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Original Research

Uterine Smooth Muscle Tumors of Uncertain Malignant Potential: Preoperative Diagnostic Challenges and Clinicopathologic Features in a Single-Center Case Series

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Abstract

Background: Uterine smooth muscle tumors of uncertain malignant potential (STUMP) are rare neoplasms that cannot be confidently classified as benign leiomyoma or leiomyosarcoma on histologic grounds. Because their symptoms and imaging features overlap with those of leiomyoma, the diagnosis is usually made only after surgery, so that some patients undergo uterine-sparing or minimally invasive procedures, including morcellation, for presumed benign disease. We aimed to characterize the clinicopathologic features and preoperative imaging findings in a single-center cohort of patients with histologically confirmed STUMP and to determine the frequency with which malignancy was suspected before surgery. Because only confirmed STUMP cases were included, the analysis reflects the proportion of suspected malignancy within the STUMP cohort rather than diagnostic accuracy. **Methods:** We retrospectively reviewed 22 women who underwent surgery between January 2020 and October 2022 and received a histopathologic diagnosis of STUMP based on the Stanford criteria. Demographic, imaging, operative, and pathological variables were extracted, and follow-up duration was calculated from the date of surgery to the last clinical contact. All variables were descriptively summarized. **Results:** The median age was 44 (range, 26–57) years, and 7 patients (32%) were nulliparous. Preoperative assessment classified the lesions as benign in 18 of 22 patients (82%; 95% confidence interval [CI], 61–93%) and as suspicious for malignancy in 4 patients (18%). Eleven patients (50%) underwent hysterectomy, and 10 (45%) underwent uterine-sparing surgery. All 10 uterine-sparing procedures were performed in patients with a benign preoperative impression; these included 7 minimally invasive resections, in each of which the specimen was extracted by contained in-bag hand morcellation. Coagulative tumor cell necrosis was present in 13 patients (59%), and moderate-to-severe cytologic atypia was observed in 5 patients (23%). Over a median follow-up of 56 (range, 39–73) months, no confirmed recurrence was identified (0/22; 95% CI, 0.0–15.4%), and no patient underwent reoperation for recurrence. Two patients (9%) had indeterminate, myoma-suspicious lesions under imaging surveillance without histological confirmation, whereas 20 (91%) had no evidence of disease. **Conclusions:** Uterine STUMP was rarely suspected preoperatively, and many patients underwent minimally invasive, uterine-sparing surgery for presumed benign disease, with tissue extracted by contained in-bag morcellation. Although no confirmed recurrence occurred over nearly 5 years of follow-up, the small sample size precludes concluding that recurrence risk is low or excluding the possibility of recurrence. Standardized long-term surveillance and prospective studies with routine p53/p16 immunohistochemistry are warranted.

Keywords: smooth muscle tumor of uncertain malignant potential; uterine neoplasm; leiomyoma; preoperative diagnosis; morcellation; uterine-sparing surgery; immunohistochemistry

1. Introduction

Uterine smooth muscle tumors of uncertain malignant potential (STUMP) occupy an equivocal morphological category between benign leiomyomas and leiomyosarcomas. They are uncommon and account for only a small fraction of all uterine smooth-muscle neoplasms [1,2]. The diagnosis is based on the Stanford criteria and is incorporated into the World Health Organization classification, which integrates the degree of cytologic atypia, mitotic index, and the presence of coagulative tumor cell necrosis. Lesions that cannot be confidently assigned to either the benign or malignant category are designated STUMP [3,4]. Because these features lie on a morphological continuum and their assessment is partly subjective, interobserver variability in diagnosis is well recognized [4,5].

