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A comparative survey of various uterine manipulators used in operative laparoscopy

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Abstract This survey compares seven commonly used uterine manipulators in various laparoscopic procedures. These devices were compared with each other in respect of the various movement ranges they offered with anteversion, retroversion, lateral movement, elevation, and any special movement. It also compares the ability of the uterine manipulators with regard to the presentation of the vaginal fornices, and the ease of assembly, handling, and maintenance of the pneumoperitoneum. The information about the instruments was collected from the instrument manufacturer's websites and other related articles. No single uterine manipulator seems to have all the attributes of an ideal manipulator and the choice of uterine manipulator need to be individualized according to the surgical procedure in which it is used. The Clermont-Ferrand model provides a 140° range of uterine movements and it allows the uterus to flex on itself, but it requires cervical dilatation prior to insertion and is difficult to assemble. The RUMI with the KOH colpotomizer has a 140° range of uterine manipulation and delineates the vaginal fornices nicely, but has restricted elevation of the uterus and is difficult to assemble. The Hourcable is easy to use and allows easy stapling of the uterine pedicles, but is poor in maintaining the pneumoperitoneum. The Endopath and Vcare are single-use manipulators and are useful only in laparoscopic assisted vagina hysterectomy (LAVH) or laparoscopic assisted supra-cervical hysterectomy (LASH) procedures, as they cannot delineate the vaginal fornices. The HOHL and TLH-Dr Mangeshikar manipulators provide a 130° range and have good uterine elevation; hence, they are useful for total laparoscopic hysterectomy

(TLH) and endometriosis procedures. Ultimately, the TLH-Dr Mangeshikar and the Clermont-Ferrand model come close to being versatile.

Keywords Laparoscopic hysterectomy · Supracervical hysterectomy · Uterine manipulator

Abbreviations LAVH: Laparoscopic assisted vagina hysterectomy · LASH: Laparoscopic assisted supra-cervical hysterectomy · TLH: Total laparoscopic hysterectomy

Introduction

Our aims and objectives were to survey and compare commonly used uterine manipulators used in laparoscopic hysterectomy, and to find the best versatile and safe uterine manipulator.

The uterine manipulators in use for laparoscopic hysterectomy or endometriosis have to achieve many different tasks in order to arrive to a safe and successful outcome. Their most obvious function is to suitably mobilize the uterus [1].

This survey was conducted between 15 October 2005 to 15 January 2006 at Kiel School of Gynecological Endoscopy, University Hospitals Schleswig-Holstein, Germany. The uterine manipulators were compared with each other in respect of the various movement ranges they offered with anteversion, retroversion, lateral movement, elevation, and any special movement. The survey also compared the ability of the uterine manipulators with regard to the presentation of the vaginal fornices, and the ease of assembly, handling, and maintenance of pneumoperitoneum. The information about the instruments was collected from the instrument manufacturer's websites and other resources.

By anteverting or retroverting the uterus, we get a good exposure of both the anterior wall and vesico-uterine fold and the posterior wall and utero-sacral ligaments. Lateral movements allow the exposure of the infundibulo-pelvic

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Table 1 The Clermond-Ferrand uterine manipulator

Advantages	Disadvantages
Movement ranges +140° in the anterior plane, +90° in the posterior plane, 5-way snap-in lock system	Requires dilatation of the cervix up to Hegar dilator no. 9
Allows independent movements, internal shaft moves independently of the rest of the device	It requires training to be used in the proper way and is complex to assemble
Reusable instrument	It is an expensive device
Enables easy grasping of the uterine pedicles and lateral fornices as the lateral fornices are not tensed	
Pneumoperitoneum is maintained	

ligaments, utero-ovarian ligaments, and the anterior and posterior leaves of the broad ligament. These movements are important in cases of large uteri, but are difficult in such cases. The elevation movement is important in cases of recto-vaginal endometriosis in which the uterus needs to be moved upward into the abdomen, providing the best exposure of the utero-sacral ligaments and the cul-de-sac.

Results

The manipulators considered have been discussed in table format (Tables 1, 2, 3, 4, 5, 6, 7, 8).

