INTRODUCTION

The microsurgical tubal (or “microtubal”) reanastomosis (MTR) can be performed via laparotomy, minilaparotomy, or laparoscopy (either direct or by robotics), although the principles and precepts of the procedure remain the same. Surgeons today also need to understand the impact the advent of advanced reproductive technologies, and in particular in vitro fertilization (IVF), has had on the care of patients with prior tubal ligation and the selection of patients for MTR.

First, these procedures have created a viable option to MTR for many patients who have undergone a prior tubal interruption, particularly for those women who are younger, are willing to undergo more than one IVF cycle if necessary, and do not want more than one additional child. Alternatively, for women who have undergone a tubal ligation and desire more than one child, are concerned about the maternal and pediatric risks of multiple pregnancies, or are older (~38 years of age), MTR may prove to be a viable and useful alternative. Both types of procedures are expensive if the full cost is borne by the patients, and so finances are also a factor in the decision between MTR and IVF.

Second, we should note that as the number of patients who undergo IVF has increased, the number of MTR procedures performed has declined, decreasing the availability of skilled and experienced reproductive surgeons.

PREOPERATIVE CONSIDERATIONS

Factors affecting pregnancy success following MTR include: a) total tubal length remaining (>4 cm best); b) type of sterilization (Pomeroy, clip, and ring sterilization best); c) site of reanastomosis (isthmic–isthmic best); d) time from sterilization (the less time the better); e) techniques employed (microsurgical technique best); f) surgeon expertise (best if done more than 50 cases); g) patient’s age (younger the better); and h) presence or absence of other infertility factors. In well-selected patients, MTR results in 60% to 80% intrauterine pregnancy rates.

Thus, careful patient selection is critical prior to undertaking the procedure. Usually this should include a review of the prior tubal ligation (tubal interruption) operative note, and the associated pathology report if pertinent, along with a brief assessment of the couple’s fertility potential. The latter should include a semen analysis, ovulation monitoring, and ultrasonographic assessment of the uterine and pelvic anatomy. In women who are older, say over the age of 35 years, or who have begun to experience other concerning signs or symptoms, including irregularity in menstrual cycles, vasomotor flushing or hirsutism, intermittent or persistent pelvic pain, and dyspareunia, a more comprehensive evaluation may be required.

The presence of obesity should also be a consideration, as it not only impacts on the obstetrical outcome of any resulting pregnancy but also on the technical
ease and feasibility of the MTR itself, at least via laparotomy or minilaparotomy. Thus, many reproductive surgeons advise obese patients to lose weight prior to an MTR, if age is not an issue.

Of importance, and beyond the scope of the current discussion, is for the surgeon to recognize the various types of tubal ligation or interruption performed, as some are not amenable to reanastomosis. Only those anastomoses in which relatively healthy and sufficient tubal segments are left behind should be attempted, including those with a total tubal length of at least 4 cm and in which the intramural and fimbriated portions of the tube are preserved. For example, tubal ligation by fimbriectomy or sterilization using cornual occlusion (e.g., using the Essure® and Adiana® procedures) are not amenable to reanastomosis. Likewise, patients who have undergone a monopol “triple-burn” tubal interruption often have so much destruction of the tube that MTR is not possible.

The condition of the intramural and proximate portions of the occluded tube can be assessed preoperatively using a hysterosalpingogram (HSG). Assessment of the proximate portion of the tube is particularly critical in patients who have undergone cauterization of the tubes, either as the primary interruption procedure or after the tubes have been severed. While the condition of the uterine cavity today can be easily and less invasively assessed using transvaginal ultrasonography and/or sonohysterography, these procedures are not helpful in visualizing the intramural/proximate portions of the occluded fallopian tube.

If no portion of the occluded tube is visualized by HSG, it is possible that most, or all, of the intramural portion of the fallopian tube has been destroyed, often by excessive use of electrosurgery at the time of the original tubal ligation. If this is the case, the prognosis for a successful MTR is significantly reduced. This information will help in guiding the surgeon at the time of the procedure, allowing him/her to know how far back they may need to resect the proximal portion of the tube before a healthy lumen is identified; arrangements to use the HSG films available for intraoperative examination at the time of the MTR should be made. This information may also help in counseling the patient concerning the best method of approaching her secondary infertility.

The condition of the distal portion of the occluded/interrupted fallopian tube may be guessed at preoperatively based on the description provided in the tubal ligation procedure note. This report should optimally note whether or not periadnexal or peritubal adhesions or endometriosis were observed and the condition of the tubal ostia and fimbria. In addition, particularly in those procedures where a portion of the tube is resected (e.g., Pomeroy’s tubal ligation), a description of what tubal length was removed and confirmation of the same by the pathologic report is also helpful. Unfortunately, because the original operator is often focused primarily on destroying the fallopian tubes, not considering that the patient may change her mind and desire later fertility, often little useful description is available in the tubal ligation operative note beyond the type of procedure performed.

