Chapter

Fibroids and Hysteroscopy: An Overview

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Abstract

Submucosal fibroids account for 10% of total fibroids. They significantly impact quality of life causing abnormal uterine bleeding (AUB), reduction in fertility rates/infertility, obstetrics complications and abdominal pain. They are a major public health concern because of economic cost their monitoring and treatment requires. Hysteroscopic myomectomy is the first line minimally invasive and conservative surgical treatment. Treating a fibroid correctly implies knowing its physiopathology: What is a submucosal fibroids and what is its origin, what is the Pseudocapsule?. Proper diagnosis and standardized classification such as the Wamsteker classification are required. What are the limits to perform a hysteroscopic myomectomy? What devices are currently used? What are the requirements for conducting myomectomy procedures in the outpatient setting?. Different forms of surgical approach. Complications and consequences of a myomectomy. What will we do in the future with the management of small submucosal fibroids in asymptomatic patients with future genetic desires and can we resect type 3 fibroids by hysteroscopy avoiding a higher risk surgery by abdominal route?

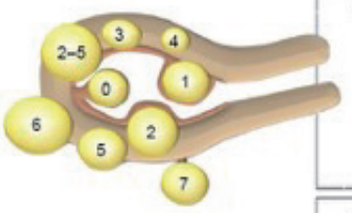
Keywords: submucosal fibroid, pseudocapsule, hysteroscopic approach, outpatient myomectomy, economic impact

1. Introduction

Uterine fibroids are the most common benign pelvic tumors of the female genital tract. Their incidence is approximately 25–30% and may be higher depending on race, family history and genetics. Although most fibroid tumors are asymptomatic, they are a significant health issue due to the economic cost incurred by healthcare systems to monitor and treat them. The impact on the quality of life of women with this condition can be considerable.

Direct medical care expenses include surgery, treatment expenses for outpatient care and monitoring expenses. The indirect expenses include costs derived from inability to work and deterioration in the ability to perform usual tasks. Moreover, they include the expenses for obstetrical complications related to their presence or treatment. Obstetrical morbidity costs amount to $7.76 billion in the annual costs of myoma in the US. They cost more each year in the US than breast, ovarian and colon cancer [1–3].

When talking about fibroids and hysteroscopy, we are talking about submucosal fibroids, since they are the types of fibroids in the FIGO classification that can be approached in this way (FIGO Leiomyoma classification system) (**Figure 1**).



SM – Submucosal	0	Pedunculated intracavitary
	1	<50% intramural
	2	≥50% intramural
O – Other	3	Contacts endometrium; 100% intramural
	4	Intramural
	5	Subserosal ≥50% intramural
	6	Subserosal <50% intramural
	7	Subserosal pedunculated
	8	Other (specify eg, cervical, parasitic)
Hybrid leiomyomas (impact both endometrium and serosa)	Two numbers are listed separated by a hypen. By convention, the first refers to the relationship with the endometrium, while the second refers to the relationship to the serosa. One example is given below	
	2–5	Submucosal and subserosal, each with less than half the diameter in the endometerial and peritoneal cavities, respectively

Figure 1.
FIGO Leiomyomas subclassification system.

Submucosal fibroids amount to 5.5–10% of all uterine fibroids. They are frequently associated with abnormal uterine bleeding and infertility: women with submucous myomas are less likely to conceive, have significantly higher miscarriage rates and lower rates of successful deliveries, regardless of the conceptive method. There is scientific proof to support this fact. They have an impact on the functioning of the uterus and they cause changes in the normal anatomy of the uterus, alterations in blood supply, increased contractility, local hormonal changes and an action on the genetic expression of the endometrium (the endometrial RNA levels of HOXA11, LIF and BTEB1 decrease significantly in unfertile patients with uterine fibromas compared to healthy fertile control subjects at the moment of implantation). Removal of the myoma increases the fertility potential and the IVF results, increasing pregnancy rates from 17% to up to 80% according to the series. Therefore, it is reasonable to recommend surgical treatment in women who want to get pregnant and women that present abnormal uterine bleeding (AUB) [4–6].

Hysteroscopic myomectomy can be considered as the first-line minimally-invasive surgical treatment for submucosal myomas. This technique allows submucosal fibroids to be removed and the uterus to be preserved with minimal complications and rapid recovery times [7–10].

The execution of surgical hysteroscopy on an outpatient setting has turned into the gold standard of the medical practice.

There are many benefits to performing hysteroscopy in an outpatient setting, provided it is done safely and effectively, compared to hysteroscopy in the operating room: it does not require hospital admission, preoperative testing, or general or local anesthesia; it decreases post-surgical recovery times and overall procedure costs and it improves procedure satisfaction level for both healthcare providers and patients [11–15].