One central clinical difficulty is that STUMP cannot be reliably distinguished from benign fibroids before surgery. Presenting symptoms such as abnormal uterine bleeding, pelvic pain, or a palpable mass and imaging features overlap with those of leiomyoma; therefore, diagnosis is usually made incidentally upon examination of the surgical specimen [1,2]. These findings have important implications in surgical treatment. Many patients, particularly younger women who wish to preserve their uterus, undergo myomectomy or minimally invasive procedures for a presumed benign lesion. Intracorporeal tissue extraction (morcellation) of an unsuspected STUMP or leiomyosarcoma has been associated with intra-abdominal dissemination and recurrence, concerns that prompted the 2014 United States Food and Drug Administration safety communication on laparoscopic power morcellation [1,6].

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Although STUMP generally follows an indolent course, recurrence and occasional metastasis can occur, sometimes several years after the index operation, with reported recurrence rates ranging from approximately 8% to >20% across series [1,2,7]. No adjuvant therapy has been established, and long-term surveillance is advised, but not standardized. Immunohistochemical markers, particularly p16 and p53, together with molecular approaches such as genomic index profiling, have been proposed to refine the distinction between indolent and aggressive lesions. However, they are not yet part of the diagnostic criteria and require further validation [2,7].

Existing knowledge on STUMP is derived largely from small retrospective series and pooled literature reviews, and relatively few studies have specifically examined how often the diagnosis is suspected before surgery or the resulting surgical exposure to morcellation [1,2,8]. Therefore, we reviewed a consecutive single-center cohort of patients with a confirmed histologic diagnosis of STUMP to describe their clinicopathologic and preoperative imaging characteristics, quantify the proportion of patients in whom malignancy was suspected preoperatively, and characterize the surgical approaches used, with particular attention to minimally invasive, uterine-sparing procedures performed for presumed benign disease. Because the cohort comprised only confirmed STUMP cases without leiomyoma or leiomyosarcoma comparison groups, this study characterized this proportion within STUMP rather than preoperative diagnostic accuracy.

2. Materials and Methods

2.1 Study Design and Ethics

This retrospective case series was conducted in the Department of Obstetrics and Gynecology, Korea University Anam Hospital, Korea University College of Medicine, Seoul, Republic of Korea. The study was approved by the Institutional Review Board of Korea University Anam Hospital (IRB No. 2023AN0120), which waived the requirement for written informed consent, given the retrospective analysis of de-identified data. The study was conducted in accordance with the Declaration of Helsinki. This report adheres to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) recommendations.

2.2 Patients

We identified consecutive women who underwent surgery between January 2020 and October 2022 and received a histopathologic diagnosis of uterine STUMP. Diagnoses were established according to the Stanford criteria based on the combined evaluation of cytologic atypia, mitotic activity, and coagulative tumor cell necrosis [4] and were confirmed by a central re-review with agreement between two gynecological pathologists. Patients with a final diagnosis of leiomyoma, leiomyosarcoma, or another defined smooth muscle tumor subtype were excluded. Twenty-two patients met the inclusion criteria.

2.3 Data Collection and Variables

Clinical, radiologic, operative, and pathologic data were extracted from the electronic medical records. Recorded variables included age, parity, body mass index, and any previous gynecologic surgery; preoperative imaging findings (imaging modality, diameter of the largest tumor, presence of degeneration, and—when magnetic resonance imaging was performed—presence of diffusion restriction); preoperative serum cancer antigen 125 (CA-125) concentration when available; and the documented preoperative radiologic impression. Preoperative imaging was reviewed, and the preoperative impression documented, by board-certified obstetrician-gynecologists specializing in gynecologic ultrasonography as part of routine clinical care; these assessments were made before surgery and therefore without knowledge of the final pathologic diagnosis, and the images were not independently re-reviewed for this study. Operative variables included the procedure performed, surgical route when retrievable, and method of tissue extraction. The pathological variables comprised the three Stanford parameters—maximum mitotic count per 10 high-power fields, presence of coagulative tumor cell necrosis, and grade of cytologic atypia—together with tumor cellularity, which was recorded as an additional pathological variable. Immunohistochemistry (p16, p53, Ki-67, and estrogen and progesterone receptors) was not routinely performed in this cohort and therefore not analyzed.

