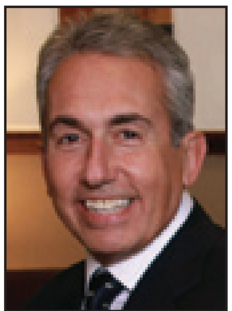
MASTER CLASS

Myomectomy – The Robotic Way



CHARLES E. MILLER, M.D.

As noted in my AAGL Presidential Address in 2008, while cholecystectomies, hernia repairs, and bariatric surgeries are generally performed via minimally invasive techniques, only a small percentage of hysterectomies are executed by a laparoscopic technique. As pointed out in the text of this edition of the Master Class in gynecologic surgery by guest author Dr. Michael C. Pitter, there has been a recent increase in the percentage of minimally invasive hysterectomies due to robotic assistance.

Even more difficult to master laparoscopically than hysterectomy is myomectomy. Despite numerous opportunities for gynecologists to learn the technique of laparoscopic suturing, laparoscopic myomectomy remains in the domain of a few minimally invasive gynecologic surgeons worldwide. As Dr. Pitter so ably demonstrates in his discourse, for the gynecologist who is challenged by a pure laparoscopic approach, myomectomy can still be performed in a minimally invasive manner with use of robotic assistance. The difficulty of suturing at bedside is simplified with use of the robot due to 3-D visualization and articulating instrumentation.

Dr. Pitter is the chief of gynecologic robotic and minimally invasive surgery and a clinical assistant professor of obstetrics and gynecology at Newark (N.J.) Beth Israel Medical Center. Dr. Pitter is vice chair of the Robotics Special Interest Group of the AAGL and is a charter member of the Society of Robotic Surgery. He has publications both on establishing training criteria in robotic assisted gynecologic surgery, as well as robotic assisted hysterectomy in patients with large uteri. It is a pleasure and honor to welcome Dr. Pitter to this edition of the Master Class in gynecologic surgery. ■

DR. MILLER *is clinical associate professor at the University of Illinois at Chicago, president-elect of the International Society for Gynecologic Endoscopy (www.isge.org), and a past president of the AAGL (www.aagl.org). He is a reproductive endocrinologist and minimally invasive gynecologic surgeon in private practice in Naperville, Ill., and Schaumburg, Ill.; the director of minimally invasive gynecologic surgery at Advocate Lutheran General Hospital, Park Ridge, Ill; and the medical editor of this column. Dr. Miller said he has no relevant financial disclosures.*

The Benefits of Robot-Assisted Myomectomy

Myomectomy offers an alternative to hysterectomy for the treatment of uterine fibroids whether or not future fertility is an issue. While many women chose a uterine-sparing approach to maintain their fertility options, there still are many women who prefer myomectomy for reasons other than fertility preservation.

The procedure is an important one for gynecologic surgeons and their patients, as it conveys a high rate of symptom resolution: Eighty-one percent of women who undergo a myomectomy experience complete resolution of their symptoms (Fertil. Steril. 1981;36:433-45).

MICHAEL C. PITTER, M.D.

Robot-assisted laparoscopic myomectomy was first described in 2004 by Dr. Arnold P. Advincula and his colleagues (J. Am. Assoc. Gynecol. Laparosc. 2004;11:511-8).

Their report played a pivotal role in the Food and Drug Administration's approval in 2005 for use of the da Vinci Surgical System (Intuitive Surgical, Sunnyvale, Calif.) for gynecologic surgical procedures.

While myomectomy still is most commonly performed via laparotomy, a significant number of surgeons have adopted the robotic approach. According to data from Solucient, a health care information company managed by Thomson Reuters, approximately 4,000 robotic myomectomies were performed in the United States in 2010. This represents 10% of the approximately 40,000 myomectomies performed each year, a significant proportion considering that robotics had been introduced to gynecology only 5 years earlier.

Myomectomy is a suture-intensive procedure, and suturing by a conventional laparoscopic approach has proved to be extremely challenging. The robotic platform gives surgeons greater capability of successfully repairing deep hysterotomy defects and provides them with a more achievable minimally invasive option to offer patients.

