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"Large Uterus, Small Ports: How Should Specimens Be Retrieved in Total Laparoscopic Hysterectomy?"

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KEYWORDS

Total laparoscopic hysterectomy; Specimen retrieval; Morcellation;Large Uterus

ABSTRACT:

Introduction: **:** Total laparoscopic hysterectomy (TLH) offers significant benefits over laparotomy, but specimen retrieval in cases of large uteri remains challenging. Multiple techniques have been described to preserve minimally invasive advantages while minimizing oncologic risks.

Objectives: To review the literature on specimen retrieval strategies for large uteri during TLH, highlighting efficacy, safety, and limitations of each approach.

Methods: A narrative review was conducted by searching PubMed and Google Scholar for studies published between 2011 and 2025 that reported specimen retrieval techniques in total laparoscopic hysterectomy (TLH). The review focused on case series and clinical reports describing methods used for uteri larger than 280–300 g or exceeding 12 weeks' gestational size.

Results: Methods included vaginal morcellation, extracorporeal morcellation via mini-laparotomy, contained in-bag morcellation, wedge resection, and innovative approaches such as Colpo-V incision, zigzag umbilical incision, and Bakri balloon–assisted dilation. Vaginal morcellation remains widely practiced (Sinha et al.), while uncontained power morcellation has declined due to oncologic concerns. Contained morcellation and extracorporeal strategies reduce tissue dissemination but prolong operative times.

Conclusion: No single technique is universally superior. Selection should be individualized, balancing uterine size, patient anatomy, and oncologic safety. Further multicenter prospective studies are required to establish evidence-based guidelines.

1. Introduction

Hysterectomy continues to be one of the most commonly performed gynecological surgeries worldwide [1]. The procedure can be performed through abdominal, vaginal, or laparoscopic routes, with the choice guided by the patient's clinical condition as well as the surgeon's training and preference. Although abdominal hysterectomy was traditionally considered the approach of choice for markedly enlarged uteri, advancements in laparoscopic and robotic technology have progressively shifted practice toward minimally invasive techniques.

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The first laparoscopic-assisted vaginal hysterectomy (LAVH) was performed by Harry Reich in 1988 [2]. Total laparoscopic hysterectomy (TLH) subsequently emerged as an alternative, not only for patients unsuitable for vaginal hysterectomy (VH) [3,4] , but also offering advantages over abdominal hysterectomy (AH) including superior anatomic images due to magnification of videolaparoscope, less blood loss, shorter hospitalization, faster recovery, fewer wound complications, less adhesion formation and less scar [5–7]Hysterectomy for large uteri is technically demanding because of limited working space, restriced range of motion of the laparoscopic instruments,distortion of pelvic anatomy, and challenges in specimen retrieval.With increasing concerns about tissue dissemination and morcellation, safe retrieval has become an important focus.

The definition of a “large uterus” is not universally standardized; however, most literature characterizes it as a uterus weighing more than 280–300 grams, corresponding in size to a gravid uterus of approximately 12–14 weeks, or with a longitudinal length exceeding 12 cm on imaging. Managing such uteri during hysterectomy presents several unique challenges. The markedly increased uterine volume restricts intra-abdominal working space and limits the range of motion of laparoscopic instruments. Furthermore, the enlarged vascular supply predisposes to greater intraoperative blood loss, while distortion of pelvic anatomy makes uterine mobilization and pedicle access more difficult. Specimen retrieval itself requires specialized techniques due to the bulk of the uterus, often contributing to prolonged operative duration. These factors collectively make hysterectomy for large uteri technically demanding and highlight the need for careful preoperative planning and surgical expertise.There is no universally established cutoff value for uterine size that dictates the feasibility of laparoscopic hysterectomy. However, increasing uterine volume is consistently associated with technical challenges, particularly during specimen retrieval. Several studies have demonstrated that specimen extraction remains one of the most significant barriers in performing minimally invasive hysterectomy for large uteri, often influencing the decision to convert to laparotomy[8–10]

Multiple retrieval techniques have been described in the literature, including vaginal morcellation, electromechanical (power) morcellation, contained in-bag morcellation, and mini-laparotomy extraction. Comparative studies suggest that while these methods vary in operative time, blood loss, and recovery outcomes, the safety profile and risk of tissue dissemination remain central considerations [11]

The concern regarding ina dvertent spread of occult malignancy following morcellation has further prompted modifications in practice, with professional societies issuing evolving guidelines on specimen extraction strategies. For instance, the FDA has stated that “laparoscopic power morcellators are contraindicated for removal of uterine tissue containing suspected fibroids in peri- or postmenopausal women, or in those eligible for intact tissue removal” [12].The choice of retrieval method is influenced by multiple factors such as uterine size, anatomical constraints, surgeon expertise, and availability of equipment. Despite a wide range of options, there is no consensus on the optimal technique, and current evidence remains heterogeneous. Therefore, a systematic appraisal of available approaches is essential to guide surgical decision-making, optimize patient outcomes, and reduce the likelihood of conversion to open surgery.