2.4 Definitions

The preoperative impression was classified as benign when the imaging report described a leiomyoma or myoma and as suspicious for malignancy when the possibility of sarcoma or malignancy was raised. Surgical procedures were grouped into hysterectomy, uterine-sparing surgery (myomectomy or myoma resection), and other. For minimally invasive uterine-sparing resection (laparoscopic, robot-assisted, single-port, or hysteroscopic) of a presumed benign uterine mass, the method of tissue extraction was recorded; in all cases, the specimen was retrieved by contained in-bag hand morcellation, and uncontained power morcellation was not used. The mitotic index was recorded as the highest number of mitoses per ten high-power fields.

2.5 Outcomes and Follow-Up

Follow-up was conducted from the date of surgery to the date of the last clinical contact and comprised standardized imaging surveillance, principally with computed tomography and, alternatively, pelvic ultrasonography. Recurrence was defined as histologically or radiologically confirmed recurrent disease. Newly detected, indeterminate myoma-suspicious lesions identified on surveillance imaging in the absence of histological confirmation were recorded separately and were not classified as recurrences.

2.6 Statistical Analysis

Given the small size of the cohort and descriptive study design, continuous variables are summarized as medians with ranges and categorical variables as counts with percentages; no inferential comparisons or survival analyses were performed. Ninety-five percent confidence intervals for key proportions were calculated using the Wilson method and the exact (Clopper–Pearson) method for the zero-event recurrence proportion. Analyses were performed using R software (version 4.5.1; R Foundation for Statistical Computing, Vienna, Austria).

3. Results

3.1 Patient Characteristics

Twenty-two women with a histopathological diagnosis of uterine STUMP were identified. The median age at surgery was 44 (range, 26–57) years, and seven patients (32%) were nulliparous. The median body mass index was 22.2 (range, 17.1–32.9) kg/m^2, and one patient (5%) had undergone previous gynecologic surgery. The baseline characteristics are summarized in Table 1, and patient-level details are provided in Table 2.

3.2 Preoperative Findings

The median diameter of the largest tumor was 7.8 (range 1.5–23.0) cm. Degeneration was reported on preoperative imaging in seven patients (32%). Magnetic resonance imaging with diffusion-weighted sequences was performed in 11 patients (50%), of whom only one showed diffusion restriction. Serum CA-125 was measured in 10 patients (45%); the median value was 21.9 (range 7.1–47.6) U/mL and exceeded 35 U/mL in two patients. The preoperative radiologic impression was benign (leiomyoma or myoma) in 18 of 22 patients (82%; 95% CI, 61–93%) and raised the possibility of malignancy in only four (18%; 95% CI, 7–39%).

3.3 Surgical Management

Eleven patients (50%) underwent hysterectomy, 10 (45%; 95% CI, 27–65%) underwent uterine-sparing surgery (myomectomy or myoma resection), and one (5%) underwent excision of a pelvic mass. Seven patients (32%; 95% CI, 16–53%) with a presumed benign uterine mass underwent a minimally invasive, uterine-sparing resection by a laparoscopic, robot-assisted, single-port, or hysteroscopic route. In every case, the specimen was retrieved by contained in-bag hand morcellation, and uncontained power morcellation was not performed. The distribution of procedures differed markedly according to the preoperative impression (Fig. 1). All 10 uterine-sparing procedures were performed in patients with a benign preoperative impression, whereas none of the four patients with a preoperative suspicion of malignancy underwent uterine-sparing surgery. The median number of myomas was two (range, 1–77).