2. Submucosal myoma. Physiopathology

Submucosal fibroids are those fibroids that grow into the uterine cavity (**Figure 2**).

2.1 Origin submucosal fibroid

In order to treat a fibroid correctly, we must know its origin and the concept of pseudocapsule.

Fibroids are benign tumors that develop from a myometrial cell. It is not known why a myometrial cell starts multiplying uncontrollably, but we do know that their growth is estrogen-dependent. Fibroids have the mechanical capacity to push the healthy myometrium around them; the mechanical properties of fibroids are a key factor in their growth. Due to the compression exerted on surrounding structures, the fibroid induces gradual formation of a protective structure known as pseudocapsule that separates the fibroids from healthy uterine tissue. They grow inside the myometrium towards the least-resistance zone and, in the case of submucous myomas, they grow into the endometrial cavity. Submucosal myomas G0, G1 and G2 are classified as different transition phases of the same myoma [16] (**Figure 3**).

2.2 Pseudocapsule

Pseudocapsules are entities whose existence has been proven both histologically and through Doppler echography (this structure is seen as a ring of fire on an echogram). It has a different genetic expression profile than a normal myometrium and the surrounding myoma. This pseudocapsule is an independent entity, expressed as a layer between myometrium and myoma. It is comprised of collagen fibers,

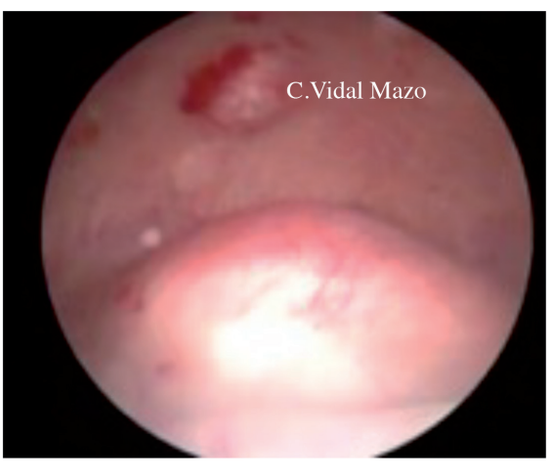


Figure 2.
Submucosal fibroid.

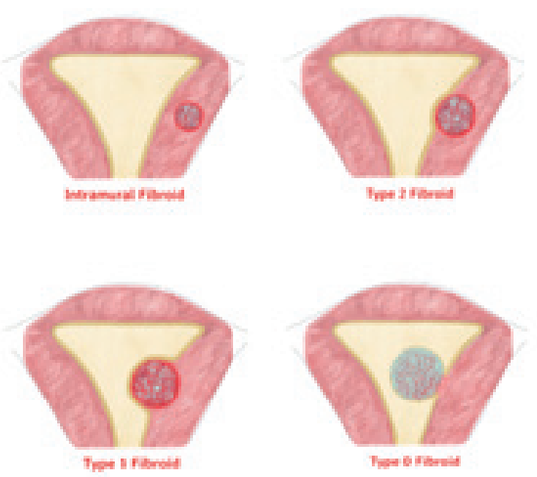


Figure 3.
Transition phases of fibroids.

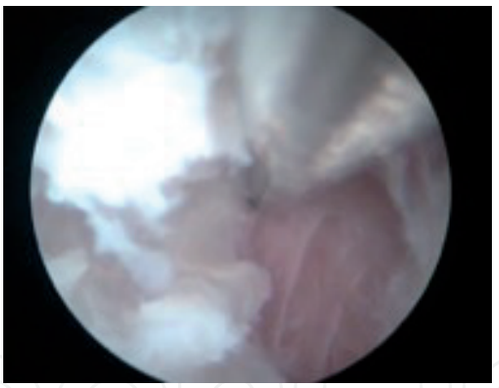


Figure 4.
Pseudocapsule and abscission plane.

blood vessels and neurofibers and it is rich in neuropeptides and neurotransmitters. These substances are believed to have an important role in wound healing and nerve repair, and they may be important for sexual and reproductive functions after resection of the myoma.

The fibroid is anchored through the pseudocapsule through connective bridges and small vessels creating a clear abscission plane between the fibroid and the pseudocapsule.

Contrary to popular belief, and except for pedunculated fibroids, other fibroids do not have a vascular pedicle that feeds them. The neurovascular network of the pseudocapsule is responsible for their irrigation (**Figure 4**) [17, 18].

3. Hysteroscopy: diagnosis and treatment

Hysteroscopy is currently the gold standard used to diagnose and determine the feasibility of resection of submucosal fibroids. It allows direct visualization of the uterine cavity and the identification of other intracavitary lesions. However, it only provides a subjective assessment of the size of the fibroid and indirect information about the degree of extension of the fibroid into the endometrial cavity.