This article aims to review the current evidence on specimen retrieval techniques for large uteri during laparoscopic hysterectomy, highlighting their efficacy, safety, and implications for clinical practice.

2.Objective:

To review the literature on specimen retrieval strategies for large uteri during TLH, highlighting efficacy, safety, and limitations of each approach.

3.Methods:

A narrative review was conducted by searching PubMed and Google Scholar for studies published between 2011 and 2025 that reported specimen retrieval techniques in total laparoscopic hysterectomy (TLH). The review focused on case

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series and clinical reports describing methods used for uteri larger than 280–300 g or exceeding 12 weeks' gestational size.

4. Results:

Specimen Retrieval Methods in TLH – Evidence from Literature

1. Extracorporeal Morcellation Using the Uterine Serosa as a Natural Containment System

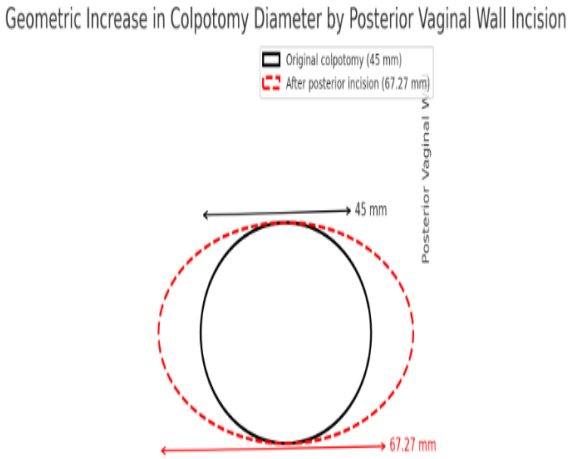
A novel approach to specimen retrieval in laparoscopic hysterectomy for very large uteri, in which the uterus itself becomes its own containment system. After completing the laparoscopic dissection and colpotomy, the intact uterus is delivered through a small abdominal incision, such as a Pfannenstiel or infraumbilical mini-laparotomy(around 4-9 cm incision depending on the size of the uterus.Through the mini-laparotomy incision, the cervix was exteriorized and a wide trachelectomy was undertaken. The uterus was subsequently extracted in a stepwise manner using four traction forceps applied at its corners. Then, we can proceed with gradual manual morcellation with cold scalpel, using the outermost layer of the uterus as a bag. In this way, the serosa acted as a natural containment bag, preventing spillage of tissue fragments into the peritoneal cavity and preserving specimen integrity for histopathological examination. The technique was successfully applied even in uteri weighing up to 3700 g, highlighting its feasibility in extreme cases. By transforming the uterus into its own protective sheath, this method offered a safe, low-cost, and practical alternative to commercial in-bag systems or uncontained power morcellation, while still preserving the minimally invasive advantages of laparoscopy.[13]

2. Colpo-V Incision

The Colpo-V incision is a modification of the posterior colpotomy designed to facilitate retrieval of bulky uteri during laparoscopic hysterectomy. After Laparoscopic hysterectomy and achieving vault hemostasis, the posterior vaginal fornix is identified laparoscopically, the mid-posterior vaginal wall is grasped on either side of the midline and a V-shaped incision is made toward the perineum using Harmonic shears. If necessary, the rectovaginal septum is dissected to mobilize the rectum away from the operative field, with the rectum kept under constant laparoscopic visualization to avoid injury. The incision can then be extended according to uterine size, creating a wider and more accessible extraction route. Once the uterus is removed, either intact or by cold-knife vaginal morcellation, the Colpo-V incision is closed laparoscopically using two to three figure-of-eight sutures of 0-Monocryl.[14]

Remarkably, the method was successful in 94% of cases, allowing for smooth retrieval of large uteri with no major complications, and offered an elegant, vaginally based solution that maintained minimally invasive principles while enhancing safety and efficiency.