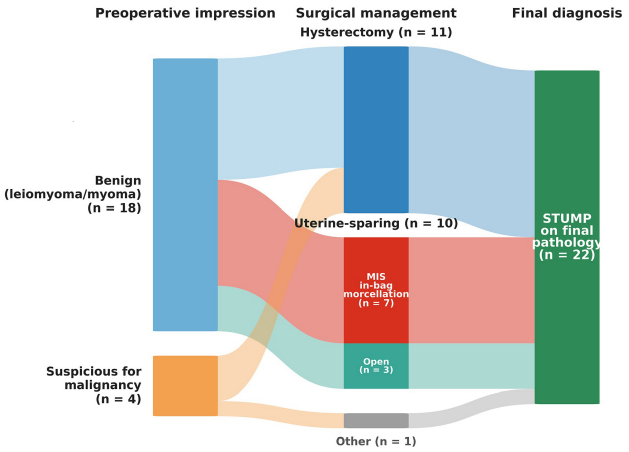


Fig. 1. Diagnostic and surgical flow from preoperative impression, through surgical management, to final pathology in 22 patients with uterine STUMP. The diagnosis was suspected preoperatively in only four of 22 patients (18%). Ten uterine-sparing procedures—including seven minimally invasive resections, each using contained in-bag hand morcellation (red)—were performed in patients with a benign preoperative impression. All 22 tumors were STUMP on final pathology. MIS, minimally invasive surgery; STUMP, smooth muscle tumor of uncertain malignant potential.

3.4 Pathologic Findings

The median mitotic count was 5 per 10 high-power fields (range 0–14), and only one tumor reached 10 or more mitoses per 10 high-power fields. Coagulative tumor cell necrosis was observed in 13 patients (59%; 95% CI, 39–77%). Cytologic atypia was absent in six patients (27%), mild or minimal in eight (36%), moderate in three (14%), and moderate-to-severe in five (23%). Tumor cellularity was intermediate in 19 patients (86%), low or mild in two (9%), and high in one (5%).

3.5 Follow-Up and Outcomes

Surgery was performed between January 2020 and October 2022. All patients were last examined between November 2025 and June 2026, yielding a median follow-up of 56 (range, 39–73) months (approximately 4.7 years). No confirmed recurrence was identified (0/22; 95% CI, 0.0–15.4%), and no patient underwent reoperation for recurrence. Two patients (2/22, 9%) had indeterminate myoma-suspicious lesions on imaging surveillance without histological confirmation and were therefore not classified as recurrences. In one patient (S10), a pre-existing deep posterior intramural myoma (1.5 cm, lower uterine segment) remained unchanged in size with no vascularity on Doppler interrogation. In the other patient (S21), a new hypoechoic lesion at a site remote from the myomectomy bed (anterior uterine body), currently measuring 1.8 cm, has shown slow growth on ultrasonography.

Table 1. Baseline, preoperative, surgical, and pathologic characteristics (N = 22).