3.1 Historical perspective

During the last two decades, thanks to advances in instruments and refinement of techniques, hysteroscopic myomectomy has acquired the status of 'surgical technique' and, today, represents the minimally invasive standard surgical procedure for the treatment of fibroids totally or mostly located in the uterine cavity.

William Norment performed the first hysteroscopic myomectomy in 1957 using the cutting handle. In 1976, Neuwirth and Amin reported a transcervical approach to excision of fibroids using a combination of techniques such as electrocautery and egg forceps. Neuwirth subsequently introduced a new technique for the resection of submucosal fibroids using the urologic resectoscope in 1978. Glycine (1.5% solution) was used for the first time by Haning et al. as a means of distention. Hallez created a specially designed dual-flow resectoscope for the uterus that allows full myomectomies even in cases of embedded fibroids. The gynecological resectoscope is currently the instrument of choice for the treatment of submucosal fibroids but mechanical morcellators are gaining popularity due to their mechanical

characteristics for the performance of myomectomy and their lower rates of complications and synechiae after myoma surgery [19–23].

3.2 Other diagnostic procedures

There are other less invasive diagnostic procedures such as sonohysterography (SHG) that can provide better objective knowledge of the fibroid and with less cost and low complication rate.

Two-dimensional ultrasound with installation of sterile physiological saline in the endometrial cavity called sonohysterography is an established technique that allows the visualization of intracavitary lesions such as submucosal myomas with a higher precision than conventional two-dimensional ultrasound and comparable to that of diagnosis hysteroscopy. In addition, SHG allows an accurate assessment of the number of fibroids, measurement of fibroid size, and the thickness of the overlying myometrium, which is called the myometrial free margin.

The myometrial free margin is a limiting factor for safe myoma resection during hysteroscopic myomectomy, but we can fix this problem by taking advantage of the contractile capacity of the myometrium with different pressure changes of the distension medium [24].

3.3 Classification: fibroid types 0, 1, and 2

In 1993, in the face of the surgical complexity posed by some deeply penetrating submucosal myomas, Wamsteker et al. proposed a classification system for submucosal fibroids to predict the difficulty of the surgical procedure, depending on the penetration degree of the fibroid in the myometrium. With this classification, gynecologists can estimate the likelihood of completing the hysteroscopic removal of the submucosal fibroid in a single procedure. The Wamsteker classification was adopted by the European Gynecological Endoscopy Society (ESGE) and the leiomyoma classification system of the International Federation of Gynecology and Obstetrics (FIGO) includes the Wamsteker classification for submucosal fibroids, depending on the penetration degree of the fibroid in the myometrium, the fibroid will form an angle with the uterine cavity: Type 0 = fibroids attached to the cavity by a narrow pedicle, Type 1 = fibroids with an angle of less than 90° with the adjacent uterine wall, Type 2 = fibroids forming an angle of 90° or more with the adjacent uterine wall (**Figure 5**).

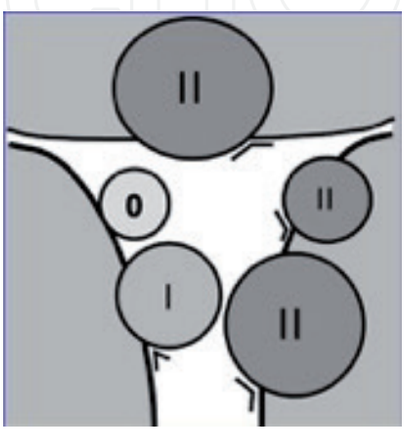


Figure 5.
Wamsteker and ESGE classification depending depth myometrial penetration.

4. Therapeutic approach

Should we treat all submucosal fibroids in the same way?

The approach to G0 fibroids with pedicles and without an intramural component should be different from G1-G2 fibroids that have an intramural component. We need to standardize the therapeutic approach to fibroids and follow pre-established guidelines [19, 25, 26].

4.1 Approach to fibroid type 0

It is recommended to cut the vascular pedicle and then the extract the fibroid with forceps, morcellation, vaporization, etc. These options depend on the size of the fibroid. Some authors recommend leaving the fibroma fragments inside the uterine cavity, which will be expelled naturally after several menstrual cycles.. There are other authors who advise against it due to bleeding and colicky pain until expulsion. A preliminary biopsy will always be necessary, if left in situ until its expulsion.