In patients scheduled to undergo a laparoscopic MTR, the absence of such information is offset by the fact that at the time of surgery the operator will be able to inspect the pelvis in a minimally invasive fashion. Alternatively, for those surgeons who are planning to perform the MTR via laparotomy, consideration should be given to performing a concomitant initial laparoscopy if the condition of the distal segment of the tubes is unclear (e.g., in “triple-burn” procedures). In these circumstances, only if the tubal condition appears to be favorable at laparoscopy should the surgeon proceed with the laparotomy and MTR or laparoscopic MTR.

For this the patient may be placed supine on the operating table, an insufflating needle placed through the umbilicus and a laparoscope placed as per routine. Manipulation of the uterus and adjacent structures through a vaginally placed sponge on a grasper, or via a suprapublically placed probe, is usually sufficient to expose the tubal ligation sites. Performing the diagnostic laparoscopy on a day separate from the MTR is not recommended, due to the added costs and risks, except when a more thorough discussion of the pelvic findings with the patient may alter the decision for surgery.

**Surgical Technique**

The MTR is a microsurgical procedure, in other words a reproductive surgery that utilizes sutures best viewed with magnification, that is, equal to or smaller than 8.0G. These procedures usually call for the use of magnification of some type, either using magnifying loupes (1.7× to 6×) or an operating microscope (2× to 40×), although the need for magnification obviously varies according to the surgeon’s visual acuity. Some of us even use loupes when performing macroscopic surgical procedures, a response more to failing eyesight than the need for microsurgical technique.

However, the true basis of microsurgery, as discussed in Chapter 22, is not the size of the sutures used or the degree of magnification utilized. The success of reproductive microsurgery principally lies in the ability of the surgeon to intimately understand the tissues.
that she/he is operating upon, thus minimizing the degree of tissue damage. Reproductive surgeons should be well acquainted with what is commonly called the *microsurgical technique*, as its principles are applicable to surgery in general, and to reproductive organ surgery in particular. Following we will review the surgical technique of MTR step by step, initially describing the procedure when performed by laparotomy (see also video: *Microsurgical Tubal Reanastomosis*). However, during the entire procedure surgeons should be fully aware and use all principals related to micro or peritoneal surgery.

1. **Ensuring all necessary instruments are available and ready:** In addition to the standard laparotomy instruments, specialized instruments for microsurgery should be available. The microsurgeon should have intimate knowledge of the surgical instruments used during an MTR (see Box 23.1 and Figure 23.1) and should check them immediately before surgery to ensure they are available on the surgical table and are in good working condition, as these delicate instruments are easily damaged during sterilization and storage.

   A needle or wire-tip monopolar electrosurgery tip (0.3 mm or less) should be available and should be set to 10 W cutting current or less, depending on the electrosurgical unit, and the patient appropriately grounded. The tip should not become red hot or melt when the current is turned on; otherwise the wattage should be reduced. Likewise, if the instrument does not cut through fine adhesions, cauterizing them instead, the wattage should be increased slightly. In addition a fine bipolar forceps (e.g., McPherson curved bipolar uncoated forceps, 3½ inch in length with 5-mm tips) should be available.

   Continuous irrigation of the surgical site to minimize the risk of desiccation is critical to the success of the procedure. This surgeon prefers the use of Lactate Ringer's as there is some evidence to indicate that this isotonic crystalloid solution causes less peritoneal swelling than other solutions. To the extent possible the fluid should be warmed to body temperature, but no more, to avoiding freezing or scalding the peritoneal surfaces. Various filled syringes with 20-18G IV catheter (e.g., Angiocath®) tips should be available for this purpose.

   Before beginning, the surgeon should also examine and set up the operating microscope, if one is available and to be used, fixing the height and separation of the ocular pieces. The microscope should also be steriley draped at this time. In addition, if magnifying loupes are to be used, they should be put on.