Characteristic	Value (N = 22)
Demographics	
Age, years — median (range)	44.0 (26.0–57.0)
Body-mass index, kg/m^2 — median (range)	22.2 (17.1–32.9)
Nulliparous — n (%)	7 (32%)
Prior gynecologic surgery — n (%)	1 (5%)
Preoperative Findings	
Largest tumor diameter, cm — median (range)	7.8 (1.5–23.0)
Degeneration on imaging — n (%)	7 (32%)
MRI DWI performed — n (%)	11 (50%)
Diffusion restriction present — n	1
CA-125 measured — n (%)	10 (45%)
CA-125, U/mL (if measured) — median (range)	21.9 (7.1–47.6)
CA-125 >35 U/mL — n	2
Preoperative impression: benign — n (%)	18 (82%)
Preoperative impression: suspicious for malignancy — n (%)	4 (18%)
Surgical Management	
Hysterectomy — n (%)	11 (50%)
Uterine-sparing (myomectomy/resection) — n (%)	10 (45%)
Other (mass excision) — n (%)	1 (5%)
Minimally invasive uterine-sparing (in-bag morcellation) [2] — n (%)	7 (32%)
Number of myomas — median (range)	2.0 (1.0–77.0)
Pathologic Features (Stanford Criteria and Cellularity)	
Mitoses per 10 HPF — median (range)	5.0 (0.0–14.0)
≥10 mitoses/10 HPF — n	1
Coagulative tumor cell necrosis present — n (%)	13 (59%)
Cytologic atypia: none/absent — n (%)	6 (27%)
Cytologic atypia: mild/minimal — n (%)	8 (36%)
Cytologic atypia: moderate — n (%)	3 (14%)
Cytologic atypia: moderate-to-severe — n (%)	5 (23%)
Cellularity: low/mild — n (%)	2 (9%)
Cellularity: intermediate — n (%)	19 (86%)
Cellularity: high — n (%)	1 (5%)
Follow-up and Current Status	
Surgery period	January 2020 to October 2022
Last clinical contact	November 2025 to June 2026 (all patients)
Follow-up, months — median (range) [1]	56 (39–73)
Follow-up, years — median (range) [1]	4.7 (3.2–6.1)
Confirmed recurrence — n/N (%) [3]	0/22 (0%; 95% CI 0.0–15.4)
Reoperation for recurrence — n/N (%)	0/22 (0%)
Indeterminate lesion under imaging surveillance (S10, S21) — n/N (%) [4]	2/22 (9%)
No evidence of disease, no indeterminate lesion — n/N (%)	20/22 (91%)

[1]Follow-up duration calculated from the date of surgery to the date of last clinical contact.

[2]Minimally invasive (laparoscopic, robot-assisted, single-port, or hysteroscopic) uterine-sparing resection of a presumed benign uterine mass. In all cases, the specimen was retrieved by contained in-bag hand morcellation.

[3]No confirmed recurrence and no reoperation for recurrence to date.

[4]Cases S10 and S21 were under imaging surveillance for an indeterminate myoma-suspicious lesion without histological confirmation (S10, a stable pre-existing myoma; S21, a new, slowly growing lesion remote from the operative site); neither had a confirmed STUMP recurrence.

Abbreviations: CA-125, cancer antigen 125; DWI, diffusion-weighted imaging; HPF, high-power field; MRI, magnetic resonance imaging.

Both patients remain under surveillance, and neither has a confirmed STUMP recurrence. The remaining 20 patients (91%) had no evidence of disease and no indeterminate lesion.

Table 2. Case-by-case clinicopathologic characteristics (N = 22).

Case	Age, years	Parity	Tumor diameter, cm	Preoperative impression	Procedure	Group	Mitoses/10 HPF	Coagulative tumor cell necrosis	Atypia	Cellularity	Follow-up, months[1]	Status
S01	34	0	8.0	Benign	Myomectomy	Spar	7	Y	None	Intermediate	73	NED
S02	44	1	6.0	Benign	RA-TLH, BS	Hyst	9	Y	Mild	Intermediate	71	NED
S03	39	2	12.5	Benign	TAH, BS	Hyst	5	Y	Mild	Intermediate	69	NED
S04	43	2	8.4	Benign	TAH, BS, bladder wall suture	Hyst	6	Y	Mild	Intermediate	70	NED
S05	51	0	14.0	Suspicious	Pelvic mass removal	Other	2	N	Moderate	High	67	NED
S06	52	2	10.0	Benign	TLH, BS	Hyst	0	Y	None	Low	64	NED
S07	40	0	1.5	Benign	Hysteroscopic removal of leiomyoma	Spar	1	N	Moderate to severe	Intermediate	66	NED
S08	49	2	6.0	Benign	TLH, BS	Hyst	3	N	Moderate to severe	Intermediate	63	NED
S09	27	0	8.0	Benign	RA-LM	Spar	1	Y	Mild	Intermediate	59	NED
S10	26	0	3.6	Benign	RA-LM	Spar	8	N	Moderate to severe	Intermediate	58	Surveillance[2]
S11	28	0	7.0	Benign	Myomectomy (mini-laparotomy)	Spar	5	N	Moderate	Intermediate	59	NED
S12	57	2	23.0	Suspicious	TAH	Hyst	1	N	Moderate to severe	Intermediate	54	NED
S13	52	1	4.2	Benign	TLH	Hyst	8	Y	None	Intermediate	51	NED
S14	43	2	10.0	Suspicious	RA-TLH	Hyst	5	Y	None	Intermediate	54	NED
S15	46	3	7.3	Benign	LM	Spar	1	Y	Mild	Low	52	NED
S16	44	2	5.0	Benign	TLH, BS	Hyst	6	Y	Mild	Intermediate	53	NED
S17	32	2	8.4	Benign	C-sec, myomectomy	Spar	7	Y	Mild	Intermediate	43	NED
S18	53	2	9.0	Benign	TLH, BS	Hyst	1	N	Moderate to severe	Intermediate	47	NED
S19	46	3	6.5	Suspicious	Ex-lap, TAH/BSO	Hyst	3	N	Mild	Intermediate	46	NED
S20	46	0	8.0	Benign	RA-LM	Spar	8	Y	None	Intermediate	40	NED
S21	46	2	7.5	Benign	RA-LM (multiple myomas)	Spar	14	Y	None	Intermediate	39	Surveillance[2]
S22	41	3	6.6	Benign	SPA-myomectomy	Spar	8	N	Moderate	Intermediate	40	NED