4.2 Approach to fibroid types 1 and 2

The general principle for a correct myomectomy is the enucleation of the fibroid; for that purpose, we must find the correct plane and that is the pseudocapsule plane. Enucleation of the fibroid through the pseudocapsule allows for preservation of the neurovascular network of the myoma, rich in neuropeptides and neurotransmitters, which are important for a correct healing of the affected myometrium. When cutting at the correct plane of the pseudocapsule, we find lax bridges of connecting tissue and multiple capillaries or small vessels. Dissecting this plane is easy due to its laxity, and it progressively detaches from the fibroid while its irrigation becomes compromised by cutting off the surrounding irrigation. Dissection of the correct layer decreases bleeding during surgery.. Another benefit of retaining its plane is the preservation of the integrity of the underlying myometrium, thus preventing scars. Scars on the myometrium affect fertility after the procedure and contribute to the formation of post-surgical adhesions.

There are different techniques to approach the pseudocapsule, but in all of them we have to weaken the endometrial surface that covers the fibroid and that contains it within the intramural plane, we must weaken it to allow the fibroid to protrude into the uterine cavity, helped by the pressure changes of the median distensor and physiological myometrial contraction. The technique to address fibroids will depend on the intracavitary component:

On the one hand, if the fibroid has a small intracavitary component, we can choose one of the following techniques: all of them involve making an incision in the endometrial lining of the fibroid and promote the protrusion of the fibroid inside the uterine cavity. We can remove the fibroid in one or two step.

Bettochi technique (OPPIuM). this incision is made on the line **of the reflection of the fibroid** with uterine wall.

Myomectomy in toto. In this technique the incision is elliptical.

On the other hand, if the fibroid has a large intracavitary component, first we resect this component, then to perform the enucleation of the pseudocapsule and lastly remove the rest of fibroid, using the following techniques:

Mazzon technique. Also known as the "Cold loop" technique, developed by Mazzon in 1995, it uses monopolar or bipolar electrodes by slicing the intracavitary component and the Cold loop. It is a mechanical instrument to perform the enucleation of the pseudocapsule.

This technique is characterized by a sequence of three different operational steps:

First, the intracavitary portion of the fibroid is cut by repeated and progressive steps of a semicircular monopolar cut. This action stops at the plane of the endometrial surface so that the passage between the fibroid and the adjacent myometrium are clearly identified (pseudocapsule). Second, cold enucleation of the intramural portion of the fibroid is performed by pulling and lever maneuvers with non-electrical "cold" loops. Once the intracavitary portion is resected, the usual cutting loop is replaced on the same resectoscope using a suitable cold loop blunt dissection. By gentle traction on the fibroid, the pseudocapsule is clearly identified and the cold loops are then inserted into this avascular space. These loops are progressively used in a mechanical form that hooks and lacerates the connective bridges that join the fibroid to normal tissue.

Lastly, the removal of the enucleated intramural portion is completed by progressive cutting, being completely dislocated and therefore safely treatable as a lesion with a total intracavitary development which can thus be completely and safely excised by standard progressive excision using an angled cutting loop [27].

Hydromassage Technique. It changes the distention pressures of the uterine cavity, which achieves the same effect as the mechanical instruments such as Cold loop and Tissue Removal device (TRD).

Hydromorcellation Technique: Maneuvers combined with the TRD and the irrigation system (continuous infusion pump) are performed to distend the intrauterine cavity, making changes in intrauterine pressure with rises and falls of flows that will favor myometrial contractions.

The objective of this combined technique is to weaken the endometrial surface that lines the fibroid and thus allow the fibroid to protrude into the cavity. To weaken the endometrial surface that covers the fibroid, we will use the TRD and to promote the protrusion of the fibroid into the uterine cavity with the contractions of the myometrium, we will perform "hydromassage maneuvers" with changes in the flow of intrauterine distension.

We will approach the TRD to the surface that covers the fibroma, either in its upper pole or in the cleavage plane of the fibroid with the uterine cavity and once this surface has been weakened, we will perform maneuvers to change the intrauterine distension, lowering and raising the pressures of flow, even stopping the procedure for 1 or 2 minutes, in cases of fibroids with a large intramural component.

With these innovative maneuvers to change intrauterine pressure, we promote contractions of the myometrium and allow the myoma to protrude into the cavity, visualizing the plane of the pseudocapsule and its bridges and proceeding to morcellate the intracavitary portion that protrudes from the intramural portion of the myoma [28].

4.3 On-site hysteroscopy

There are many centers where hysteroscopy, even diagnostic hysteroscopy, is commonly performed with general anesthesia in the operating room. In reality, while it is a challenge to perform hysteroscopy in an outpatient setting, it is even harder to convince gynecologists around the world, who are still performing this procedure as a surgical procedure that women deserve the option of a less invasive approach. While the skillset needed for outpatient hysteroscopy can be demanding, global progress in this procedure is patchy. Recommendations for the execution of an outpatient hysteroscopy [29–31].

1. The incorporation of "outpatient hysteroscopy" into clinical practice has shown economic benefits (Grade II evidence, Grade A recommendation).