Fig 1. Colpo V Incision



3. Umbilical Mini-Laparotomy with Extracorporeal C-Incision Morcellation.

Cesta et al. (2021) [15] pushed the boundaries of minimally invasive hysterectomy by successfully managing a uterus weighing 7400 g in a patient with multiple comorbidities. After completing the laparoscopic steps, the surgeons created a 4-cm umbilical mini-laparotomy incision and employed an extracorporeal "C-incision" scalpel morcellation technique to gradually reduce uterine size while keeping the process entirely outside the peritoneal cavity. The patient recovered

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uneventfully, and this report demonstrated that even extreme uterine weights do not necessarily mandate a laparotomy, provided innovative specimen retrieval strategies are applied with care and precision.

4. **Umbilical Zigzag Incision.**

In their Method , after laparoscopic hysterectomy, the specimen was removed intact through an umbilical incision which can be supraumbilical or infraumbilical that was modified into a zigzag shape. This design allowed greater stretch and expansion of the abdominal wall opening without significantly enlarging the skin incision, enabling safe and practical removal of the uterus while preserving cosmetic outcomes.[16] The technique highlighted how patient-specific factors like nulliparity, vaginal narrowing, or oncologic concerns can be addressed with thoughtful modifications that keep the procedure minimally invasive yet oncologically sound.

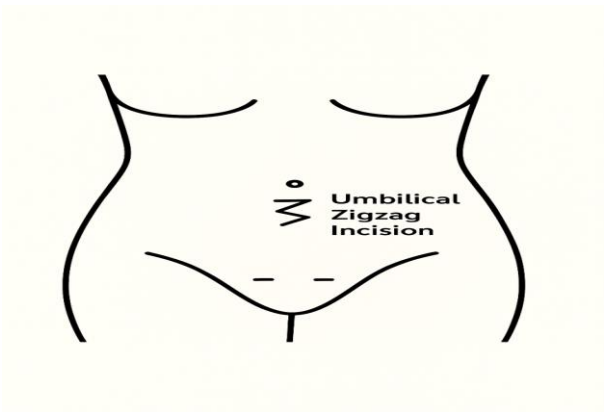

Fig 2- Umbilical Zigzag incision

5. **Bakri Balloon–Assisted Vaginal Dilation .**

It a simple but ingenious technique to assist intact specimen removal for large uterus. After the colpotomy, when the vaginal cuff was too narrow for easy extraction of a large uterus, the surgeons inserted a Bakri postpartum balloon into the vaginal canal and inflated it with 420 mL of saline for ten minutes. This gentle mechanical dilation widened the vaginal opening sufficiently to permit intact removal of the uterus, avoiding morcellation and minimizing oncologic risk.[17] The patient recovered uneventfully, and the method stood out as a low-tech, cost-effective adjunct that can transform a difficult retrieval into a straightforward one without compromising safety.

6. In-Bag Power Morcellation

In the contained power morcellation technique, the resected specimen is placed inside a large impermeable isolation bag introduced laparoscopically. Following secure containment of the specimen, the retrieval bag is insufflated to provide sufficient operative space.Under direct laparoscopic vision, a secondary trocar is inserted into the bag, allowing the introduction of the power morcellator. Morcellation is then performed entirely within this sealed chamber, thereby preventing tissue spillage into the peritoneal cavity.[18] Their study demonstrated the technical feasibility of the approach, with minimal spillage and acceptable operative times, highlighting the potential of in-bag morcellation as a safer alternative to uncontained methods.

7. **Contained Vaginal Morcellation**

In this technique of contained vaginal manual morcellation, the resected uterus is placed into a reinforced endoscopic extraction bag that is deployed transvaginally. The open end of the bag is delivered outside the vagina safely , creating a protective barrier. Manual morcellation is then performed entirely within the bag under direct control, and all tissue fragments are removed without spillage into the peritoneal cavity.[19] This technique combined the advantages of vaginal specimen retrieval with enhanced oncological safety, reducing contamination risk while maintaining efficiency. Their experience showed that contained vaginal morcellation was particularly useful in cases of large uteri, where transabdominal retrieval could be challenging.

8. Vaginal Wedge Resection Method

In the vaginal wedge resection technique, once the laparoscopic hysterectomy is completed, the mobilized uterus is brought to the level of the vaginal vault. Through the colpotomy incision, wedge-shaped segments of the specimen are sequentially excised and removed. This stepwise debulking continues until the remaining uterine tissue is reduced in size sufficiently to allow complete extraction. Throughout the process, care is taken to preserve the serosal envelope as much

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as possible, thereby minimizing tissue spillage and maintaining control during removal.[20] .This stepwise wedge excision allows removal of large-volume tissue without requiring morcellation with a power device and provides a relatively controlled method that reduces the risk of disseminating tissue fragments in the peritoneal cavity. The technique is simple, cost-effective, and does not require specialized equipment, making it an attractive option in resource-limited settings while still adhering to principles of containment.