[1]Follow-up duration in months from surgery to last clinical contact.

[2]Cases S10 and S21 were under imaging surveillance for an indeterminate myoma-suspicious lesion without histological confirmation (S10, a stable pre-existing myoma; S21, a new, slowly growing lesion remote from the myomectomy bed); neither had a confirmed STUMP recurrence.

In all minimally invasive uterine-sparing cases, specimens were retrieved via contained in-bag hand morcellation.

Abbreviations: BS, bilateral salpingectomy; BSO, bilateral salpingo-oophorectomy; C-sec, cesarean section; Ex-lap, exploratory laparotomy; HPF, high-power field; Hyst, hysterectomy; LM, laparoscopic myomectomy; N, no (coagulative tumor cell necrosis absent); NED, no evidence of disease (no confirmed recurrence and no indeterminate lesion); RA, robot-assisted; SPA, single-port access; Spar, uterine-sparing; TLH/TAH, total laparoscopic/abdominal hysterectomy; Y, yes (coagulative tumor cell necrosis present).

4. Discussion

In this single-center series of 22 patients with uterine STUMP, the diagnosis was almost never anticipated before surgery. More than four-fifths of the lesions were interpreted radiologically as benign fibroids, and a suspicion of malignancy was raised in fewer than one in five patients. Consequently, nearly half of the cohort underwent uterine-sparing surgery, and approximately one-third underwent minimally invasive resection carrying a risk of inadvertent morcellation, procedures performed exclusively in women whose tumors had been judged benign. These observations frame four issues of practical importance: the limitations of preoperative diagnosis, oncologic risk of morcellation, fertility-sparing treatment, and the potential of immunohistochemistry for risk stratification.

4.1 Preoperative Diagnosis and Emerging Predictive Tools

Distinguishing STUMP and frankly malignant leiomyosarcoma from benign leiomyoma before surgery remains one of the most difficult problems in gynecologic oncology [1,2]. The clinical presentation is dominated by nonspecific bulk symptoms, and no single imaging feature is diagnostic. In our cohort, degeneration was noted in only a minority of patients, diffusion-weighted magnetic resonance imaging was obtained in only half and showed restriction in a single case, and CA-125 was rarely elevated. The diagnosis was incidental in most patients, which mirrors findings in the literature [1]. Multiparametric magnetic resonance imaging—integrating T2-weighted signal heterogeneity, diffusion restriction, and apparent diffusion coefficient mapping—enhances diagnostic discrimination but leaves a substantial gray zone in which STUMP overlaps with cellular and atypical leiomyoma. To narrow this gap, multivariable models that combine clinical, laboratory, and ultrasound variables have been proposed. One recent nomogram integrating age, postmenopausal bleeding, lactate dehydrogenase, CA-125, tumor echogenicity, and margin characteristics distinguished uterine sarcoma from fibroids with an area under the curve of 0.90 [9]. Applied prospectively, such tools might have flagged a proportion of the 82% of our patients initially judged benign, prompting earlier referral and a more deliberate surgical plan.