Interestingly, utilization of the laparoscopic approach for hysterectomy also has increased with the introduction of robotics. Current statistics show that only 16% of all hysterectomy procedures performed in the United States are done via conventional laparoscopy (20 years, approximately, after the techniques were developed), while another 20% are now being performed with robot assistance. A new AAGL position statement saying that surgeons who offer hysterectomy should be able to perform either vaginal hysterectomy (the preferred approach) or laparoscopic hysterectomy (the second best approach) – or refer their patients to a surgeon who can (J. Minim. Invasive Gynecol. 2011;18:1-3) – is indicative of the growing belief that the benefits of minimally invasive surgery over open procedures should be considered where possible in aspects of gynecologic surgery.

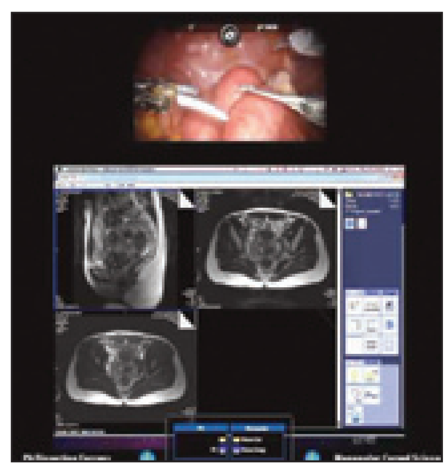
At our institution, we saw a significant improvement in operative time after the first 20 cases of robot-assisted myomectomy and hysterectomy. Our operative time went from a mean of 212 min. for cases 1-20 to a mean of 151 min. for cases 21-40 (Int. J. Med. Robot. 2008;4:114-20).

Others have reported similar findings on the learning curve for robot-assisted gynecologic surgery: Another case series published several years ago, for instance, showed operative times for various surgical procedures for benign gynecologic problems stabilizing within 50 cases (J. Minim. Invasive Gynecol. 2008;15:589-94). In general, these data are indicative of a significantly shorter learning curve than seen with traditional laparoscopic surgery.

Incorporation of MRI

The main drawback to robotics always has been the absence of haptics or tactile feedback. This limitation has, however, spurred the development of creative techniques to compensate, including the use of real-time magnetic resonance imaging.

MR images can now be incorporated in a real-time, 3-dimensional fashion into the surgeon's console for use in mapping, detecting, locating, and enucleating myomas. All three views – axial, coronal, and sagittal – can be seen during the surgery. This enables the surgeon both to overcome the haptic limitations and to remove multiple fibroids. (See images 1 and 2.)



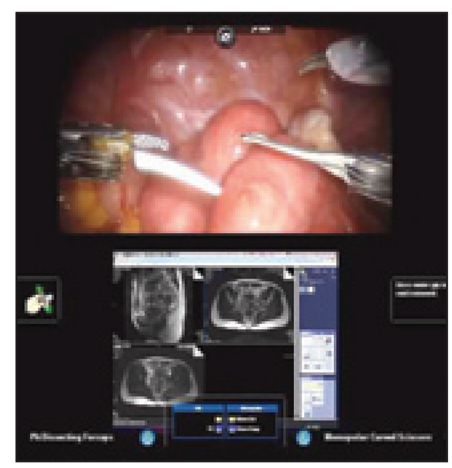


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Image 1 (left): Below the endoscopic view of the fibroid uterus (top), MR images are superimposed in the surgeon's console viewer. The upper left MR image is a sagittal pelvic view indicating the presence of fibroids (left to right) in the posterior fundal, submucosal, and posterior midportion of the uterus. The upper right and lower left images are axial views showing fibroids (top to bottom) in the anterior left, submucosal left midportion, and posterior midportion of the uterus. In Image 2, the relative size of the images are adjusted to the surgeon's needs.

Certainly, the gynecologic surgeon employing this technique must be comfortable reading and interpreting MR images. The necessary comfort level can be achieved, on an individual basis, with time spent reviewing series of pelvic MR images with a radiologist.

MR imaging also has proved, of course, to be an excellent preoperative tool for determining ahead of time the size, number, and location of myomas, and for ruling out adenomyosis. In my experience, MR imaging can be useful preoperatively in conjunction with pelvic exams to effectively screen for patients who are likely to have successful outcomes with robotic myomectomy.