9.Uncontained Power Morcellation:

Uncontained power morcellation, introduced in the 1990s, involves intra-abdominal fragmentation of the uterus or fibroids with a rotary device to facilitate removal through laparoscopic ports. The method preserves minimally invasive benefits—less pain, quicker recovery, and reduced blood loss—but carries the risk of disseminating occult malignancy or benign tissue fragments, leading to regulatory restrictions since 2014.[21]Currently, it is reserved for carefully selected low-risk patients, with precautions such as controlled morcellation under vision, thorough fragment retrieval, and copious irrigation. Despite its efficiency, most surgeons now prefer contained or intact specimen extraction due to oncological safety concerns

5.Discussion

Specimen retrieval in total laparoscopic hysterectomy (TLH) has progressed through multiple techniques, each weighing the advantages of minimally invasive surgery against oncological and technical concerns. Vaginal morcellation, as described by Sinha et al. [22], allowed removal of large uteri through colpotomy with reduced morbidity compared to laparotomy. Its advantages include low cost, avoidance of abdominal incisions, and relative simplicity, making it highly feasible in resource-constrained settings. However, limitations include dependence on vaginal dimensions, challenges in nulliparous or obese patients, and risks of uncontrolled tissue spillage that could complicate future interpretation of pathology or cause parasitic myomas.

The subsequent introduction of uncontained power morcellation in the 1990s offered another means of debulking large specimens intra-abdominally, further extending laparoscopic feasibility. Its major advantages included preservation of minimally invasive benefits even for very large uteri, reduced operative time compared to contained methods, and broad applicability regardless of vaginal size. However, concerns regarding dissemination of occult sarcoma and benign tissue led to significant regulatory restrictions (FDA, 2014)[12]. The catastrophic implications of inadvertent tumor upstaging have made this approach largely obsolete in contemporary practice.

In response, several containment methods were developed to balance minimally invasive advantages with oncologic safety. Cohen et al. [18] pioneered **in-bag power morcellation**, where the specimen was placed in a sealed insufflated bag to limit tissue spread .The main benefit is secure containment of tissue, which ensures oncological safety without compromising minimally invasive advantages. Nonetheless, technical challenges include limited maneuverability within the bag,

Table 1: Specimen Retrieval Techniques for Large Uteri in TLH – Summary of Literature

Author/Year	Type of Study	Sample Size	Retrieval Method	Specimen Size / Weight	Key Findings / Outcomes
Macciò et al., 2021	Case series	3 patients	Extracorporeal intrauterine morcellation using uterine serosa as containment	Up to 3700 g	Preserved specimen integrity; minimized spillage risk; feasible for very large uteri.

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Rosen et al., 2021	Prospective case series	34 patients	Colpo-V posterior vaginal wall incision with intact or cold-knife morcellation	Large bulky uteri (94% feasible)	Safe vaginal retrieval; no major complications; high success rate.
Cesta et al., 2021	Case report	1 patient	Umbilical mini-laparotomy (4 cm) with extracorporeal C-incision scalpel morcellation	7400 g uterus	Successful removal in extreme size; uneventful recovery; feasible in comorbid patient.
Sinha et al., 2019	Retrospective cohort study	64 patients	Vaginal morcellation after TLH	Uteri >16 weeks (mean 17.5 weeks)	Safe, effective; OT 107 min; Hb drop 1.72 g/dL; hospital stay 2 days.
Kato et al., 2017	Case series	6 patients	Umbilical zigzag incision for intact retrieval	Enlarged uterus, cancer, severe atrophy	Safe intact extraction when vaginal route not feasible; practical alternative.
Allahbadia et al., 2017	Narrative review	–	Review of power morcellation (uncontained vs contained)	–	Risks emphasized in >50 yrs & cancer syndromes; uncontained discouraged.
Agrawal et al., 2016	Retrospective cohort	232 patients	Morcellation during laparoscopic/vaginal hysterectomy for fibroids	Reproductive-age women	No LMS detected; very low risk in young women; need Indian guidelines.
Bogani et al., 2016	Review	–	Review – alternatives to intra-abdominal morcellation	–	Highlighted poor outcomes in occult sarcoma; recommend mini-lap or contained methods.
Clark Donat et al., 2015	Retrospective study	44 patients	Transvaginal wedge-resection morcellation	Mean 608 g	No complications attributable to morcellation; safe in selected patients.
Cohen et al., 2014	Prospective feasibility study	73 patients	Contained power morcellation within insufflated bag	Median 257 g	Feasible in all; OT 114 min; low blood loss (50 mL); preserved MIS benefits.
Wyman et al., 2012	Prospective case series	14 patients	Anchor Tissue Retrieval System bag + pneumo-occluder via colpotomy	Bulky uteri and adnexa	Safe, efficient, cost-effective; avoided laparotomy/uncontained morcellation.