2. **Preparation of the surgical field:** Before proceeding further the surgeon should wash his/her gloves off with irrigating fluid, which is then discarded, to remove any potential contaminating talc or, more commonly, corn starch.

   a. **Ensuring access:** Ensuring adequate access to and exposure of the surgical site is critical, and greatly depends on the patient’s body mass. In thinner patients access to the surgical site can be achieved easily through

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   **BOX 23.1**

   **Specialized instruments necessary for microtubal reanastomosis**

   - Buxton uterine manipulator
   - 22 to 20G IV catheter (e.g., Angiocath®) for transfundal chromotubation
   - 20 to 18G IV catheter (e.g., Angiocath®) and 20 cc syringes for irrigation
   - Electrosurgical wire-tip (0.5 mm or less) electrode
   - Microbipolar (with tips 5 mm or less)
   - Fine-tip suction probe
   - Atraumatic tubal graspers
   - Atraumatic ovarian graspers
   - Jeweler’s forceps
   - Micro-Adson forceps, with and without teeth
   - Straight and curved iris scissors
   - Microsurgical (microinfertility) scissors
   - Locking and nonlocking microsuture holders (Castroviejo)
a small Pfannenstiel or minilaparotomy incision. Alternatively, access to the pelvic cavity of an obese patient is more difficult, and may require a more extensive abdominal port, including a Mallard incision. And even in this setting, it may be difficult to operate on a very obese patient due to the short length of most microsurgical instruments. Thus, many surgeons consider marked obesity to be a relative contraindication to MTR via laparotomy, and either suggest weight loss, if time and patient inclination permits, or performing the procedure via laparoscopy. Once an incision has been made, the sides of the wound are often wrapped in lap packs to minimize bleeding into the surgical site.

**FIGURE 23.1** Common microsurgical instruments used for MTR.
b. Examining the anastomosis sites and surroundings: At this point the surgeon should examine the surgical site, determine the status of the tubes and adjacent pelvic organs, ensure adequate exposure of the surgical field, and arrange the surgical field. In most circumstances, the surgeon should have determined the adequacy of the tubes for reanastomosis preoperatively, or at least before performing the laparotomy (see above). However, the surgeon should verify his/her preoperative assessment directly.

c. Exposing the anastomosis site and ensuring a surgical platform for the microsurgical reanastomosis: The bowel is gently packed away from the pelvis, over the pelvic brim, a procedure assisted by placing the patient in moderate Trendelenburg. This surgeon prefers to use laparotomy packs placed inside sterile plastic sandwich bags, one per bag, thus protecting the peritoneum from abrasion by this material. It also allows the bagged laparotomy packs to be used as the surgical platform upon which the anastomosis is performed (see below).

d. Establishing an avenue for intraoperative chromotubation: Next, a method for intraoperatively insufflating the tubes with a dilute solution of saline and indigo carmine (chromopertubation) is readied. One method is to place a small pediatric Foley bulb into the uterine cavity vaginally once the patient is draped, and then chromotubating with indigo carmine as needed via a syringe held by an assistant. While this is a simple method, this surgeon prefers to chromotubate through the uterine fundus, in order to minimize the risk of tubal contamination by vaginal organisms.

First, a Buxton uterine manipulator is placed abdominally, which not only allows for atraumatic manipulation of the uterus during surgery but also can be used to clamp the cervical os closed (Figure 23.2), allowing for transfundal chromotubation. Grasping the uterus at its base, a 20G needle and IV catheter is then placed through the fundus of the uterus, at a point midway between each tubal insertion and in the direction of the uterine cavity, until a gentle pop is felt when entering the cavity.

A syringe containing indigo carmine is connected via an IV connector to the IV catheter, after all air has been expressed from the line and the IV catheter needle has been removed. Proper placement of the IV catheter into the uterine cavity can be verified when symmetric distention of the uterus is palpated (and often seen) as insufflation of dye via the syringe is pulsated. A moderate amount of skill is necessary.
to place the IV catheter transfundally correctly into the uterine cavity and, of course, a relatively normal uterus is necessary. Only at this point is the surgeon ready to proceed with the actual tubal reanastomosis.

3. Preparation of tubal stumps and anastomosis site anchoring: Microsurgery of the tubes, including dissection, preparation, and reanastomosis, is best performed over a stable platform of uniform height (to facilitate manipulation of the tubes while keeping tissues in within the focal length of the microscope. We use bagged laparotomy packs placed into the cul-de-sac as a suitable and stable platform.

The preparation of the tubal stumps varies according to the type of anastomosis to be performed, whether it is isthmic–isthmic, ampullary–ampullary, or isthmic–ampullary, and reference to these types will be made below (Figure 23.3). Different types of anastomosis may be necessary for each side. Less frequently performed anastomoses, such as the cornual–isthmic or cornual–ampullary (i.e., anastomosing the intramural portion of the tubal lumen to the distal isthmic or ampullary lumen) will not be discussed further, as these patients should preferably be treated by IVF.