4.2 Inadvertent Morcellation: Oncologic Risk and Prevention

The principal clinical hazard arising from this diagnostic gap is related to the surgical route. Because the lesions were presumed benign, 10 patients underwent uterine-sparing surgery and seven underwent minimally invasive resection—each performed in a patient with a benign preoperative impression. Intracorporeal uncontained power morcellation of an unsuspected STUMP or leiomyosarcoma can disseminate tumor fragments throughout the peritoneal cavity, seeding iatrogenic disease, and worsening prognosis [1]. This underlies the 2014 United States Food and Drug Administration safety communication and its subsequent restriction of power morcellation in peri- and postmenopausal women and in those with suspected malignancy [6]. In our cohort, all minimally invasive resections used contained in-bag hand morcellation rather than uncontained power morcellation—a strategy shown in a systematic review of enclosed-bag morcellation to carry a low risk of tissue dissemination while preserving the advantages of minimally invasive surgery [10]. Nonetheless, because the diagnosis is rarely known beforehand, contained extraction appears to be a prudent default, and preoperative counseling should be candid whenever a presumed fibroid exhibits atypical imaging features or rapid growth.

4.3 Fertility-Sparing Management and Pregnancy-Associated Recurrence

Because STUMP commonly presents in women of reproductive age, fertility preservation is frequently a priority; approximately one-third of our cohort was nulliparous, and uterine-sparing surgery was predominant among these women. The two patients currently undergoing radiologic surveillance for indeterminate myoma-suspicious lesions—a stable pre-existing myoma in one (S10) and a new, slowly growing lesion in the other (S21)—were instructive. The former was a 26-year-old nulliparous woman who underwent robot-assisted myomectomy for a presumed fibroid that proved to be a STUMP with moderate-to-severe atypia, and the latter was a woman whose tumor showed a high mitotic count with coagulative necrosis. The oncological safety of conservative surgery is supported by a systematic review [8] and, most robustly, by a recent multicenter study of 106 women managed with fertility-sparing treatment, which found the approach feasible and safe [11]. Importantly, however, that study observed a higher uterine recurrence rate among women who subsequently became pregnant than among those who did not, possibly reflecting the marked increase in estrogen and progesterone levels during pregnancy acting on hormone receptor-expressing residual tumor cells [11]. These data support counseling fertility-sparing candidates that subsequent pregnancy has been associated with a higher rate of uterine recurrence, maintaining close imaging surveillance, and considering completion hysterectomy once childbearing is complete.

4.4 Immunohistochemical Risk Stratification

The morphological criteria that define STUMP lie on a continuum and are subject to well-documented interobserver variability, particularly in distinguishing coagulative tumor cell necrosis from benign ischemic necrosis [4,5]. Immunohistochemistry offers a route for a more objective risk stratification. In a systematic review and meta-analysis, abnormal p53 expression and diffuse p16 expression were significantly associated with recurrence (p53: sensitivity 83%, specificity 86%; p16: sensitivity 84%,

specificity 88%), increasing the post-test probability of recurrence from approximately 7% with normal staining to approximately 54–56% when either marker was aberrant, whereas the Ki-67 index was not independently predictive [12]. Similarly, multicenter clinicopathological data implicate these markers in the risk of recurrence [7]. These estimates are derived entirely from the published literature rather than from the present study, in which immunohistochemistry was not performed. However, they suggest that p53 and p16 immunohistochemistry may be a useful adjunct in the work-up of STUMP, potentially helping to identify patients who warrant closer surveillance; prospective validation is needed before these markers can be used to guide decisions between conservative management and definitive surgery.