Discussion

Adequate exposure is vital in pelvic surgery, and uterine manipulators go a long way in achieving that. During laparoscopic procedures, uterine manipulation is an integral part of obtaining exposure. The ideal uterine manipulator should be inexpensive (whether reusable or

Table 2 The Hohl uterine manipulator

Advantages	Disadvantages
Movement ranges +130°, +90° in the posterior plane	Elevation of the uterus is restricted
Allows independent movements	The initial screwing movement can cause cervical bleeding
Less traumatic	Can be used effectively only in hysterectomy procedures
Reusable instrument	
Pneumoperitoneum is maintained	

Table 3 The Endopath uterine manipulator

Advantages	Disadvantages
Movement ranges +130°, +90° in the posterior plane	Disposable device
	Does not provide presentation of the vaginal fornices
	Pneumoperitoneum is maintained with difficulty

disposable), convenient and quick to use, safe (especially by avoiding the need for dilatation and a tenaculum), and have the ability to inject solutions into the uterine cavity and most importantly offer the optimal range of motion of the uterus while avoiding the need for an assistant.

No one device appears to have all these attributes. Most uterine manipulators are essentially rigid instruments that are attached or fixed to the uterus, protrude from the vagina, and require the use of a tenaculum to grasp the cervix, which occasionally may bleed.

Later, uterine manipulators with balloon inflated tips were developed, which did not require the tenaculum during manipulation. These are held in place by a balloon inflated within the uterine cavity with counter-pressure applied against the external cervical portion by a second balloon (BARD), a friction-adjustable (ZUMI) or spring-loaded platform (HUMI) on the handle of the manipulator, or an attachable weight and chain (Hasson). These instruments also allow intrauterine instillation of liquid for chromopertubation [1].

Some manipulators, including the tenaculum-free types, have affixed curves in their shafts to assist in flexing the uterus. The handle of the instrument is grasped 4 to 6 inches outside the vagina, allowing approximately 45° of anterior motion and 15° of posterior motion. The external vaginal orifice is the fulcrum for these manipulators whether or not they have straight or curved shafts.

The newer uterine manipulators use the external cervical os as the pivot point, and therefore the effects of obesity and other anatomic impediments to the range of uterine flexion are diminished.

Table 4 The RUMI system with the KOH colpotomizer

Advantages	Disadvantages
The snap drum rotates the tip through a 140° arch	It is not always easy to put the device in place, especially in the case of a narrow vagina
Pneumoperitoneum is quite well maintained	The device is complex to assemble
Good delineation of the vaginal fornices	Elevation of the uterus is restricted
It can be used with harmonic or other types of ultrasound energy sources	

Table 5 Hourcable or Histerophore

Advantages	Disadvantages
The device leaves the lateral fornices free, which enables easy grasping of the uterine pedicles and lateral fornices by means of automatic staplers	Less range of motion with anteversion and retroversion movements and lateral movements are restricted)
The steel shaft of the manipulator is able to move independently of the rest of the device	The peripheral ring of the pneumo-occluder, which increases toward the exterior, does not always allow a good delineation of the vaginal fornices
The instrument is reusable	The pneumoperitoneum is maintained with difficulty
The instrument is easy to assemble	

The Clermont-Ferrand uterine manipulator provides a good 140° movement of the uterus in the anterior and posterior directions. In addition, it has the ability to flex the uterus on itself. Its graduated snap-in mechanism, which has five different positions, gives stability to the uterus at various angles, and the snap-in release button allows unrestricted movement. The manipulator rod, when pushed forward, helps to delineate the vaginal fornices with the help of an anatomical blade attached anteriorly. It has a series of silicon seals to maintain the pneumoperitoneum after the colpotomy incision. It is a reusable instrument. Though versatile, this instrument has its drawbacks; it requires cervical dilatation up to Hegar number 9 before its insertion in the cervix, so may not be useful in cases of cervical stenosis. It is pretty complex to assemble and requires a fair amount of training to use this device properly. It seems to be a good choice for operative laparoscopies involving hysterectomy, endometriosis in the posterior cul-de sac, and sling surgeries [2].

