
Generalist division (n=351)	10 (14.5) θ	1 (4.4)	2 (0.8) θ	<.001
REI division (n=72)	1 (4.8)	0 (0.0)	0 (0.0)	.292
Younger than 35 y (n=133)	2 (10.0)	0 (0.0)	1 (1.1)	.073
Nulliparous (n=118)	4 (16.0)	0 (0.0)	2 (2.9)	.035
Depth of myometrial resection (mm) [median (IQR)]				
Generalist division (n=126)	1 (1) θ	1.5 (3)	0 (1) θ	<.001
REI division (n=17)	1.5 (1) θ	0 (1)	0.5 (1) θ	.015
Younger than 35 y (n=86)	2 (1) θ	0.5 (1)	0 (1) θ	.002
Nulliparous (n=33)	1.5 (1) θ	1 (0)	1 (1) θ	.001
% myometrial tissue				
Generalist division (n=351)	Bθ	β	θ	<.001
0	24 (34.8)	19 (82.6)	217 (83.8)	
1–25	24 (34.8)	2 (8.7)	40 (15.4)	
26–50	15 (21.7)	1 (4.4)	1 (0.4)	
51–75	4 (5.8)	0 (0.0)	0 (0.0)	
More than 75	2 (2.9)	1 (4.4)	1 (0.4)	
REI division (n=71)	B	β		.011
0	12 (60.0)	25 (96.2)	22 (88.0)	
1–25	4 (20.0)	1 (3.9)	3 (12.0)	
26–50	3 (15.0)	0 (0.0)	0 (0.0)	
51–75	1 (5.0)	0 (0.0)	0 (0.0)	
More than 75	0 (0.0)	0 (0.0)	0 (0.0)	
Younger than 35 y (n=132)	Bθ	β	θ	<.001
0	7 (36.8)	20 (95.2)	81 (88.0)	
1–25	5 (26.3)	1 (4.8)	9 (9.8)	
26–50	6 (31.6)	0 (0.0)	1 (1.1)	
51–75	1 (5.3)	0 (0.0)	0 (0.0)	
More than 75	0 (0.0)	0 (0.0)	1 (1.1)	
Nulliparous (n=118)	Bθ	β	θ	<.001
0	9 (36.0)	21 (87.5)	58 (84.1)	
1–25	9 (36.0)	3 (12.5)	10 (14.5)	
26–50	4 (16.0)	0 (0.0)	0 (0.0)	
51–75	3 (12.0)	0 (0.0)	0 (0.0)	
More than 75	0 (0.0)	0 (0.0)	1 (1.5)	

D&C, dilation and curettage; REI, reproductive endocrinology and infertility; IQR, interquartile range.
Data are n (%) unless otherwise specified.
* Matching Greek letters across the rows indicate statistically significant pairwise comparisons using the Bonferroni correction of 0.0125.
† *P* values are for primary outcomes by surgical method in individual subgroups.

of multiple measures of myometrial resection. However, we found a lack of diversity among patients who were undergoing polypectomy procedures, which may make these findings less generalizable. In addition, given the retrospective nature of the study, patients were not randomized to a procedure method, and reasons for surgeon choice of which method to use could not be assessed. These findings do, however, provide justification for larger prospective studies to confirm the findings in this study and evaluate the potential risks and benefits of choosing a method associated with more or less myometrial resection at the time of endometrial polypectomy.

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