For example, a patient with a 12- to 14-week-size uterus may not be a good candidate for robotic myomectomy if on the MR image the uterus has innumerable myomas without a clearly defined cleavage plane between the tumors. A woman with a significantly larger uterus may be an excellent candidate, on the other hand, if the number and location of leiomyomas is determined by MRI.

Set-Up, Technique

The three basic components of the da Vinci system are a patient-side cart, a vision system, and a surgeon's console. The patient-side cart has four robotic arms that are attached or "docked" to trocars that are placed in the abdomen in strategic locations. One arm holds the endoscope (either an 8.5-mm or 12-mm diameter, with a 0-degree or 30-degree configuration) and the other three arms hold miniaturized 8-mm (or 5-mm) instruments. Some surgeons employ only two of these arms. The vision system delivers a high-definition 3D image to the viewer in the surgeon's console, and 2D images to other monitors in the operating room.

From the console, the surgeon uses hand controllers and foot pedals to move the instrument and camera robotic arms of the patient cart via a process of computer algorithms that reduce tremor and employ motion scaling to deliver precise movements within the surgical field. The robotic instruments have seven degrees of

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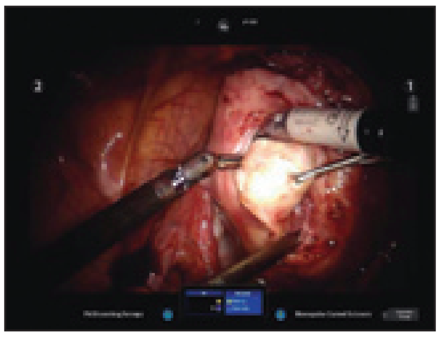
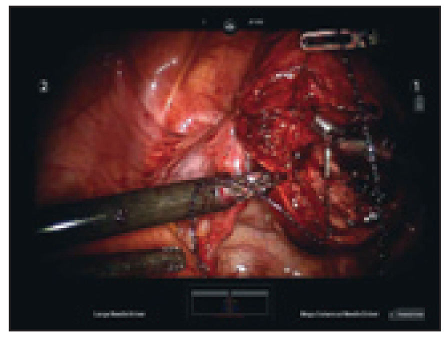
freedom that replicate or surpass the motions of the human hand, allowing the surgeon to essentially perform open surgery through laparoscopic access.

A uterine manipulator is typically used for traditional laparoscopic myomectomy procedures, and robotic myomectomy is no exception. I typically use a standard HUMI manipulator (Harris-Kronner Uterine Manipulator Injector by CooperSurgical), and I dock the patient-side cart between the patient's legs rather than on the side. This placement of the patient cart enables me to employ a four-arm approach for robotic myomectomy, which I prefer, rather than a three-arm approach. With this configuration, I can use one of the instrument arms to manipulate the uterus instead of relying on a bedside assistant having vaginal access to do this task.

One arm, at or above the umbilicus, holds the endoscope. At the beginning of the procedure, an instrument arm on the left side holds a bipolar device (a PK Dissector that is made by Gyrus ACMI for Intuitive Surgical), and one of two instrument arms on the right side holds the robotic scissors (the da Vinci HotShears). The other right-handed instrument arm holds tenaculum forceps, which can be used to manipulate the uterus or fibroid in any direction. At the end of the procedure, for closure of the hysterotomy incision, needle drivers may be substituted for the ProGrasp Dissector and HotShears and the ProGrasp (part of the da Vinci Surgical System) substituted for the tenaculum.