The HOHL uterine manipulator can move the uterus in a 130° degree arc in the antero-posterior plane. Although it can give an unrestricted movement, it does not lock in a

Table 6 The Vcare uterine manipulator/elevator

Advantages	Disadvantages
The device allows optimal exposure of the vaginal fornices and a wide range of uterine movements	Disposable instrument
Allows independent movements	It cannot be used as a laser backstop
The pneumoperitoneum is well maintained	The device seems to be too light in cases of very large uteri
Easy manipulation	

Table 7 Total laparoscopic hysterectomy uterine manipulator

Advantages	Disadvantages
Movement ranges +130°, +90° in the posterior plane	Has restricted movement of the external device over the internal rod
Provides good presentation of the vaginal fornices	
Pneumoperitoneum is maintained	
Reusable device	

specific position as the Clermont-Ferrand type does. Since it screws into the cervix it cannot be utilized in cases in which cervical function is needed later. It does not precisely delineate the vaginal fornices as the RUMI and the Clermont-Ferrand types do. It is easy to use and assemble and is essentially used mainly for total laparoscopic hysterectomy (TLH). But since it can give good elevation to the uterus it has its uses in advanced procedures such as endometriosis too [2].

The Endopath uterine manipulator is a single-use instrument and hence adds to the cost. It provides a good range of motion; 130° in the antero-posterior plane. The uterus can also be moved laterally by directing the handle to one side or the other. It is obvious that this device perfectly enables both the anteversion and retroversion movements and the lateral mobilization, but it does not help to provide presentation of the vaginal fornices and neither does it help maintain the pneumoperitoneum.

These characteristics make this instrument the ideal tool for LASH.

The RUMI manipulator with the KOH colpotomizer is a versatile uterine manipulator. Not only does it have extremely good uterine manipulation in the anterior, posterior, and the lateral planes, it also helps with the very easy delineation of the vaginal fornices. The KOH-cup distances the ureter from the uterine vessels and facilitates its easy coagulation. This device helps to complete laparoscopic dissection of the cervix and vagina much more easily, resulting in greater efficacy and less blood loss while eliminating the difficulties pertaining to vaginal access. This enhanced uterine mobility also speeds utero-vesical peritoneal dissection and inferior displacement of the bladder. Furthermore, the RUMI manipulator allows for significant lateral uterine displacement, improving visualization and ease of dissection of the uterine vasculature and broad ligament.

During LH, significant upward traction must be applied to the cervix and uterus, which is a drawback of this instrument. This stretches the utero-sacral ligaments, and delineates the cervico-vaginal reflection at its uppermost point. This is crucial, because the traction enables the surgeon to incise the vagina very near the cervix, thereby retaining the maximal length of the remaining vaginal canal while allowing the utero-sacral ligaments to be transected above their insertion point in the vagina. The latter step is

Table 8 Movement ranges of the various manipulators

Sr No:	Model of uterine manipulator	Reusable	Anteversio retroversion movements	Lateral movements	Elevation movements	Vaginal fornices identification	Independent movements	Easiness of use and assembling	Handling	Pneumoperitoneum maintenance
1	Clermont-Ferrand	Yes	++++	+++	+++	+++	+++	+	++	+++
2	HOHL	Yes	+++	+++	++	++	+++	+	++	++
3	Endopath	No	+++	+++	++	+	+	++	++	++
4	RUMI with Koh-cup	Partially	++++	+++	++	++++	-----	+	++	+++
5	Hourcable	Yes	++	++	++++	+++	+++	+++	+++	+
6	Vcare	No	++	++	++	++++	---	++++	+++	+++
7	TLH-Dr Mangeshikar	Yes	+++	+++	++	+++	++	+++	+++	+++

Movement ranges: 140 degrees = +++++; 130 degrees = ++++; 90 degrees = ++; restricted = +

very important, because it reduces the risks of ureteric injury and provides better vaginal vault support, eliminating the need to place additional sutures through the utero-sacral ligaments and vagina during vault closure [3]. The RUMI System uterine manipulator and the KOH colpoto-mizer system also confer many benefits when performing laparoscopic hysterectomy in patients with enlarged uteri, including those women who have associated pelvic adhesions, endometriosis, or other adnexal pathologies [3].