In preparing and opening the lumens of the tubal segments for anastomosis, the surgeon should keep in mind two factors that will improve the success of the procedure. First, the proximal and distal lumen diameters opened should be as similar in size as possible. Second, the tubes should be, and should heal, as free of peritubal and tubo-ovarian adhesions as possible to maximize their mobility during ovulation.

a. Exposure and preparation of the proximal (uterine side) stump: Exposure and preparation of the tubal stumps can usually be accomplished by either direct visualization, or better still using magnifying loupes. While an operating microscope is not necessary for this part of the procedure, it may be useful when opening the lumen in the distal ampulla of an isthmic–ampullary reanastomosis (see below).

i. Proximal isthmic segment: In the vast majority of patients the proximal stump will be 0.5 to 2 cm in length, representing an isthmic interruption. The distal portion of the proximal tubal stump will be buried in the adhered mesosalpinx that connects the proximal and distal tubal stumps. The tube should be grasped with a jeweler’s forceps, or preferably an atraumatic tubal grasper, and the occluded distal end is released and cleared of surrounding mesosalpinx and adhesions using the wire-tip electrosurgery (Figure 23.4A and B).

Care should be taken to not undermine excessively the tube during this process, a constant temptation, as the proximal stump will have to be approximated to the distal stump and anchored via the mesosalpinx (see below), which will be made more difficult if excessive undermining of the tube has occurred (Figure 23.4C). Furthermore, excessive undermining will risk bleeding and may compromise the inferior tubal blood vessels, increasing the risk of tissue hypoxia. Hence, it is preferable at this point to do less than too much. The surgeon can always undermine the tubal stumps further as needed.

![FIGURE 23.3 Transverse tubal anatomy, indicating layers of muscle/serosa from intramural segment to ostia.](image)
The distal occluded stump of the tube is then distended by gentle chromotubation, and the tip of the occluded isthmic stump grasped with a small Addison’s (toothed) forceps and pulled outward. Using iris scissors placed perpendicular to the long axis of the tube, the occluded portion of the tube is resected, in one single stroke if possible (Figure 23.5A). Care should be taken not to try and create a flat end. In fact, if the transection has been done correctly the cut end of the tube will extrude in a conical fashion, as muscularis expands outward (see Figure 23.6C). Trimming the endosalpinx should be avoided; rather the surgeon should push the mucosal folds into the lumen when later performing the anastomosis.

Chromotubation is gently continued and if no obvious tubal patency is observed, the tubal stump is regrasped at its tip, over the site of the putative lumen, and another transection performed. This process is repeated.
SECTION III  REPRODUCTIVE SURGERY

until a patent and healthy (nonfibrotic) tubal lumen is observed. Small bleeding encountered is managed expectantly, unless persistent, in which case irrigation is used to uncover the exact bleeding sites, which are then cauterized with wire-tip or microbipolar electrosurgery. Care should be taken to continuously irrigate the tissues.

ii. Proximal ampullary segment: If the proximal stump is ampullary (meaning the tube has been interrupted in the ampullary region, the diameter of the lumen will be larger than if it were isthmic. As the distal stump that the proximal ampullary stump will be reanastomosed to will also be ampullary (see below), it may be best to await for exposure and preparation of the distal segment before opening the proximal lumen, to maximize the chances that the tubal lumen will be as close in diameter as possible. In either case, a perpendicular transection using iris scissors of the occluded portion of the proximal ampullary stump will likely be the best approach to prepare this tubal segment for anastomosis.

However, we should remember that the ampulla is less rigid (has less muscularis), and has a larger and more convoluted lumen due to more extensive mucosal folds, than the isthmus. Thus, continued gentle chromotubation to expand the occluded ampullary segment while transecting it is critical to ensure that only the minimum amount of tissue required to open the lumen is removed. In fact, it generally is best not to open the full tubal lumen, but only enough for the lumen to be visible and patent to chromotubation. The lumen can always be opened further if necessary.

b. Exposure and preparation of the distal stump: Attention is then paid to the distal tubal stump. The occluded tip of the tube is covered by adhesions and mesosalpinx, and the tube is grasped atraumatically, and freed using the wire-tip electrosurgery. Care not to excessively undermine the tube and to minimize damage to the inferior tubal vessels, should be made. At this point the occluded portion of the distal stump must be opened, and there are various approaches to do so, depending on what the proximal and distal segments of tubal stumps are, whether isthmic or ampullary.

i. Isthmic–isthmic segments: If both the proximal and distal tubal segments are

FIGURE 23.5 Transection of occluded portion of tube, including proximal isthmic stump (A) and distal ampullary stump (B). This latter transection is facilitated if the surgeon distends the occluded distal ampullary segment by inserting an IV catheter sleeve through the tubal fimbria and gently occluding the surrounding ostia using digital pressure.
isthmic, then the distal stump should be prepared and opened in the same manner as the proximal isthmic stump (see above). The surgeon should test the tension on freed stumps, by pulling the tubal ends to be anastomosed together. There should be no tension. At this point, some surgeons elect to thread a stent through the tubal ostia (see below) into the isthmic lumen to facilitate the subsequent reanastomosis.