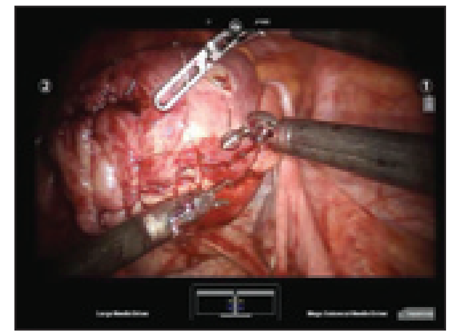


Image 6 (left): The fibroid is enucleated using three robotic instruments and a suction irrigator from the assistant port. Clockwise from 12 o'clock are HotShears, robotic tenaculum, laparoscopic suction irrigator, and PK Dissector. Image 7 (middle): Closure of the hysterotomy incision is done using a 2-0 V-Loc suture to close the myometrium in two layers. Instruments (from left, upward, to right) are the standard large robotic needle driver; the Prograsp, which holds the suture and supports the uterus while the layers are being closed; and the Mega SutureCut needle driver, used to drive the needle through the myometrium. Image 8 (right): The final layer is closed with a monofilament suture, with optimal leveraging of all three robotic instruments.

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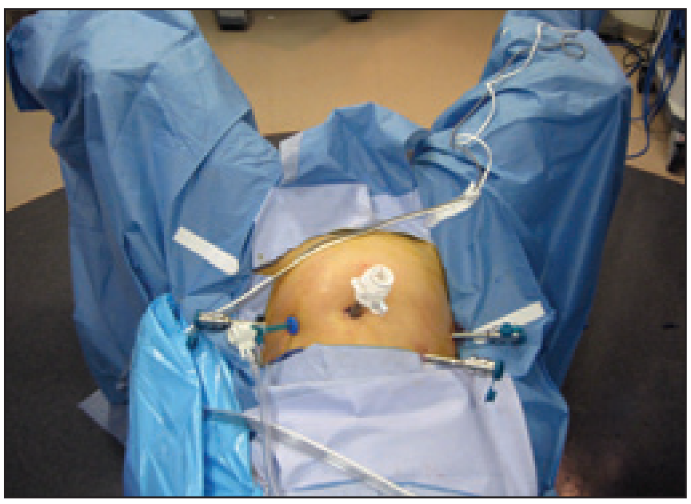
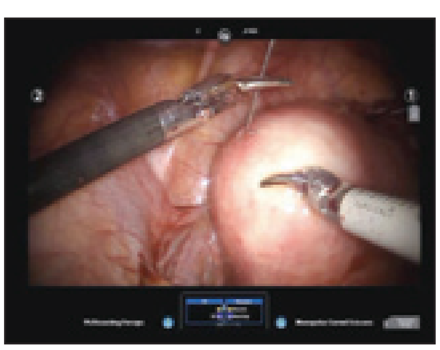


Image 3 shows robotic trocar placement in a 4-arm approach.



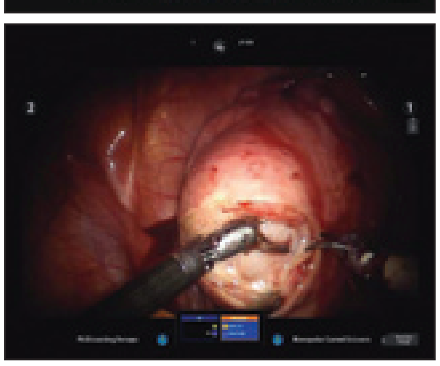


Image 4 (top): A spinal needle injects a dilute vasopressin solution into the fibroid pseudocapsule. Image 5: An initial incision is made to find the fibroid, using the PK Dissector (left) and HotShears (right).

The ports or trocar sites are placed after establishing pneumoperitoneum, typically starting with a Veress needle at the primary or camera site. The camera site is chosen based on the size of the uterus, and an attempt is made to keep at least 10 cm (one handbreadth) between the fundus or top of the presenting fibroid and the camera trocar site.

The left lower quadrant port is placed at least 4-5 cm (three fingerbreadth) directly cephalad to the anterior superior iliac spine. The right lower quadrant port is similarly placed, and then the right upper quadrant port, with the distance between the two right ports being at least one handbreadth (10 cm) in a medial direction. The assistant's port is placed in the left upper quadrant near Palmer's point (the point 3 cm below the last rib in the left midclavicular line). (See image 3.)

One can also "side dock" the patient cart using this configuration to provide more access to the vagina when necessary, and the ports can be adjusted higher or lower on the abdomen depending on the size of the uterus. Clearly, there is a limit to how high one may traverse on the abdomen before entering the thoracic cavity using these principles. There are cases, though, in which the camera port may end up below the fundus of the uterus.