2. Gynecologists should be able to perform outpatient hysteroscopy for the diagnosis and treatment of women with abnormal uterine bleeding, infertility and intrauterine abnormalities.

3. Outpatient hysteroscopy should be performed in a room of adequate size and fully equipped, there must always be an assistant/companion in the room for patient safety and privacy (Grade II evidence, Grade B recommendation).

4. The hysteroscopist must have the skills and experience to perform a hysteroscopy (Grade VI, Grade A recommendation).

5. Written informed consent must be obtained before initiating the procedure.

Moving hysteroscopic procedures outside the operating room and bringing them into the outpatient setting facilitates the logistics around hysteroscopy: they are more cost-effective, they will improve the productivity of doctors and allow for easier surgical scheduling, they will improve patient satisfaction and make recovery times shorter. In the United States in 2017, the payment for hysteroscopic polypectomy was reduced by $30 when performed in an operating room, while the payment increased by $972 when performed as an outpatient procedure. Performing the hysteroscopy as a surgical procedure will incur additional costs for anesthesia fees and hospital fees. There is a significant benefit in increasing the number of outpatient procedures.

Patients appreciate the convenience of the "see and treat" approach to a gynecological problem and often prefer to avoid the inconvenience of going through surgery and the additional risks of undergoing anesthesia. They are associated with greater patient satisfaction and faster recovery compared to hysteroscopy in a hospital [12, 32].

The treatment sequence will depend on the workflow of each department and the surgical material available. It can be done in one step –"see and treat" – or in two or more steps, depending on the complexity of the pathology to be treated.

Therefore, it will be possible to conduct a hysteroscopy in an operating room or on an outpatient setting.

4.4 Surgical devices

Technological advances in surgical devices over the last 2 decades have brought hysteroscopy to maturity in the 21st century, allowing for many outpatient procedures.

Reliable equipment is an essential prerequisite for safe surgery.

The advent of modern small diameter (less than 5.5 mm) hysteroscopes, along with 5–7 Fr miniature mechanical ancillary instruments (scissors, forceps, bipolar electrodes, e.g. Versapoint™ [Gynecare, Ethicon Inc., Menlo Park, CA, USA). U.S]; tissue retrieval systems: TRUCLEAR ™ [Smith & Nephew Inc., Andover, MA, UH. USA], MyoSure® [Hologic, Marlborough, MA, USA] have led to a paradigm shift in surgical interventions leading to procedures that were performed under general anesthesia being conducted in an outpatient setting with local anesthesia only and if necessary [14, 33].

In 2005, Campo et al. evaluated the effects of instrument diameter, patient parity and surgeon experience of pain during office hysteroscopy and the success rate of the procedure. They found that all outcomes (pain, visualization and

success rate) were largely influenced by patient parity and the diameter of the hysteroscope. Compared to less experienced surgeons, those with more experience caused less procedure pain. In contrast to the use of a hysteroscope with an outer diameter of 5 mm, outpatient hysteroscopy with a mini-hysteroscope (outer diameter of 3.5 mm) was preferable. The operating hysteroscope contains a working element which introduces electrosurgical and mechanical instruments for the myomectomy surgery [34].

Working with minimal intrauterine distension pressures, sufficient for adequate visualization, will reduce patient discomfort and serious complications such as fluid overload. Isotonic solutions (normal saline) are recommended as distension medium. It is essential that all hysteroscopic surgery offices have a control system for the balance fluids during the procedure and a protocol for the management of excessive fluid deficit [35–38].

In order to perform outpatient myomectomy, these devices must work quickly but the surgeon should also be comfortable with the device that they are using.

It exists new surgical devices with small diameters that can be used for myomas in an outpatient setting, without general or local anesthesia and using different types of energy such as the Versapoint system with bipolar energy, mechanical TRDs or laser.

4.4.1 Versapoint

Versapoint® with bipolar energy system. Currently, there are 5 bipolar electrodes available on the market, three of these electrodes can be used with small-diameter hysteroscopes and they have different terminals for specific tasks. The three different terminals are: the spring (for vaporization), the twizzle (for cutting) and the ball (for coagulation), and the other two electrodes can only be used with a classic resectoscope. They cannot be used in an outpatient setting.

4.4.2 Laser

This device achieves different effects depending on the wavelength: cutting, coagulation, vaporization. The laser most commonly used in hysteroscopy was the Neodymium laser and currently BIOLITEC with Selective Light Vaporization.

4.4.3 Mini-resectoscopy

The Gubbini Mini-resectoscope which has a small diameter for outpatient procedures uses terminals with bipolar energy and different tips (ball, loop, blade) to perform the same function as traditional resectoscopes.