ii. Ampullary–ampullary segments: The occluded ampullary stump is freed from overlying adhesions and mesosalpinx, and the tension between the two stumps tested. If the distal segment of the tube is ampullary, the approach taken to open the lumen will depend on the size of the lumen on the proximal tubal segment. If the proximal segment is also ampullary then a simple, single stroke perpendicular transection may be appropriate.
However, before doing so the surgeon should recognize that the distal ampullary lumen will be larger than that of the proximal segment.

Thus, care should be taken to only open a section sufficient in size to match that of the proximal segment. One way to visualize and control for the size of the proximal lumen is to distend the tube by chromotubation (see above). Similarly, the surgeon can distend the occluded distal ampullary segment by inserting an IV catheter sleeve through the tubal fimbria and gently occluding the surrounding ostia using digital pressure (Figure 23.5B). The IV catheter is connected via an IV connector to a syringe containing indigo carmine, which the assistant gently injects. In this manner the outline of the tubal lumen can be clearly visualized, and a more controlled transection can be performed.

iii Ampullary–isthmic segments: If the distal segment is ampullary and the proximal segment is isthmus, again the occluded ampullary stump is freed from overlying adhesions and mesosalpinx, and the tension between the two stumps tested. In this situation, the lumen of the ampullary segment needs to be opened in such a way as to match as closely as possible the size of the isthmic lumen (see below).

4. Performing the reanastomosis: Once both occluded ends of the tubal segments are mobilized and lumens open, the surgeon is ready to perform the reanastomosis.
a. **Anchor stitch:** The next step is to place the anchor stitch so as to position both lumens to be reanastomosed facing each other as close as possible, without unduly distorting the normal anatomy. Much will depend on how well the tubal stumps were undermined. Generally, and as noted above, it is best to leave sufficient mesosalpinx beneath the transected portions of the tubes so as to allow proper positioning of the lumens (Figure 23.6A). This step can be performed by direct visualization or using magnifying loupes. The anchor stitch is placed through the mesosalpinx as closely to the tubal lumens as possible, ensuring that the apposing lumens touch each other at the same height without tension. Alternatively, the anchor stitch placement should also allow sufficient tubal segment mobility for the anastomotic sutures to be placed through tubal muscularis (see below). The stitch may have to be replaced more than once before tying down, to ensure correct placement. The suture is placed through and through the mesosalpinx, generally beginning and ending on the lateral aspect of the tube, so as to place the knot away from the ovary and minimize the risk of tubo-ovarian adhesions, which could compromise the free mobility of these organs at the time of ovulation. Generally, a 3-0G or 4-0G absorbable or nonabsorbable minimally reactive suture on a noncutting needle is used.

b. **Reanastomosis:** The reanastomosis portion of the tube involves the reconnection of the muscularis and the serosal layers of the tubal segments. While an operating microscope is not necessary when performing an ampullary–ampullary reanastomosis, which can be easily performed using loupes, an operating microscope will be useful when performing isthmic–isthmic and isthmic–ampullary reanastomoses.

We prefer to use 8-0 to 10-0 non-absorbable monofilament suture on a cutting needle for the inner (muscularis) layers of the anastomosis. The handling and control of sutures this size requires skill and training, and there are a few nuances that should be kept in mind. First, a demagnetizer should be available on the field, since the microsurgical instruments (e.g., needle holder) often become magnetized making it difficult to control the needle.

Second, care should be taken to keep the needle under direct visualization at all times, to ensure it is not accidentally pulled off and misplaced. If a needle of this size is lost in the patient it generally cannot be detected by x-ray, and in fact, may be left behind, as it often cannot be located and the risk of organ damage is minimal. To minimize the risk of loss, it is best to continuously stick the needle back into the foam pad of the suture package when not in use.

Third, the needle should be grasped at its midpoint to insert, and the surgeon should ensure the needle is directed in the correct direction before advancing into the tissue. The suture should be advanced progressively through the muscularis following the curvature of the needle. We should note that the needle is quite fragile and easily bent or broken if an attempt to redirect the path of the suture is made by trying to redirect the needle once it is lodged in the tissue. Finally, the surgeon should avoid anything that could worsen hand tremor, including excessively strenuous exercise, nicotine, and caffeine, in the hours prior to surgery.