Spacing of the arms also can be negatively affected by a lower body mass index (BMI), but every attempt should be made to obtain at least 8-10 cm of spacing between the robotic port sites to minimize or prevent collision of the instrument and camera arms externally and internally. Caution also must be employed to place the trocars perpendicular to the plane of the abdominal wall; this prevents tunneling of the port, which would defeat the purpose of the strategic placement of the arms externally.

The use of two robotic instruments on the patient's right side is key. Having two right-handed instruments gives the surgeon the ability, at any point in the operation, to manipulate the uterus or the fibroid(s) with two graspers, and to be fairly self-sufficient in enucleating and retracting the fibroid(s) as well as in closing the myometrium.

Prior to the hysterotomy, a vasopressin solution of 20 U diluted in 60 cc of normal saline is injected transcutaneously into the myometrium surrounding the myomas using a 22-gauge 3½-inch or 7-inch spinal needle. This is done by direct vision under endoscopic guidance while using MR imagery. (See image 4.)

An incision is then made over the serosa overlying the fibroid to the level of the pseudocapsule. Whenever possible, and especially when the woman plans to have children, we make a transverse incision, as cesarean-section data of vertical versus low transverse incisions demonstrate that the strongest closure is obtained from transverse incisions. (See image 5.)

The myoma is grasped with the robotic tenaculum, and traction/counter-traction is then used to enucleate the myoma, with the tenaculum pulling away from a push-spread motion created with the scissor and a curved bipolar device in the opposite direction. The push-spread technique is preferable over significant use of cautery for two reasons: It reduces the amount of necrosis that occurs within the myometrium as a result of excessive thermal injury, and it promotes healing within the myometrium after the surgery is completed. Any vessels present at the base of the myoma can be addressed with use of the bipolar device. (See image 6.)

Indigo carmine dye may be injected through the uterine manipulator to help discern the location of the endometrial cavity, but the presence of the inflated balloon of the HUMI manipulator is also sufficient for that purpose.

The removed myoma is stored in the cul-de-sac or in the right upper quadrant, and must be counted upon removal just as any other sponge or instrument would be counted. Alternatively, the myomas can be attached on a suture, as a string of pearls, using a needle introduced laparoscopically.

Robotic needle drivers, one standard large and one Mega SutureCut, are then placed. Closure of the hysterotomy incision can currently be achieved with the use of barbed suture, a recently developed type of product that enables consistent tension on the suture line and does not need to be tied. Closure of the deep hysterotomy defect should be done in layers, especially if the defect is greater than 4-5 cm, using at least a 2-0 barbed suture. The myomas are subsequently removed from the abdomen by a process of morcellation. (See images 7 and 8.)

I recommend not using barbed suture on the serosa, but instead using a monofilament, nonbarbed suture of a smaller gauge such as 3-0. This is because exposure of the barbs on the serosa of the uterus may lead to adhesion formation by catching bowel or omentum.

Closure of the serosa can be achieved with either a running, imbricating stitch, or a baseball stitch. Morcellation is performed under direct vision (after undocking the robotic patient side-cart) using a 15-mm mechanical device placed either in the camera port or the left upper quadrant assistant port. A traditional 5-mm laparoscope or a robotic 8.5-mm endoscope can be used to facilitate this process.

Patients and Outcomes

Based on the published literature to date, and on MRI mapping, I recommend that the number of myomas removed not exceed five, and that the uterus be no larger than a 20-week gestational size. One can certainly exceed these limits, but these criteria are advisable for a surgeon with an average level of experience with robotics.

Although the cost of robotic myomectomy may be greater than that of myomectomy performed by laparotomy, a standardization of the type and number of instruments used, as well as a reduction in the number of disposables used per case, may result in significant cost savings in an institution that already has a robotic system.

Regarding pregnancies achieved after robotic myomectomies, preliminary data have been positive. We will report studies of long-term experience this fall. ■

DR. PITTER *disclosed that he is a consultant and on the speaker panel for Intuitive Surgical and is a consultant for Covidien.*

Download a mobile quick response (QR) code reader from your smartphone's app store to view a video by Dr. Pitter, or visit www.aagl.org/obgynnews.