4.4.4 Hysteroscopic TRDs

The Hysteroscopic TRD is a hysteroscopic mechanical system used to remove polyps and submucosal myomas. It has a terminal with a side window and a mechanical cutting blade, which rotates and oscillates at the same time. It is based on a rotary tubular cutting system with mechanical energy based on suction instead of the high-frequency electric power historically used in resectoscopy.

There are two brands in the market for performing outpatient myomectomy with different diameters and speeds.

The Truclear 5.0 system was the first mechanical TRD for intrauterine pathologies approved by the FDA (Food and Drug Administration) in 2005. It has a small diameter of 5 mm, ideal for outpatient procedures without anesthesia, with a speed of 750 rpm.

The MyoSure® system was the second mechanical TRD for intrauterine pathologies approved by the FDA in 2009. The MyoSure® suite includes four devices (MyoSure MANUAL, LITE, REACH, XL) allowing flexibility to treat a wide range of intrauterine pathologies in any setting. MyoSure works at a faster speed (8075 rpm), which reduces the duration of the procedure [39, 40]. The device can be introduced via the new generation Omni scope (diameter from 5.5 mm up to 6 mm) or the MyoSure hysteroscopes (from 6.25 mm up to 7.25 mm).

5. What factors influence for a successful myomectomy?

The main limiting factor for a successful one-step myomectomy is the duration of the procedure because the volume of fluid deficit depends on it, which is the main and most serious complication in the process of performing a hysteroscopy.

On the one hand, the complexity of myomas (fibroids with intramural penetration) increases the risk of systemic fluid absorption because the hysteroscopist needs more time for the myomectomy and this type of myoma disrupts the integrity of the myometrium. On the other hand, the skill level and experience of the hysteroscopist influence the duration of the procedure [41].

5.1 Complexity of the fibroid

We must analyze all the characteristics of the myomas before performing the myomectomy: size, number, location and type (G0, G1, G2) in order to perform a successful myomectomy. Within all existing classifications of submucous myoma, the Lasmar classification [42, 43] is the most accurate, even more so if associated with the concept of CONTINENT/CONTENT proposed by Haimovich (**Figures 6** and 7).

The five parameters of **STEPW** are as follows:

1. **Size (S):** the largest diameter found by any of the imaging methods. When the nodule measures <2 cm, it is given a score of 0; if it is 2.1–5 cm, it gets a score of 1; and if it measures >5 cm, it gets a score of 2.

2. **Topography (T)**: defined by the third of the uterine cavity where the fibroid is located. If it is in the lower third, the score is 0; if in the middle third, the score is 1; and if in the upper third, the score is 2.

3. **Extension of the base of the myoma (E)**: when the fibroid covers one third or less of the wall, it is given a score of 0; when the base of the nodule occupies between one and two thirds of the wall, the score is 1; and when it affects more than two thirds of the wall, the score is 2.

4. **Penetration of the nodule into the myometrium (P)**: when the fibroid is completely within the uterine cavity it is given a score of 0; if most of it is in the uterine cavity the score is 1; and if most of it is in the myometrium the score is 2.

5. **Wall (W)**: when the fibroid is on the lateral wall, 1 extra point is added regardless of the third that is affected.

	Size (cm)	Topography	Extension of the base	Penetration	Lateral Wall	Total
0	< 2	Low	< 1/3	0	+ 1	
1	> 2 a 5	Middle	> 1/3 – 2/3	< 50%		
2	> 5	Upper	> 2/3	> 50%		
Score	♦	♦	♦	♦	♦	

Score	Group	Complexity and therapeutic options
0 to 4	I	Low complexity hysteroscopic myomectomy.
5 to 6	II	High complexity hysteroscopic myomectomy. Consider GnRH use? Consider Two-step hysteroscopic myomectomy.
7 to 9	III	Consider alternatives to the hysteroscopic technique

Lasmar. New classification of submucous myomas. Fertil Steril 2011.

Figure 6.
STEPW submucous fibroid classification.

Figure 7.
The concept continent/content take into consideration the relation between the continent (uterine cavity) and content (fibroid).

Level 1	> Diagnostic hysteroscopy with target biopsy > Removal of simple polyps > Removal of intrauterine contraceptive device
Level 2	> Proximal fallopian tube cannulation > Minor Asherman's syndrome > Removal of pedunculated fibroid (type 0) or large polyp
Level 3	> Division/resection of uterine septum > Major Asherman's syndrome > Endometrial resection or ablation > Resection of submucous fibroid (type 1 or type 2) > Repeat endometrial ablation or resection

Figure 8.
RCOG classification of operative hysteroscopy levels.