Finally, approximation of the overlying tubal serosa is generally accomplished with interrupted stitches, using either a 7-0 or 8-0 absorbable or nonabsorbable suture on a noncutting needle.

i. **Isthmic–isthmic reanastomosis:** With the two apposing isthmic lumens are touching without tension, isthmic–isthmic anastomosis is accomplished in two layers (the inner muscularis and outer serosal layers). The surgeon should push the endosalpinx into the lumen while performing the anastomosis, rather than trimming the mucosal folds.

To anastomose the inner layer, sutures are placed through the tubal muscularis, beginning and ending on the outer aspect of the tube ("out-to-out"), so keep the knots away from the lumen (Figure 23.6B and C). In general, placing the suture through the tubal lumen should be avoided. Some surgeons find that a previously placed stent is helpful to visualize the lumen fully. Sutures are placed in order, beginning at 6 o’clock (lower part of lumen), then 3 o’clock (inner lateral aspect), 9 o’clock (outer lateral aspect), and 12 o’clock (upper aspect).

The muscularis sutures are tied using an instrument tie, using the curved needle driver to wrap the longer end of the suture three times around a straight or curved jeweler’s forceps,
then using the forceps to grasp the shorter end of the suture and pulling the throw through. Three throws of the knot are placed, taking care to lay each throw down in apposing direction to the one below. Some surgeons prefer to not tie the sutures as they are being placed, and tag them instead with rubber-shod hemostats until they are all placed. They are then tied at the same time. Other surgeons find it easier to maintain a clearer surgical field and tie the sutures as they are placed.

Once the muscularis sutures have been placed, gentle chromotubation is attempted and spillage of dye through the tubal ostia (i.e., tubal patency) should be observed. It is normal to have a small amount of leakage around the anastomosis site.

The overlying tubal serosa is then approximated using three or four interrupted stitches (Figure 23.6D). Care should be taken not to place the sutures too deeply, risking occluding or distorting the anastomosed lumen. Overzealous peritoneal suturing should be avoided, and if larger areas of peritoneum are missing they should be left as is, rather than place sutures under tension that may distort the tubal course and cause a greater degree of tissue strangulation.

At this point, the peritoneal window underlying the anastomosis site is closed with two or three interrupted stitches (Figure 23.6D), beginning and ending on the lateral aspect of the mesosalpinx, so as to leave the knot away from the ovary.

ii. Ampullary–ampullary anastomosis: Like the isthmic–isthmic anastomosis (see above), the ampullary–ampullary anastomosis can also be accomplished in two layers. However, the walls of the ampulla proper are thinner and contain relatively less muscularis than that of the isthmus, and it may be easiest to perform the anastomosis using a single-layer closure technique (Figure 23.7). Four to five interrupted 8-0 to 10-0 nonabsorbable stitches on a cutting needle are placed through the full thickness of the ampulla wall, “out-to-out.” The surgeon should try to minimize placing the sutures within the lumen, although may not always be possible when ensuring a solid anastomosis.

iii. Isthmic–ampullary anastomosis: One of the difficulties with this type of procedure is the difference in the lumen sizes of the isthmus and the ampulla. The easiest way to ensure relatively similar lumen sizes is to thread the tip of an IV catheter (18G) through the fimbriated opening of the tube. The catheter is connected to a syringe containing indigo carmine

![FIGURE 23.7 Ampullary–ampullary anastomosis by single-layer anastomosis.](image)
not to cut through the wall of the catheter, and pushed through the occluded wall of the ampulla. The entire IV catheter is then advanced and surrounding serosa resected back using microscissors to expose a sufficient amount of the lumen so as to match the size of the proximal isthmic lumen diameter.

Once both the proximal and distal lumens are open, some surgeons elect to thread a stent (generally a colored nonabsorbable flexible

![A] Stent

![B] Needle withdrawn

![C] Needle withdrawn

**FIGURE 23.8** Isthmic–ampullary anastomosis by (A) making small opening through the occluded portion of the proximal ampullary segment using an IV catheter needle often guided by the placement of a stent, using a 0 gauge dyed monofilamentous suture (B and C). The anastomosis is typically accomplished using simple interrupted sutures with 8-0 or 10-0 suture on a cutting needle (D and E). (Continued)
0G suture, such as 0-nylon) through the catheter into the isthmic to facilitate the subsequent reanastomosis (Figure 23.8B and C). Stretching the suture first will make it easier to pass the stent through the lumens. Placing a stent may be particularly helpful when performing a isthmic–ampullary reanastomosis. This type of anastomosis is often completed in one layer (Figure 23.8D and E).