4.5 Strengths and Limitations

The strengths of this study include a consecutive cohort with complete capture of preoperative, operative, and pathologic data; central pathologic re-review with two-observer agreement; and follow-up to the present calculated from individual surgery and last contact dates. This study also had several limitations. The sample size was small, drawn from a single center, and the design was retrospective. Because only confirmed STUMP cases were included, without leiomyoma, atypical leiomyoma, or leiomyosarcoma comparison groups, the study could not assess preoperative diagnostic accuracy and instead described only the proportion of preoperative malignancy suspicion within STUMP. Preoperative imaging was heterogeneous; magnetic resonance imaging with diffusion-weighted sequences was obtained in only half of the patients, apparent diffusion coefficient values and acquisition parameters were not systematically recorded, and images were not re-reviewed in a blinded fashion by a dedicated gynecological radiologist. As a result, imaging-based inferences were exploratory. Immunohistochemistry for p53 and p16 was not performed, precluding the marker-based risk stratification discussed above. Finally, the two indeterminate lesions under surveillance lacked histological confirmation and were not adjudicated as recurrences. Larger multicenter studies with appropriate comparison groups and routine immunohistochemical or molecular profiling are needed to define the recurrence risk and refine management.

5. Conclusions

Uterine STUMP is rarely suspected before surgery, and many patients undergo minimally invasive, uterine-sparing surgery for presumed-benign disease. In this cohort, contained in-bag extraction was used in the seven minimally invasive uterine-sparing procedures. Because this study did not compare tissue-extraction methods, it cannot demonstrate that contained extraction reduces oncologic risk; nevertheless, existing evidence supports contained extraction, together with preoperative recognition and expert pathologic assessment, as prudent measures for limiting the oncologic risk of an unsuspected diagnosis. Although no confirmed recurrence occurred over a median follow-up of nearly 5 years, the small sample size and the potential for late recurrence indicate that the recurrence risk cannot be considered low or excluded, and standardized long-term surveillance remains essential. Prospective multicenter studies with appropriate comparison groups and routine p53 and p16 immunohistochemistry are warranted.

Availability of Data and Materials

The data presented in this paper are available upon reasonable request from the corresponding author. The data are not publicly available owing to privacy and ethical restrictions.

Author Contributions

SK and JYS designed the study. SK and SL acquired and curated the clinical and pathologic data. SK performed the analysis and drafted the manuscript. SL and JYS reviewed and edited the manuscript critically for important intellectual content. JYS supervised the study. All authors have read and approved the final version of the manuscript, and have participated sufficiently in the work to take public responsibility for appropriate portions of the content and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

This study was approved by the Institutional Review Board of Korea University Anam Hospital, Seoul, Republic of Korea (IRB No. 2023AN0120). The requirement for written informed consent was waived owing to the retrospective design and the use of de-identified data. The study was conducted in accordance with the Declaration of Helsinki.

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Conflicts of Interest

The authors declare no conflicts of interest. Seongmin Kim is serving as one of the Guest editors of this journal. We declare that Seongmin Kim had no involvement in the peer review of this article and has no access to information regarding its peer review. Full responsibility for the editorial process for this article was delegated to Valerio Gaetano Vellone.

Declaration of AI and AI-Assisted Technologies in the Writing Process

During the preparation of this study, the authors used Claude Opus 5 (Anthropic) to assist with data curation and to generate R code for statistical analysis. After using this tool, the authors reviewed and verified all the outputs and take full responsibility for the content of the publication.

Supplementary Material

Supplementary material associated with this article can be found, in the online version, at https://doi.org/10.31083/CEOG54658.

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