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Giovanni et al., 2012	Case series	8 oncological cases	Contained vaginal morcellation within Lapsac® bag	Malignant specimens	Completed laparoscopically; oncological safety maintained; 1 vesicovaginal fistula.
Stitely et al., 2011	Case report	1 patient	Vaginal dilation using Bakri balloon for intact removal	Large uterus, endometrial carcinoma	Balloon dilation successful; intact removal possible; uneventful recovery.

longer operative times, risk of bag perforation, and the learning curve associated with trocar-in-bag insertion.

Favero et al. [19] introduced **contained vaginal morcellation**, using an endoscopic bag introduced transvaginally for manual morcellation. This approach leveraged the natural orifice route, offering minimal abdominal trauma, low cost, and reduced hospital stay. However, it remains limited by vaginal capacity, is technically difficult in patients with narrow or scarred vaginal canals, and may require assistance for secure bag deployment. by vaginal capacity, is technically difficult in patients with narrow or scarred vaginal canals, and may require assistance for secure bag deployment.

More innovatively, Macciò et al. [13] demonstrated **extracorporeal intrauterine morcellation**, using the uterine serosa itself as a natural containment system. This method showed feasibility even in extremely large uteri (up to 3.7 kg) while avoiding the need for commercial containment bags. The strengths of this technique include low cost, avoidance of bag-related technical issues, and minimal risk of peritoneal dissemination if performed carefully. Nevertheless, its limitations are significant: it has only been reported in a handful of patients, reproducibility across surgeons is untested, and there is potential risk of serosal breach leading to tissue spread.

Other pragmatic alternatives have also been explored. **Vaginal wedge resection**[20], where sequential wedges are excised via the colpotomy, is simple, cost-effective, and avoids power devices, making it suitable for low-resource settings. However, it can be time-consuming, technically demanding, and risks distortion of specimen architecture, potentially complicating histopathology. **Mini-laparotomy with extracorporeal morcellation** [15] provides safe, controlled tissue removal, with the advantage of intact or contained extraction in cases with suspected malignancy. Yet, this approach partially sacrifices the minimally invasive benefit by introducing an additional incision, potentially prolonging recovery and increasing postoperative pain. **Colpotomy extension or posterior colpo-V incision**[14] similarly allow intact or piecemeal vaginal removal of large uteri, offering a safe, reproducible, and low-cost solution, though they may be limited in patients with prior vaginal scarring, severe prolapse, or poor tissue healing.

Each method, therefore, carries unique strengths and drawbacks, but none fully resolves the dual challenges of feasibility and oncologic safety. The evolution of these techniques highlights an ongoing effort to safeguard the benefits of minimally invasive surgery while minimizing the risk of inadvertent tissue dissemination.

A key limitation across studies is the lack of large, randomized trials directly comparing retrieval techniques. Most evidence is drawn from single-center experiences, case series, or retrospective cohorts, which may not fully capture rare but serious adverse outcomes such as sarcoma dissemination. Moreover, heterogeneity in surgical expertise, patient selection, and specimen size introduces further variability, making it difficult to establish universally accepted guidelines.

Future directions will likely focus on refining containment technologies and tailoring retrieval strategies to patient-specific factors such as uterine size, vaginal capacity, and oncological risk profile. Greater emphasis on standardized reporting, long-term oncologic outcomes, and multicenter

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collaboration will be crucial in determining which techniques can achieve the best balance of safety, efficiency, and accessibility. Ultimately, the debate reflects a broader tension in gynecologic surgery: advancing minimally invasive approaches while maintaining an uncompromising standard of oncologic vigilance.

Conclusion:

Specimen retrieval in total laparoscopic hysterectomy remains a critical step that influences both surgical outcomes and oncological safety. While uncontained morcellation and vaginal debulking once expanded the feasibility of minimally invasive hysterectomy, the risks of tissue dissemination have shifted focus toward contained methods and safer alternatives. Current techniques—whether in-bag power morcellation, contained vaginal extraction, or innovative extracorporeal strategies—represent evolving attempts to preserve minimally invasive benefits while reducing oncologic hazards. No single method is universally ideal, and choice of technique should be individualized, based on uterine size, patient factors, and surgeon expertise. Continued innovation, coupled with well-designed prospective studies, is essential to establish evidence-based guidelines that ensure both surgical efficiency and long-term patient safety.

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