5.2 Skill level and experience of the hysteroscopist

While the skill set required for outpatient hysteroscopy is still state-of-the-art gynecological competence, global progress in this procedure has been irregular. Currently, entities such as the Royal College of Obstetrics and Gynecology (RCOG) and the International Society of Gynecologic Endoscopy (ISGE) have developed a ranking of hysteroscopic procedures, in terms of surgical complexity, guiding the accreditation and training in hysteroscopic surgery (**Figures 8** and **9**) [29, 31].

The resection of fibroids with intramural extension is advisable only for expert surgeons as it is technically difficult and has a higher risk of complications than other hysteroscopic procedures. Type G1-G2 myomas need a short procedure duration for

Classification of operative difficulty
Minor hysteroscopic surgery level I
Diagnostic hysteroscopy including vaginoscopy
Eye-directed biopsy
Intermediate hysteroscopic surgery level IIa
Cannulation of the tubal ostia
Sterilization
Non-embedded intrauterine contraceptive device non pregnant
Uterine metroplasty on partial septum
Endometrial ablation
Polypectomy
Myomectomy grade 0-I
Advanced hysteroscopic surgery level IIb
Myomectomy grade II
Large polyps
Resection of complete uterine septum + vaginal septum
IUCD removal in pregnancy
Extensive adhesiolisis

Figure 9.
ISGE classification of operative difficulty.

complete resection that is only achieved by expert hysteroscopists. Furthermore, the difference in equipment does not seem to have a significant impact on surgery for safe hysteroscopic myomectomy for fibroids with intramural extension [44].

6. Complications

Hysteroscopic myomectomy is relatively safe, but like any other surgical procedure, it is not without complications. Complication rates of 2% and 2.7% have been described in the literature [45, 46].

6.1 Fluid overload. Why is the operating time so important?

The estimated frequency of fluid overload is 0.2%. It is the most serious complication however not frequent; it is directly related to the duration of the procedure and to fibroids with a large surface due to the vascular damage associated to them and the subsequent intravasation of liquid due to distension. Therefore, in the excision of complex fibroids, sometimes it is better to stop and complete the operation during a second procedure. Whenever possible, we recommend the use of isotonic mediums such as normal saline. The distension mediums must be as low as possible while providing adequate distension with an intrauterine pressure of approximately 70–100 mmHg. This is usually achieved when the medium is suspended for approximately 1–1.5 min above the uterus with the current continuous pressure pumps. Garry et al. proved that intravasation of the mediums increases considerably once the intrauterine pressure exceeds the mean blood pressure (MBP). Most gynecologists have a termination threshold of 1000 mL for electrolyte-poor hypotonic mediums and 2500 mL for isotonic electrolytes.

6.1.1 How to decrease fluid overload?

There are several options to reduce systemic absorption of fluid such as intracervical injection of diluted vasopressin solution immediately prior to the procedure, the distension pressure in the uterine cavity should not be kept too high, it should be

maintained below the mean blood pressure (evidence level A, stopping the procedure for a few minutes (10′) reduces systemic absorption of fluids by intravascular clotting) [35, 38]. There is consistent evidence that preoperative administration of GnRH agonists reduces the risk of systemic fluid absorption and decreases the impact of hyponatremic hypotonic encephalopathy, especially in premenopausal women [36, 37].

6.2 Uterine perforations

The frequency is low, 0.13% to 0.76%. The uterus can be pierced with a dilator, hysteroscope, or power source. Management will depend on the size, the site of the perforation and whether or not there is a risk of injury to another organ. Perforation occurs most frequently at the fundus level without significant bleeding. Simple perforation rarely causes further damage and can be managed conservatively with hospitalization, no observation, and appropriate broad-spectrum antibiotics. Complex perforation can occur with a mechanical device or energy source and therefore can be associated with thermal injury to adjacent structures, including the intestine or large vessels. However, the energy sources used in the outpatient setting are usually monopolar or bipolar energy that decrease the propagation of energy through the tissue during the process and are therefore safer. Mechanical TRDs do not require energy and continuously aspirate resected tissue through the device for better visualization and thus reducing the risk of perforation.

6.3 Intrauterine bleeding during procedure

The frequency is about 0.25%. Management will depend on the site, severity, and cause of the bleeding. Intrauterine bleeding that occurs during the procedure should be immediately obvious and can usually be controlled by spot electrocoagulation. If clotting fails to control bleeding, the procedure may need to be terminated and a tamponade applied by inserting a Foley catheter and dilating the balloon. The catheter must be left in place for 4–6 hours, after which the bleeding almost always stops.

6.4 Cervical trauma

Outpatient procedures can often be performed without the need to dilate the cervix, particularly using the vaginoscopic technique described by Bettocchi et al. However, operative hysteroscopy may require cervical dilation. Trauma can be treated with pressure, silver nitrate, or sutures. It is best to avoid over dilation of the cervix because this can cause the distention medium to leak through the cervix and around the hysteroscope.