Although it is one of the best manipulators the literature has mentioned two cases of iatrogenic uterine rupture cause by over-inflation of the RUMI balloon manipulator [4]. Also, it is a complex device to assemble and it restricts the upward mobility of the uterus, and hence does not afford any benefit in cases of recto-vaginal endometriosis.

The Hourcable or the Histerophore, has a non-articulated steel shaft due to which it has less range of motion, whether in ante-/retroversion or lateral movements. But the device is good for exposing the vaginal fornices, leaving the lateral fornices free. This helps in defining the edges of the anterior and posterior colpotomy and thereby enables a perfect exposure and grasping of the uterine pedicles and lateral fornices by means of automatic staplers [5]. Since the anterior and posterior presenters can be removed after the respective colpotomy incisions it poorly maintains the pneumoperitoneum. It is easy to assemble and quick to use, and hence can be used effectively in LAVH and TLH procedures.

The Vcare uterine manipulator is a simple single-use device. It stabilizes the uterus with an internally inflated balloon. It has a forward cup that displaces the ureter, retracts the bladder, and perfectly defines the colpotomy incision and a reverse cup to maintain the pneumoperitoneum. The locking-unlocking screw allows, if necessary, independent movements between the internal shaft and the cup, which delimitates the vaginal fornices.

Except for being a disposable device it combines a good range of uterine maneuverability with good presentation of the vaginal fornices at colpotomy incision. It may have problems with larger uterine size due to its lightweight design.

The TLH-Dr Mangeshikar uterine manipulator is a reusable, completely detachable, low-cost uterine manipulator [6]. Though specifically designed for TLH, it can be used in many other laparoscopic surgeries. By appropriately mobilizing the handle, the uterus along with the

adenexa can be manipulated from side to side and can be rotated along its long axis, thus enabling anteversion and retroversion as well as dextro and laevo rotation. Sliding in the Vaginal Delineator helps identify the vaginal fornices and choosing the right sized delineator drum helps maintain the pneumoperitoneum.

Thus, the TLH-Dr Mangeshikar uterine manipulator offers advantages in its ability to perform a completely laparoscopic hysterectomy by maintaining the loss of pneumoperitoneum. The significant uterine mobility that this system provides facilitates dissection of the ascending uterine arteries in a manner that reduces the risks of ureteric injury.

The Donnez Uterus-Manipulator, a reusable instrument with a standard delineator cup, commercialized by Richard Wolf, and the ClearView Uterine Manipulator Injector, designed for complete uterine control and increased efficiency, from Pee Bee India have not been reviewed in this paper.

Ultimately the ideal choice of manipulators has to be individualized according to the needs of the surgery. During TLH in addition to adequate mobility of the uterus, good delineation of the vaginal fornices is also required. The pneumoperitoneum also needs to be maintained after the colpotomy incision. The Clermont-Ferrand, RUMI, TLH-Dr Mangeshikar, and the HOUL types seem to be ideal for TLH procedures. The best vaginal fornical delineation can be obtained with the TLH-Dr Mangeshikar, the Clermont-Ferrand, and the RUMI models when used along with the KOH-Cup.

In cases of severe endometriosis, a good deal of uterine mobilization and elevation is required, especially when the disease is affecting the recto-vaginal and cul-de-sac area where again the choice of uterine manipulator has to be individualized. When used with a rectal probe, the TLH-Dr Mangeshikar and the HOHL manipulator seem to be best suited to such scenarios as they help to elevate the uterus very nicely and thus delineate the utero-sacral and expose the cul-de-sac.

Finally, the individualization of uterine manipulator according to the needs of the surgery and the ease of use of the operating surgeon predominates the choice: we have found in our experience the TLH-Dr Mangeshikar model and the Clermont-Ferrand model are useful in all advanced cases of TLH and endometriosis, especially those involving the recto-vaginal area.

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