Assuming that the lumens are of similar size, four or five interrupted sutures “out-to-out” (again using 8-0 to 10-0 non-absorbable monofilament suture on a cutting needle) are placed. Some degree of dissection of the serosa overlying the tip of the ampulla may be needed to allow its suturing to the serosal layer of the isthmus. Alternatively, if the distal ampullary lumen is too large to match with the size of the proximal isthmus opening, then the distal ampullary lumen can be narrowed by closing the opening partially using interrupted sutures (Figure 23.9). Once completed, any stent placed to guide the suturing should be removed.

5. Completing the procedure: Once both tubes have been reanastomosed and patency has been confirmed, all instruments and packs are removed from the pelvis, and the pelvis and abdomen are thoroughly irrigated and suctioned. The anastomosed tubes and ovaries are carefully allowed to fall into the cul-de-sac freely, checking for tension and misplacement. Some surgeons elect to also place an absorbable anti-adhesive barrier (e.g., Interceed®) over the anastomoses. The pelvis is then closed in the usual fashion.

**Laparoscopic microsurgical tubal reanastomosis**

Laparoscopic microsurgical tubal reversal, particularly if robot-assisted, provides the ability to mimic the open approach while maintaining a closed environment. Like open microsurgery, the robot-assisted surgical approach allows for two-layer closure of the muscularis and serosa with fine absorbable (or non-absorbable) sutures. It also minimizes tissue desiccation, potentially reducing adhesion formation and improving surgical outcomes. However, in general, similar intrauterine and ectopic pregnancy rates occur following traditional laparoscopic surgery and minilaparotomy.

Compared to traditional laparoscopy, robot-assistance affords greater ease of tissue manipulation and less physical stress for the surgeons performing the procedure. Compared outpatient minilaparotomy the robot-assisted laparoscopic tubal reanastomosis requires greater surgical and anesthesia times, although return to normal activity was shorter with the robotic
POSTOPERATIVE CONSIDERATIONS

Intra- and postoperative complications are infrequent (see Complications box on page 207). Postoperative management should follow the general principals determined by the type of abdominal incision, including rapid ambulation. Care should be given to watching for any signs of incipient infection, including low grade temperatures, and white count elevations. As even a small amount of infection around the anastomoses can significantly reduce the success of the procedure, any sign of developing infection should be treated aggressively.

Patients should be instructed to use barrier contraception when having coitus in the first 60 postoperative days. Pregnancy can then be attempted. They should also be counseled regarding a higher rate of ectopic pregnancy, which can be as high as 10% of all pregnancies following MTR. An HSG is performed three to four months postoperatively to further determine anastomosis success. If the patient has not conceived within 12 months of surgery, consideration may be given to performing a laparoscopy, and possible salpingo-ovariolysis if necessary.

Operative Note

PROCEDURE: MICROSURGICAL TUBAL REANASTOMOSIS

The patient was placed supine upon the operating room table, and was prepped and draped in the usual sterile fashion. A Foley was placed to straight drain in the bladder. Time out was called and information reviewed. Gloves were washed in sterile water. At this point, a small transverse incision was made in the lower technique. (see also video: Robot Assisted Laparoscopic Microsurgical Tubal Reanastomosis).

Procedure in brief

1. The mesosalpinx is dissected from the underlying segments of fallopian tube to generate sufficient mobility in order to reduce subsequent tension on the muscularis at the anastomosis site.
2. Transection of the muscularis/mucosal layers exposing the tubal lumina is performed sharply with scissors and bleeding vessels are cauterized. Electro surgical energy is not applied to the mucosal or muscularis layers. Tubal patency can be confirmed by use of a stent and/or chromopertubation of the proximal segment. A stent may also be placed to align the juxtaposed tubal lumina as a guide for approximating the muscularis. Some surgeons have advocated the use of a “suture-less” approach, basically entailing the use of a transuterine placed tubal stent and the use of two external metallic clips to approximate the anastomosis site.
3. The mesosalpinx is approximated with at least one interrupted absorbable suture to reduce tension at the tubal anastomosis site and align the tubal lumina, which are approximated by circumferential interrupted absorbable suture. In general, the 6 o’clock suture is placed first, and the subsequent sutures are placed based on difficulty of positioning and visualization, with the simplest sutures placed last.
4. A second layer of similarly sized interrupted or running absorbable suture may be placed approximating the serosa. Easy passage of a stent and/or chromopertubation confirms tubal patency.

FIGURE 23.9 In an isthmic–ampullary reanastomosis, if the distal ampulla lumen is too large to match with the size of the proximal isthmus opening, then the distal ampullary lumen can be narrowed by closing the opening partially using interrupted sutures.
abdomen, about 2 cm above the pubic area. The incision was carried down through the subcutaneous fat to the fascia. The fascia was incised transversely and dissected off the rectus muscle, upward to the umbilicus and downward to the pubis. The rectus muscles were separated in the midline and the perineal cavity was entered digitally. The peritoneal incision was then extended upward to the umbilicus and downward toward the bladder. The edges of the incision were then wrapped with laparotomy packs to avoid bleeding from the incision into the abdomen; a Balfour retractor was placed into the abdomen. At this point, the uterus and adnexa were examined and the above findings were noted.