6.5 Infection

Incidence is between 0.1% and 1.42%. Acute pelvic inflammatory disease after hysteroscopic surgery is rare. Diagnosis is made from classic signs and symptoms, and treatment should be performed with appropriate antibiotics after vaginal smear and blood culture.

7. Other frequent questions regarding the handling of fibroids

7.1 Cervical maturing

There have been studies evaluating the use of cervical "maturing" agents prior to hysteroscopy; these are typically prostaglandin analog, misoprostol, progesterone

antagonist, mifepristone, or osmotic stents (laminaria stents). The literature available does not demonstrate any benefit in the use of ceramic preparations for patients undergoing diagnostic hysteroscopy. For patients who undergo surgical hysteroscopy and cervical dilation beyond 5 mm in diameter, these agents may be especially beneficial in premenopausal women [47, 48].

7.2 Paracervical block

Most outpatient procedures do not require analgesics or anesthesia, but if the patient needs any of them, paracervical anesthesia is better. According to the Cochrane database publication, anesthesia with paracervical block can decrease pain during the procedure and 30 minutes afterwards [49], while the French guidelines [50] do not recommend the use of analgesics or anesthesia to conduct outpatient hysteroscopy; in England, analgesics are administered by 62.5% of physicians [51].

7.3 Antibiotic prophylaxis

There are no studies that show any evidence to indicate antibiotic prophylaxis in hysteroscopies.

8. Adhesions

Intrauterine adhesions are frequent, especially after a myomectomy if the plane of the pseudocapsule is not respected or when two fibroids are located on opposite uterine walls; in this case, it is preferable to perform the myomectomy in multiple stages to avoid the formation of adhesions. The use of non-electrical devices (cold loop or mechanical TRDs) reduces intrauterine adhesions. Different safe and effective strategies reduce intrauterine adhesions after hysteroscopic myomectomy: early second revision hysteroscopy, barrier methods and, in particular, the barrier of non-adhesive gels, insertion of an intrauterine device and 2 months of estrogen and progestin therapy (in the form of combined oral contraceptives) [45, 52].

9. Future expectation

9.1 Should we treat small asymptomatic submucosal fibroids in patients who want to become?

Small myomas, given that they are benign hormone-dependent tumors, have a high growth potential and become symptomatic or cause complications during natural or assisted conception and pregnancy. Physicians must always take into account the biological effects of hormonal changes and/or high levels of estrogen during the reproductive life of a woman.

Even if a submucous myoma is small, it may affect the implantation potential of an embryo due to the changes produced in the myometrium, or just by causing mechanical compression.

Given that myomas are usually spherical, linear growth in the diameter of a myoma corresponds to the squared growth in surface and the cubic growth in volume [53].

The Global Congress on Hysteroscopy Scientific Committee [54] recommends the following:

When immediate fertility is not desired and in the presence of 1 asymptomatic submucous myoma smaller than 15 mm, hysteroscopic myomectomy is recommended, but expectant management is acceptable. If expectant management is favored, clinical surveillance of symptoms and serial transvaginal pelvic ultrasounds to monitor growth of the myomas are recommended.

When immediate fertility is a priority and in the presence of 1 asymptomatic submucous myomas 15 mm, hysteroscopic myomectomy is recommended.

9.2 Hysteroscopic resection of myoma type 3 (FIGO classification), is it feasible?

Type 3 fibroids are intramural fibroids in contact with the endometrium, but lack deformation of the cavity. There is no guideline for this type of fibroids. A primary goal of treating fibroid type 3 by hysteroscopic resection is to avoid open or laparoscopic myomectomy.. Hysteroscopic resection is a potential alternative to traditional surgery for this type of fibroids. This procedure should be limited to expert surgeons because it is a difficult procedure. These fibroids are not visible within the uterine cavity, but can be located by ultrasound at the beginning of surgery and resected with one of the techniques described in this chapter. The choice of hysteroscopic technique depends mainly on the intramural extension of the myoma, as well as personal experience and the available technique. The ultrasound guide is the main element to guide a safe resection [55].

10. Conclusions

Submucosal fibroids are a health problem for women and a great economic burden for National Health Systems (NHS). Nowadays, hysteroscopic myomectomy is the most cost-effective treatment because it can be performed on an outpatient setting. This type of minimally invasive surgery requires skill and an experienced hysteroscopist and new generation devices.

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Conflict of interest

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Nomenclature

AUB	abnormal uterine bleeding
FIGO	International Federation of Gynecology and Obstetrics

RCOG	Royal College of Obstetrics and Gynecology
ISGE	International Society of Gynecologic Endoscopy
SHG	sonohysterography
TRD	tissue removal device
MBP	mean blood pressure
NHS	National Health Systems

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