A Buxton uterine manipulator was placed over the uterus and the cervix was compressed. A 20G angiocath was placed through the fundus of the uterus and felt to have popped into the uterine cavity. The angiocath was now connected through an IV tubing to a syringe containing dilute indigo carmine dye. Gentle pressure was applied to the syringe which distended the uterus uniformly suggesting that the angiocath was placed correctly into the uterine cavity. At this point, the bowel was packed away from the pelvis using a lap packs placed in sterile plastic bags. Furthermore, lap packs in sterile plastic bags were placed into the cul-de-sac, elevating both adnexa including the ovaries.

Continuous irrigation using Lactate Ringer's was performed throughout the entirety of the procedure, using an 18G angiocath connected to a 20-cc syringe. Attention was given to the right adnexa. The isthmic stump was identified and grasped with Micro Adson forceps with teeth and using wire-tip electrocautery, the occluded portion of the tube was freed of overlying adhesions and mesosalpinx, attempting to preserve the underlying vessels. Likewise, the distal portion of the isthmic stump was also elevated with Adsons and freed from peritubal adhesions. The intervening Yoon ring was also dissected free and removed from the field.

At this point, using gentle pressure from the chromotubation syringe the proximal isthmic segment was slightly distended. Using a Micro-Adson forceps with teeth the tip of the occluded portion of the tube was grasped and the tube was transected perpendicular to its long axis with straight iris scissors. Chromotubation indicated tubal patency with extrusion of indigo carmine dye. Small areas of bleeding on the isthmus were irrigated, identified, and cauterized using microbipolar forceps.

Attention was then placed to the distal isthmic segment. Using Micro-Adson forceps with teeth, the occluded tip of the distal isthmus was grasped, pulled upward, and using straight iris scissors, the tube was transected in its entirety. At this point, using loupes, the tubal lumen appeared to be evident. To confirm patency of this area of the tube, an angiocath was threaded through the fimbriated portion of the tube which was them compressed digitally. Chromotubation through this angiocath reviewed patency of the distal segment of the tube. Again small areas of bleeding around the isthmus were identified by irrigation and cauterized with microbipolar.

At this point an anchor stitch using 7-0 Vicryl were placed at the base of the mesosalpinx in order to ensure that both tubal segments were brought together closely. This allowed the tubal stump to be approximated and also allowed sufficient mobility to perform the anastomosis.

Attention was paid to the left adnexa where a similar process was performed. Both tubal stumps were freed, opened, and approximated using an anchor stitch with 4-0 Vicryl. At this point, the operating microscope was now brought into the field. The focal length of the microscope had been set prior to surgery to ensure that the operating plane of the patient was visualized clearly at all times.

Under microscopic magnification the anastomosis was then performed. Four 8-0 nylon sutures were placed, from out to in and then out again, taking care to not enter the lumen. The sutures were placed at 6, 9, 3, and 12 o’clock. Chromotubation revealed tubal patency with a small amount of leakage around the anastomatic site. At this point the serosa of the tube was closed using interrupted sutures with 7-0 Vicryl. Chromotubation once again revealed tubal patency with minimal to no leakage. The peritoneal window was now closed with three interrupted sutures using 4-0 Vicryl, taking care not to injure the broad ligament or mesosalpinx vessels and to leave the knot away from the ovary. A similar procedure was performed on the contralateral side.

Once the tubes were anastomosed, chromotubation revealed them to be patent. No excessive bleeding was noted. At this point, all lap packs were removed from the pelvis after the adnexa were allowed to fall freely to the cul-de-sac. The pelvis was gently and thoroughly irrigated. At this point the sponge count was correct and the peritoneal incision was closed using a running suture using 2-0 Vicryl. The rectus fascia was closed using interrupted sutures with 0 Vicryl. The subcutaneous fat was approximated using three interrupted sutures using 2-0 Plain. The skin incision was enclosed in a subcuticular fashion using 4-0 Vicryl. At this point,
the patient went to the recovery room in good condition without any complications. The estimated blood loss was approximately 50 cc.

**COMPPLICATIONS**

- De novo pelvic adhesion formation—*Infrequent (less than 5%)*
- Postoperative infection (myometritis and adnexitis)—*Infrequent (less than 5%)*
- Hemorrhage and major vessel perforation—*Rare (less than 1%)*

**Suggested Reading**
